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BLACK'S MEDICAL DICTIONARY

BY

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REVISED BY

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EIGHTEENTH EDITION

CONTAINING OVER 500 ILLUSTRATIONS IN THE TEXT AND TWO FULL-PAGE PLATES IN COLOUR

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PREFACE TO EIGHTEENTH EDITION

It was with some diffidence that I undertook to revise this Dictionary, first because it bore so unmistakably the imprint of the late Dr. J. D. Comrie, and, secondly, because the task is almost getting beyond the competence of one man. I have, however, done what I can in the hurried days of war to keep up the standard that has been set. My first aim has been to add as many new terms as possible so as to bring the Dictionary up to date; my second, to prune with care; and my third, to revise where new knowledge has made the old definitions incomplete.

H. A. C.

May 1944.

EXCERPT FROM PREFACE TO FIRST EDITION

In the preparation of this book the object sought has been to produce a work which would occupy a position somewhere between that of a technical Dictionary of Medicine and one intended merely for the domestic treatment of commoner ailments. An endeavour has accordingly been made to give information in simple language upon medical subjects of importance and general interest.

Definitions are given of most of the terms commonly used in medical science, though no attempt has been made to include all the compound and often hybrid words which have been lately introduced, especially into surgery. Brief notices upon anatomy and physiology precede the lists of diseases to which the various bodily organs are liable. They have been designed mainly with the object of making clear to the reader what are the normal functions and how these are affected by disease. With regard to such practically important matters as those in which unskilled persons can safely be trusted to render aid to the injured, and to increase the comfort of the sick, full details have been given. It is hoped therefore that these articles will be found useful to district nurses, ship captains, dwellers in remote districts, and others who may be called upon to treat the suffering in the absence of trained supervision. Those subjects, on the contrary, which are of a more theoretical and intricate nature are sketched only in outline. In this connection, too, it may be noted that almost no reference has been made to diagnosis, a highly technical matter, which lies entirely within the province of the trained medical man. Special attention has been given to subjects in which medical science has made recent advances, but care has been taken to avoid speculative and debateable views, and to keep as closely as possible to what are generally recognised as ascertained facts. In the case of surgical subjects, the principles upon which the measures of treatment are based have been explained, but the details of operations are quite foreign to the scope of this book. Proprietary medicines and food-stuffs are mentioned as seldom as possible.

To avoid burdening the text with names, authorities are seldom introduced, and where a name is attached to any statement, this is done either because the statement is doubtful, and is made only upon the authority quoted, or because the subject under review is specially associated with this name.

With regard to etymology, the nearest word in the original language, along with its English equivalent, has in most cases been given. Words printed simply in italics belong to the Latin tongue. In cases where the original Latin or Greek word only is placed in brackets, this indicates that it was used by the writers of antiquity in the same sense that it possesses at the present day.

* * * * * *

J. D. C.

EDINBURGH, 1906.

FULL-PAGE PLATES IN COLOUR

PLATE		FACING PAGE
I.	Organs of the Body from before	I
II.	Organs of the Body from behind	I

SPECIAL SUGGESTIONS

FOR USE OF

Black's Medical Dictionary

I. **ACCIDENTS.**—In cases of injury, treat first any bleeding that may be present (see **Hæmorrhage**). Next dress the wound (see **Wounds** and **Bandages**). If a broken bone, dislocation, or sprain be present, for the treatment see under **Fractures**; **Dislocations**; or **Joints, Diseases of.** In cases of internal injury, see **Abdomen, Injuries of,** and **Chest, Injuries of.** For methods of conveyance, see **Injured, Removal of.** For accidents with electricity, see **Electrical Injuries.**

II. **BURNS AND SCALDS.**—In cases of burning, extinguish the flames by laying the person down and covering with some woollen article. For the treatment, see **Burns and Scalds.**

III. **DROWNING.**—For treatment after immersion in water, see **Drowning, Recovery from.**

IV. **GASSING.**—For treatment, see under **Coal-gas, Drowning,** and **Oxygen.**

V. **POISONING.**—For the general treatment of poisoning, see the article on **Poisons,** and also special articles under the headings of **Ptomaine Poisoning,** of **Fungus Poisoning,** and of the names of various dangerous substances.

VI. **FITS AND CONVULSIONS.**—In cases of fits and other convulsive seizures, for treatment see the article on **Convulsions** in Children; also that on **Epilepsy,** and that on **Hysteria.** For a list of the various conditions that may produce spasm, see **Spasm.**

VII. **UNCONSCIOUSNESS.**—In cases of unconsciousness from some unknown cause, see under the heading **Unconsciousness.** Apart from faints, the most important causes are alcoholism, apoplexy, and opium poisoning. Appropriate treatment will be found under the headings—**Fainting**; **Alcoholism, Acute**; **Apoplexy**; **Opium Poisoning**; **Brain, Diseases and Injuries**; and **Uræmia.**

VIII. **DEATH.**—In cases of supposed death, see the article on **Death, Signs of.**

IX. **PERSONAL HEALTH.**—With regard to the preservation of personal health, the article **Health** may be consulted. In it numerous references to important matters are given.

X. **SANITATION.**—When information is desired on matters affecting public health, the general article on **Sanitation** may be first consulted. In it numerous references to other subjects are given.

XI. SYMPTOMS OF DISEASE.—The symptoms most likely to attract attention are mentioned, and the diseases which most commonly produce them are indicated, under the following headings: **Diarrhœa; Vomiting; Expectoration; Breathlessness; Urine; Stools; Inflammation; Fever; Headache; Backache; Colic; Dropsy; Paralysis; Tremor; Abdomen, Diseases of; Chest, Diseases of; Nervous Diseases.** Under these headings references are given to other places where the individual diseases are fully treated.

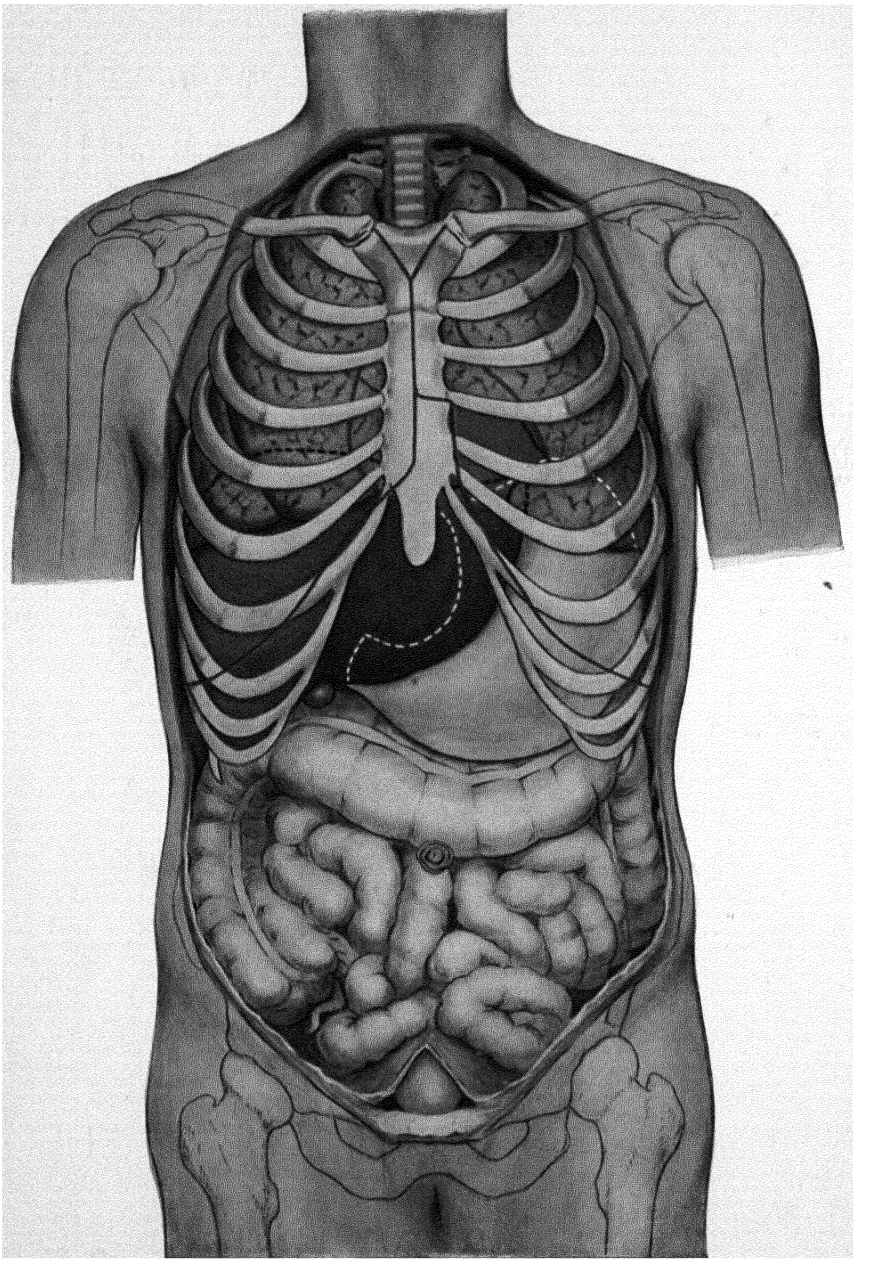
XII. NURSING.—Directions regarding attendance on the sick are given in the article on **Nursing,** from which references are also made to various special subjects and descriptions of applications like **Bandages, Bed-changing, Feeding, Fomentations, Poultices, Blisters,** etc.

XIII. MANAGEMENT OF CHILDREN.—Information regarding the avoidance or remedying of defects incidental to early life will be found under **Infant-feeding; Infection; Incubation** (of infectious diseases); **Children, Peculiarities of; School Children; Mental Defectiveness; Deafness; Ear, Diseases of; Nose, Diseases of** (section Adenoids); **Vision, Disorders of; Squinting; Palate, Malformations of; Spine and Spinal Cord Diseases.** Some of the more important diseases of children are described under **Bronchitis; Croup; Glands, Diseases of; Joints, Diseases of; Rickets;** and under the names of the various infectious diseases.

XIV. ACTION OF DRUGS.—The mode of action of various drugs and applications is given under such headings as—**Anodynes; Anæsthetics; Antiseptics; Demulcents; Disinfection; Hypnotics; Purgatives; Tonics;** etc.; the amounts commonly administered are given under **Dosage;** and the more important drugs are described at greater length under their own names.

XV. ANATOMY AND PHYSIOLOGY.—The anatomy and physiology of the body are dealt with under the headings of the various organs, and of such general functions as **Circulation; Perspiration; Respiration; Temperature; Touch; Pain; Sleep; Vision.**

NOTE.—Each of the more important diseases is fully considered under the heading of its own name; those of less frequent occurrence are included in groups under the heading of the organ affected. For example, **Bronchitis, Consumption, Pneumonia** are all dealt with under these heads, while the less important abscess, tumors, wounds, etc., of the lungs are dismissed in a few words under **Lungs, Diseases of.**



GENERAL VIEW OF THE ABDOMINAL AND THORACIC VISCERA
The lines of pleural reflection are shown in blue.

PLATE I.—ORGANS OF THE BODY FROM BEFORE, WITH THE SOFT PARTS REMOVED.

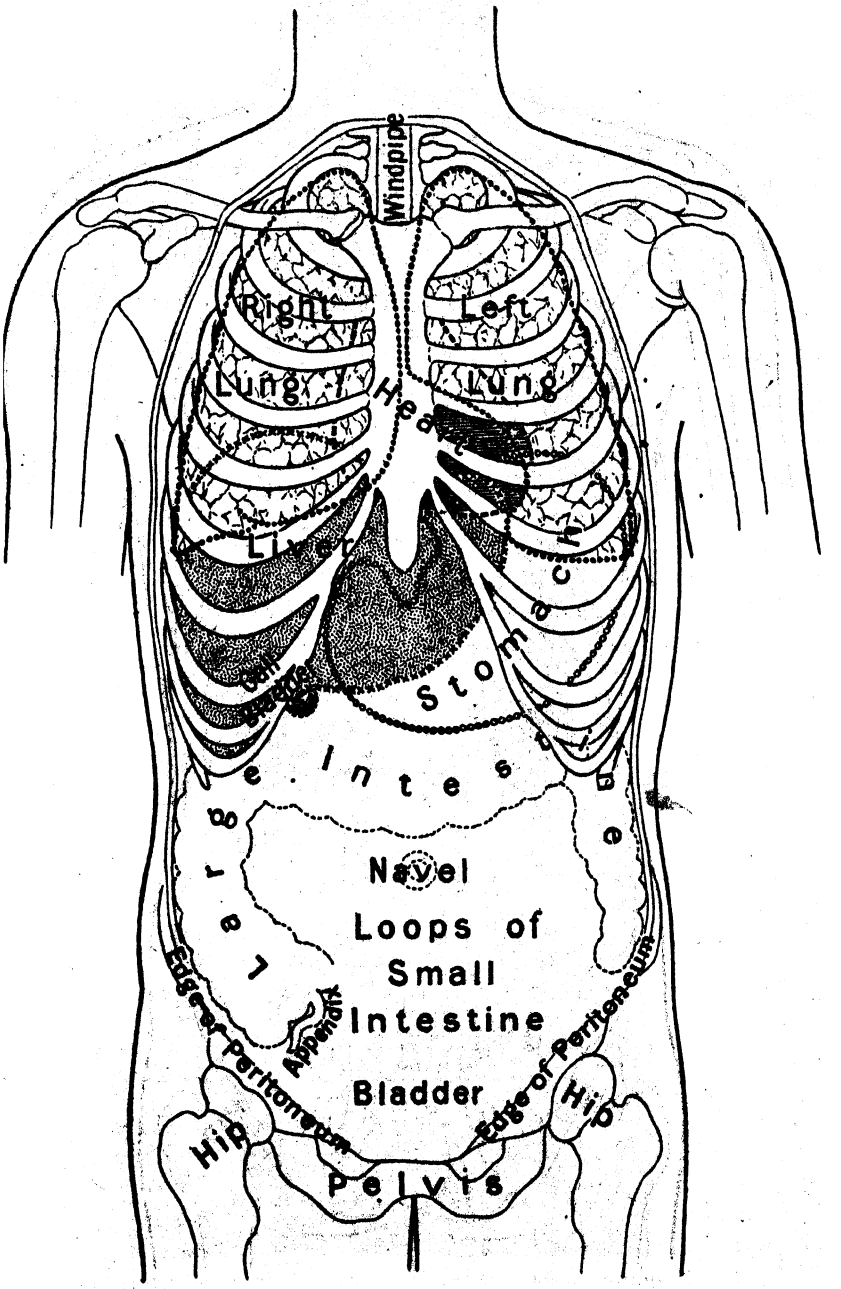
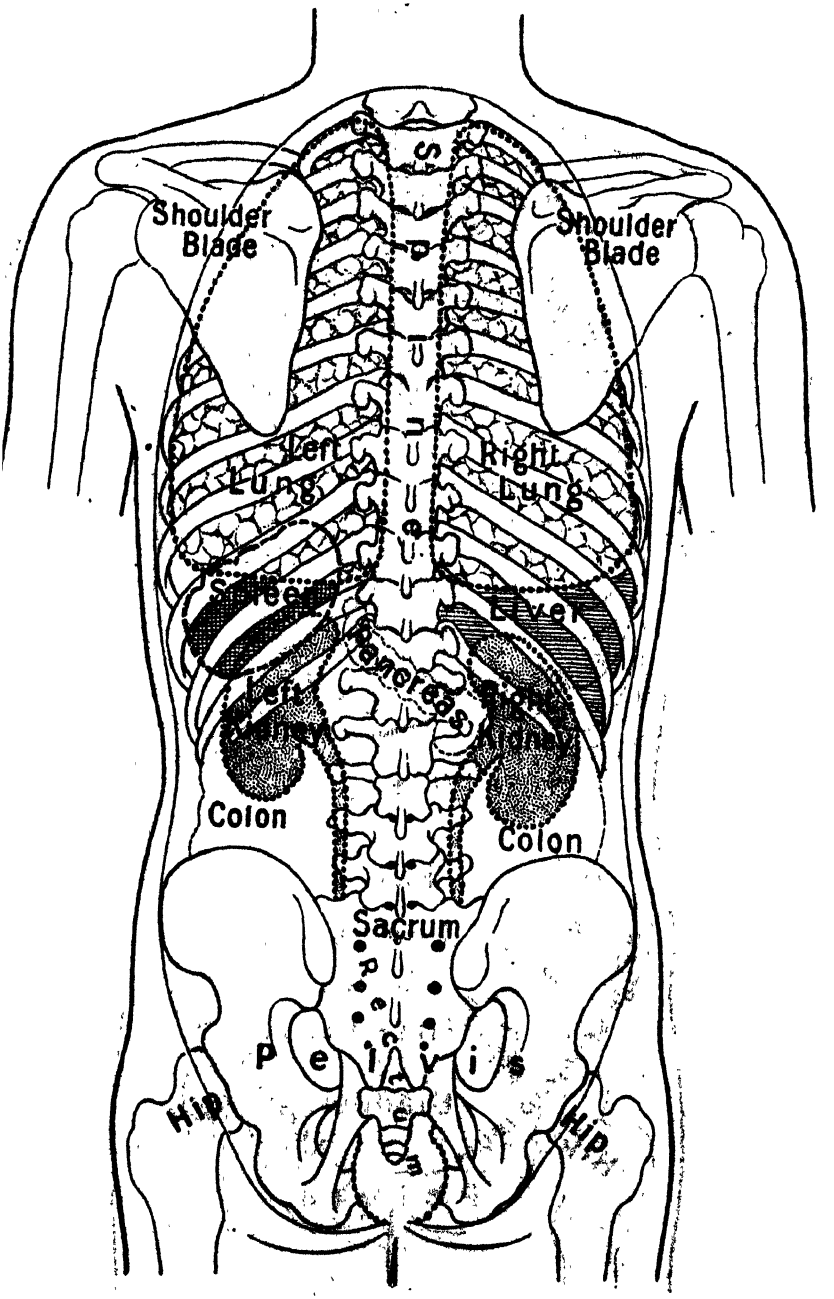
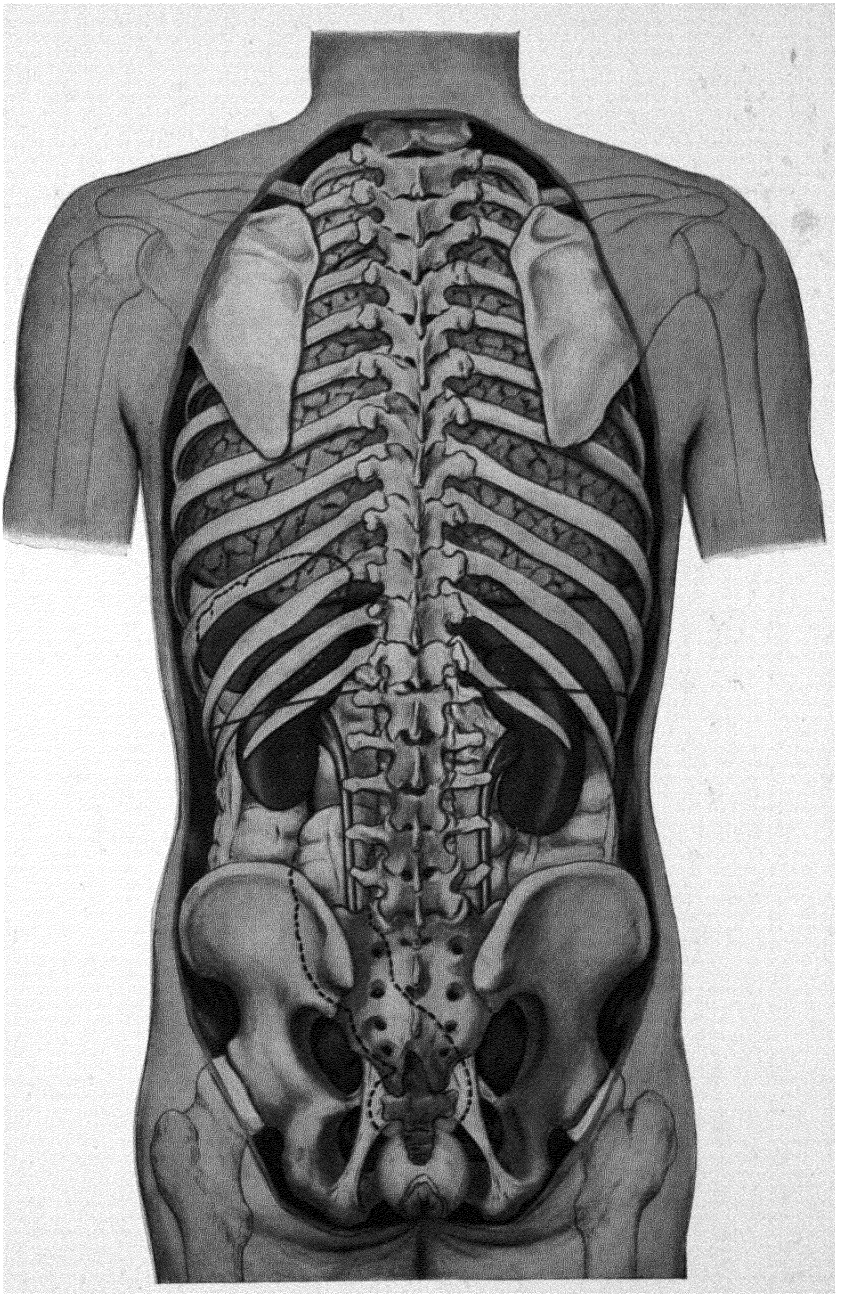


PLATE II.—ORGANS OF THE BODY FROM BEHIND, WITH THE SOFT PARTS REMOVED.





THE ABDOMINAL AND THORACIC VISCERA, FROM BEHIND

The lower limit of the pleural sac is indicated by the blue line. Note the relation of the pleura to the spleen and to the twelfth rib.

A

ABDOMEN is the lower part of the trunk. Above, and separated from it by the diaphragm or midriff, lies the thorax or chest, and below lies the pelvis, or basin, generally described as a separate cavity though directly continuous with that of the abdomen. Behind lie the spinal column and lower ribs which come within a few inches of the iliac or haunch bones; at the sides the protection afforded to the contained organs by the iliac bones and down-sloping ribs is still more effective; but in front the whole extent is protected only by soft tissues. The latter consist of the skin, a varying amount of fat, three layers of broad, flat muscle, another layer of fat, and finally the smooth, thin peritoneum which lines the whole cavity. The absence of rigidity allows of the necessary distension when food is taken into the stomach, and of the various important movements of the organs associated with digestion. The shape of the abdomen varies; in children it may protrude considerably, though if this be too marked it may indicate disease, *e.g.* the presence of fluid; in healthy young adults it should be either very slightly prominent or slightly indrawn, and should show the outline of the muscular layer, especially of the pair of muscles running vertically (recti), which are divided into four or five sections by transverse lines; while with advance of age it is quite natural that a considerable amount of fat should be deposited both on and inside of the abdomen.

Contents.—The principal contents of the abdominal cavity are the digestive organs, *i.e.* stomach, intestines, and the associated glands the liver and pancreas. The position of the stomach is above and to the left, of the liver above and to the right, both lying to a large extent under cover of the ribs, and occupying the hollow of the diaphragm, by which alone they are separated from the lungs and heart. Against the back wall on either side lie the kidneys, protected also to a great extent by the last two

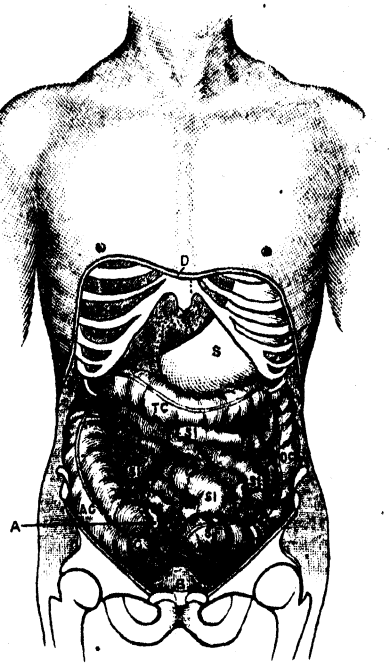


FIG. 1.—Contents of abdomen in position; the front wall of the abdomen and the omentum removed. *A*, Appendix; *B*, bladder; *C*, cæcum; *D*, upper limit of diaphragm; *AC*, ascending, *TC*, transverse, *DC*, descending colon; *L*, liver; *S*, stomach; *SF*, sigmoid flexure of colon; *SI*, coils of small intestines. (After Luschka.)

ribs; and from the kidneys run the ureters or urinary ducts down along the back wall to the bladder in the pelvis. The pancreas lies across the spine between the kidneys, and upon the upper end of each kidney lies a suprarenal body. High up on the left and partly

behind the stomach lies the spleen. The great blood-vessels and nerves, the absorbent vessels and the glands connected with them, lie on the back wall, and the remainder of the space is taken up by the intestines or bowels (*see* INTESTINE), the large intestine lying in the flanks on either side in front of the kidneys and crossing below the stomach from right to left, while the small intestine hangs from the back wall in coils which fill up all spaces between the other organs. Hanging down from the stomach in front of the bowels is the omentum, or apron, containing a considerable amount of fat, and helping to protect the bowels from cold and injury. In the condition of pregnancy the womb rises up from the pelvis into the abdomen, as it increases in size, lifting the coils of the small intestine above it.

The *pelvis* is that portion of the abdomen which lies within the bony pelvis (*see* BONES), and contains the rectum or end part of the intestine, the bladder, the prostate and, in the female, the womb, ovaries, and Fallopian tubes.

ABDOMEN, DISEASES OF.—(*See under* STOMACH, DISEASES OF; INTESTINE, DISEASES OF; DIARRHŒA; LIVER, DISEASES OF; PANCREAS, DISEASES OF; KIDNEY, DISEASES OF; BLADDER, DISEASES OF; HERNIA; PERITONITIS; APPENDICITIS; TUMORS.)

Symptoms.—The symptoms of various diseases will be found under the above headings, and only some general symptoms of abdominal disease, or symptoms whose meaning is not plain, but which nevertheless point to trouble in definite organs, will be mentioned here.

PAIN.—This is a most important symptom, because the internal organs being devoid of ordinary sensation, pain in them generally means a considerable interference with structure or function. The *site* of the pain may indicate the organ affected. Thus pain under the ribs on the left, or in the pit of the stomach, generally points to the stomach as being at fault. When it is felt on the right high up, and shoots through to the right shoulder, it indicates trouble connected with the liver or gall-bladder. Pain situated on the right, and low down in the iliac region, may arise from a diseased appendix. On the left, and low down, or at the exit of the bowel, it means some rectal trouble. Finally, pain situated vaguely all over the front of the abdomen, especially round the navel, points to inflammation of the peritoneal lining of the abdomen, or to irregularity in movement of the small intestine. The *character* of the pain is also important. A dull, aching pain is not generally serious, though it may indicate chronic peritonitis or obstruction. (*See* PERITONITIS *and* INTESTINE, DISEASES OF.) A twisting, griping pain is generally, *e.g.* in babies, due to spasmodic movements of the small intestine, often produced by errors in diet, and called colic. A straining pain with frequent calls to stool indicates irritation low down in the large bowel; and the pains of stomach trouble are of various nature. (*See* DYSPEPSIA.) Sudden, colicky, agonising pain is very often due to the passage of a gall-stone, if situated high up on the right, shooting through towards the back, or to the passage of a renal calculus, if shooting from the back down into the groin. Pain of a dull character slightly to the right of the pit of the stomach, especially when it is relieved by taking food, suggests some trouble in the duodenum.

TENDERNESS on pressure is generally a sign of inflammation either of an organ situated beneath the tender spot, or of the peritoneum. (*See* APPENDICITIS, PERITONITIS.)

VOMITING is an important symptom. (*See* VOMITING.) When due to irritation of the stomach, it usually ceases as soon as the contents of this organ are brought up. If it persist, it may be due to some obstruction in the bowels, or may be of nervous origin, *e.g.* in sea-sickness, or cerebral tumor, and have no direct connection with the abdomen.

DIARRHŒA is a very important symptom, generally of serious import. (*See* DIARRHŒA.)

SWELLING of the abdomen is often so marked as to call the patient's attention to it. This may be due merely to excessive deposit of fat, especially in elderly people, for example, in women at the menopause. (*See* CORPULENCE, DIET.) Enlargement, of course, occurs in pregnancy: and married women should remember this before conclud-

ing, as is frequently done, that they are the subject of some tumor-growth. The abdomen in habitual constipation may become more distended partly by the undischarged remnant of the food, and partly by gases arising from its decomposition, or this condition may be due to chronic obstruction of the bowels. (*See* CONSTIPATION *and* INTESTINE, DISEASES OF.) Finally, a collection of fluid may produce the swelling (*see* DROPSY; LIVER, DISEASES OF; HEART, DISEASES OF; PERITONITIS), or it may be due to enlargement of a single organ.

INDRAWING of the abdomen occurs in wasting diseases, and also to a remarkable extent in meningitis. (*See* MENINGITIS.)

DISTENSION OF THE VEINS on the surface of the abdomen indicates some interference with the circulation in the portal vein or in the inferior vena cava.

VISIBLE MOVEMENTS are sometimes seen, due to the bowels being distended and contracting forcibly in the attempt to drive their contents onwards. They indicate (unless they are visible merely on account of extreme thinness of the abdominal wall) some obstruction in the bowel. (*See* PERISTALSIS.)

The differentiation of abdominal diseases is often one of the most difficult problems with which even an expert has to deal, and frequently it is only after a period of observation, lasting in difficult cases perhaps some weeks, that a diagnosis of approximate accuracy can be arrived at. This is partly due to the difficulty or impossibility of feeling the surface and dimensions of the contained organs, *e.g.* the kidneys, especially in stout persons; partly to the vagueness of symptoms set up in organs which are very little sensitive to even extreme changes in their structure; and partly to the readiness with which the organs change their relative positions, and to the great changes in shape and position often brought about by previous disease.

Treatment.—Details of treatment are given under the headings of the various diseases. On the whole, people are rather too much given to regarding abdominal symptoms as trivial and amenable to home treatment. In many a case incurable dyspepsia would have been got rid of in its early stages if its symptoms had not been neglected, and not infrequently, patients with acute obstruction of the bowels die because a dose of castor oil was taken when a medical man should have been consulted. In this connection one may say that whenever the three symptoms of (*a*) abdominal pain, (*b*) vomiting or retching, and (*c*) stoppage of the bowels for a day or two, or stoppage followed by a little diarrhœa, have occurred together, the case demands the attention of a skilled medical adviser. If severe abdominal pain be directly traceable to some dietetic indiscretion, the offending material should be got rid of speedily by an emetic, if it is still in the stomach (*see* EMETICS); or by a purgative if the symptoms are referable to the bowels. If the pain be griping in character, *e.g.* in babies, relief is often given by pressure; thus nurses often lay their charges stomach downwards across the arm, or adults get some relief by lying face downwards on a pillow. (*See* COLIC, LEAD POISONING.) When the pain is of an agonising nature, stronger remedies are necessary. (*See* COLIC.) The pain of inflammation is soothed by poultices or fomentations (*see* POULTICE); or sometimes better by an ice-bag. (*See* COLD.) An alternation, however, between hot and cold is a bad thing; and, in general, cold should only be tried on the order of the medical adviser. Chronic pains and vomiting are treated by blisters (*see* BLISTERS) as well as by internal remedies.

ABDOMEN, INJURIES OF.—When one considers the exposed nature of the abdomen to the front and the thinness of the wall covering the viscera, it is surprising how seldom blows and crushes damage the contained organs. This is to be explained by the fact that the firm muscles, which are perhaps half an inch in thickness, offer the same type of protection which would be given by a slab of india-rubber of like thickness tightly stretched, while the fat still further dissipates the effect of violence. When a kick or blow causes rupture of an organ, the violence has generally been unexpected, and the muscles have been surprised in a lax condition. It is true that instantaneous death may follow a comparatively trivial blow on the epigastrium or pit of the stomach

and this is due to shock (*see* SHOCK) caused by injury to a nerve-plexus situated in the back of the abdomen in that region. Rupture of the liver, kidney, or spleen may occur with hæmorrhage into the surrounding tissues from severe crushes between railway-carriage buffers, from falls from a height, motor-car accidents, etc.; but these are not necessarily fatal unless some large blood-vessel be torn. Rupture of the bowel occasionally follows a blow or wound and is almost necessarily fatal in a few days, unless the abdomen be opened by a surgeon and the torn bowel stitched within a few hours of the accident.

Persons run over by carts or cars are liable to have the bladder ruptured. This occurs especially in the case of children, and it happens only when the bladder is full, or nearly so, of urine. In such a case the inability to pass water soon after the accident, supposing that it was not passed for some hours previously, or the passage of blood, indicates the necessity of a speedy operation to stitch the torn bladder.

Straining to lift a weight beyond the strength, or excessive straining at stool, may force a loop of the intestine through the muscular part of the abdominal wall, so producing a hernia or rupture. Though there is often a feeling that something has given way, or even the noise of a crack, there is, as a rule, no immediate danger, the bowel going back into the abdomen again, but leaving the abdominal wall permanently damaged. (*See* HERNIA.)

ABDOMEN, REGIONS OF.—For convenience of reference the abdomen is divided into regions by artificial lines. Two are vertical, passing through the middle of Poupart's (inguinal) ligament, a band which crosses the groin obliquely and divides thigh from abdomen; and two are horizontal, one halfway between top of breast-bone and of pubis, the other at the most outwardly projecting points of the iliac or haunch bones. These divide off nine regions named as follows: Epigastrium or pit of the stomach (E), two Hypochondriac regions (He), Umbilical or Navel region (U), two Lumbar or Loin regions (L), Hypogastric region (H), and two Iliac regions or Groins (I) (*see* diagram). The inguinal region on each side is the lower and outer part of the hypogastric.

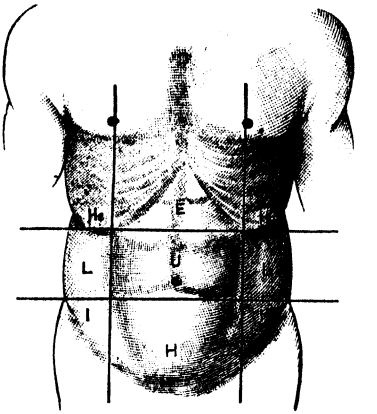


FIG. 2.—Abdomen mapped out in regions. For meanings of the letters see text. The outline of the recti muscles and of their tendinous divisions is also shown.

This contains the inguinal canal which pierces the abdominal wall obliquely.

ABDUCENT NERVE (*abducens*) is the sixth nerve rising from the brain and controls the external rectus muscle of the eye, which turns the eye outwards. It is particularly liable to be paralysed in diseases of the nervous system, thus leading to an inward squint.

ABLATION means the removal of any part of the body by a surgical operation.

ABORTIFACIENT is a drug which causes artificial abortion.

ABORTION (*see* MISCARRIAGE).

ABRASION means the rubbing off of the surface of the skin or of a mucous membrane due to some mechanical injury. Such injuries, though slight in themselves, are very apt to allow entrance of dirt containing organisms and so to lead to an abscess or some severer form of inflammation.

Treatment.—The most effective form of treatment consists in the thorough and immediate cleansing of the wound with soap and water. An antiseptic such as dettol or acriflavine can then be applied, and a sterile dry dressing.

ABSCESS (*abscessus*) is a localised collection of pus or matter. A minute abscess is known as a pustule (*see* PUSTULE), a diffused production of pus is known as cellulitis or erysipelas (*see* ERYSIPELAS). An abscess may be acute or chronic; the two have almost nothing in common, and so will be considered separately.

ABSCESS, ACUTE.—An acute abscess is one occupying in its development some days, or at most weeks, and characterised by a definite set of symptoms.

Causes.—Formerly chills, injuries, and similar occurrences, which served to depress the vitality of a portion of the body, were looked upon as the cause; now the direct cause is proved to be the activity of various bacteria, while these depressing factors render the tissues more liable to bacterial attack. In a very few cases irritating substances other than micro-organisms, such as croton oil, ammonia, or turpentine injected beneath the skin, the presence of movable foreign bodies, such as bullets, or contact with poisonous plants, such as poison ivy, may produce abscesses, but practically these do not come into operation, and foreign bodies, if they do not form irritating chemical substances with the bodily fluids, or cause irritation by their movements, may remain for life buried in the tissues without causing any trouble. The micro-organisms most frequently found are *staphylococci*, and next to these *streptococci*, though the latter cause more virulent abscesses, or in general the more serious condition of erysipelas or cellulitis. Other abscess-forming organisms are *micrococcus tetragenus*, especially in abscesses about the mouth or throat, or in the lung; *bacillus pyocyaneus*, which produces blue or greenish pus; and *bacillus coli communis*, which lives always in the bowels, probably aiding digestion, and under certain conditions wanders into the surrounding tissues and produces abscesses. From the last remark it will appear that the mere presence of micro-organisms is not sufficient to produce suppuration (*see* IMMUNITY *and* INFECTION); indeed streptococci, which upon occasion produce most disastrous effects, can often be found on the skin and in the skin glands of perfectly healthy individuals. Given the proper micro-organisms in the tissues, whether they will produce abscesses or not depends upon two factors: (1) the virulence of the organism at the time, for this varies with presence of light, air, food, other bacteria, etc.; and (2) the resisting power of the individual in whose tissues the bacteria are, for in the case of bad health, in diabetes, in fever, in Bright's disease, the tissues are much less resistant, and cold, injury, or previous disease of a part renders that particular part less able to cope with bacterial invasion. On the other hand, good food, vigorous exercise, and healthy open-air life render the whole individual more or less completely immune from the ill effects of these bacteria. They are communicated, principally in a virulent form, from one wound to another; but they live also in the air, in dust, and in water. They enter the body generally by a wound, but may also come through the mucous membrane of the intestine when this is rendered less resistant by the poisoning effects of constipation, as in appendicitis; also they may pass through the mucous membranes of the nose, mouth, respiratory, and urinary passages, and cause local abscesses, or even through the skin by way of its minute lubricating glands.

When bacteria have gained access, for example, to a wound, they rapidly multiply, and, by the formation of poisonous substances, irritate the surrounding tissues, and so produce local dilatation of the blood-vessels, slowing of the blood-stream, and exudation of blood corpuscles and fluid. The leucocytes, or white corpuscles of the blood, collect around the invaded area, apparently under some attractive influence of the bacteria ('chemotaxis'), and destroy the latter either by actually devouring and digesting them (*see* PHAGOCYTOSIS), or by forming some substances which cause their death. These white corpuscles undergo a granular fatty degeneration, and in turn die, and form the white constituent of the pus (pus corpuscles). Meanwhile, the area where these changes have been taking place has been cut off from communication with the rest of the body by plugging of the blood and lymphatic vessels

around. The tissues of the affected area die and are digested by the action

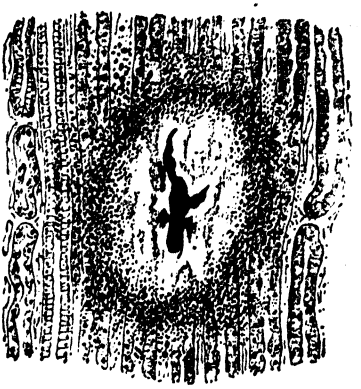


FIG. 3.—Small abscess in the kidney. In the centre is a mass of bacteria; round it is an area of dead tissue; at the margin of this the surrounding tissues are infiltrated with leucocytes. Magnified by 108. (Thoma's *Pathology*.)

of the white corpuscles, and the cavity so produced is distended by fluid and by the white corpuscles which flock to it in increasing numbers till all bacteria have disappeared. The abscess is shut off from healthy tissue by what is known as the 'abscess wall.' The bacteria may find their way along a vessel to some little distance, where the same process takes place, and these secondary abscess cavities may coalesce with the original one.

Symptoms.—We have the classic symptoms of inflammation, *rubor*, *calor*, *tumor*, and *dolor*, *i.e.* redness, warmth, swelling, and pain; and, besides these, when the abscess is well developed a considerable amount of fever, perhaps with delirium, sets in, and the temperature rises to 100°-104° Fahr. When the cavity containing fluid has been formed a sign, known as 'fluctuation', can be made out. Later, as the abscess is distended almost to bursting, the skin becomes reddish blue, glazed, and thin; and this is known as 'pointing' of the abscess; or if the abscess is very deep-seated the skin over it becomes swollen, and 'pits' on pressure. The lymphatic glands in the neighbourhood may be swollen and tender. Immediately the abscess is opened, or bursts, the pain disappears, the temperature falls rapidly to normal, the elasticity of the tissues around the cavity diminishes its bulk, and the healing of the small space left proceeds rapidly. If, however, the abscess discharge into an internal cavity, as the bowel or bladder, it may heal very slowly, and the reabsorption of its poisonous products may cause general ill-health for long. When an abscess is deep-seated a very important sign for diagnosis is given by examination of the blood. (*See* LEUCOCYTOSIS.)

Treatment.—As soon as there is evidence that pus has formed, we know that Nature's attempt to destroy the bacteria has been successful, and, as the further formation of pus is designed simply to burst a passage to the exterior, we can relieve pain, stop unnecessary destruction of tissue, and shorten the process by opening the abscess. This is done as soon as there is evidence from fluctuation, redness, or pitting of the skin that pus has formed. Previous to this, Nature's efforts may be aided by the application of poultices (*see* POULTICES), or better, because of its cleansing effect on the skin, by applying warm antiseptic fomentations, *e.g.* boracic lotion. These have the effect of diminishing the pain; of aiding resolution, if abscess formation is not going to take place; and of hastening the formation of an abscess cavity, and softening the overlying tissues if the latter process has already begun. When the abscess is opened three things are attended to:

(1) That important structures such as arteries in the neighbourhood are not damaged.

(2) That the opening is as far away as possible from a new source of infection like the mouth or anus.

(3) That the opening is large and so situated that the cavity can drain itself completely; otherwise, if the abscess cavity be large or irregular, a collection of fermenting pus takes place, and the wound will not heal but forms a sinus (*see* SINUS); for this reason it may be necessary to make two or more 'counter-openings'.

After the abscess is opened a simple wet dressing, of moist lint covered by gutta-percha tissue, and this again covered by absorbent wool (to absorb the remaining discharge) and a bandage, should be applied and changed daily. If the cavity be large it may be necessary to 'pack' the opening with a strip

of gauze or lint, or to insert a drainage tube, so as to ensure healing from the bottom of the cavity.

Special varieties of acute abscess: ABSCESS IN ABDOMEN.—When this occurs in the iliac region it is generally a result of appendicitis (*see* APPENDICITIS); when in the lumbar region it may be the result of this disease 'pointing' backwards, or may be the result of inflammation in the loose tissue around the kidney (perinephric abscess). In the upper part of the abdomen it is known as a subdiaphragmatic abscess, and may be the consequence of ulceration from the stomach, or bowels, or of abscess in the liver. All these conditions are very grave.

ABSCESS IN BONE (*see* BONE, DISEASES OF).

ABSCESS OF BREAST (*see* BREAST, DISEASES OF).

CEREBRAL AND CEREBELLAR ABSCESS.—These are apt to come on suddenly in cases in which the middle ear is diseased, generally after long-standing discharge from the ear. The stoppage of the discharge in such a case is a warning of danger. (*See* EAR, DISEASES OF.)

ABSCESS IN THE FINGER (*see* WHITLOW).

ILIAC ABSCESS (*see* APPENDICITIS).

ABSCESS OF THE JAW (*see* GUMBOIL).

ABSCESS OF THE LUNG may follow pneumonia or the drawing of some foreign body, such as food, down the windpipe. Being deep-seated its presence is very hard to diagnose till it bursts either into a bronchus, and pus is spat up, or into the pleural cavity.

ABSCESS IN THE PLEURAL CAVITY is known as empyema. (*See* EMPYEMA.)

ABSCESS, CHRONIC.—A chronic abscess is one which takes weeks or months for its development, and is in the vast majority of cases tuberculous.

Causes.—The tubercle bacillus is generally the direct cause. Some acute abscesses may, instead of bursting, quiet down, become surrounded by dense fibrous tissue, and so form chronic abscesses, but these are rare. Abscesses in the liver following dysentery may be due to an amœba. (*See* DYSENTERY.) How the tubercle bacillus obtains entrance is still in dispute; probably in the case of abscesses of the neck it may be through the throat or tonsil, and in the case of abscesses elsewhere, through the circulation from the lung or intestinal canal, owing to polluted air or food. A common source of infection is milk which has not been boiled or Pasteurized; the tubercle bacillus is actually in the milk, as tuberculosis among cows is common. Abscesses arise most commonly from tuberculous deposits in glands or bones, especially in the vertebræ or bones of the spine, the epiphyses or large ends of long bones near a joint, and the ribs. They may start also in the synovial membranes, *i.e.* membranes lining a joint (*see* JOINT DISEASES), in the loose tissue beneath the skin, quite apart from disease of any other structure, and, not uncommonly, in the testicle. If the disease begin in a bone, such as a vertebra, a tubercle forms (*see* CONSUMPTION), spreads by the formation of others around, and causes crumbling away of the proper bony tissue. So far, beyond the poor health always accompanying early tuberculosis, there is little complaint, but, when the process reaches the surface of the bone and bursts, there may be more or less pain and deformity, and a swelling, due to the abscess, forms. This abscess cavity is lined by a ragged membrane composed partly of dead tissue, partly of tuberculous granulations; and, whereas the organisms causing an acute abscess are found in the centre of the abscess with dead, and farther out with healing tissue around, the tubercle bacilli are found in the wall of the chronic abscess. Hence the greater difficulty in treating the latter, because the cause of the abscess may remain behind after the abscess contents are let out.

Symptoms.—There is far less in the way of symptoms than in acute abscess. Sometimes the swelling is noticed by accident, and it is not hot, nor red, nor in general painful, as is an acute abscess. The skin becomes red only a short time before the abscess bursts. Sometimes there are several abscesses, for instance on the chest from diseased ribs. There is no definite fever, but, if the temperature be taken every four hours it will generally be found that there is a slight rise either in the forenoon or late afternoon. If the abscess be untreated it generally enlarges till it bursts, then

a ragged wound is left, infection with other organisms takes place, and the resulting sinus with 'mixed infection' becomes extremely difficult to heal. If such a sinus be large, as in a psoas abscess, it may persist for years, and the patient becomes exhausted by the resulting hectic fever; or waxy disease (*see* WAXY DISEASE) attacks the liver and kidneys, and causes wasting and death. In a few cases an untreated abscess dries up and disappears without bursting. Not infrequently tuberculosis in other organs, *e.g.* the lungs, breaks out. The older the patient the worse the prospect of cure; but in children treated early the outlook is generally favourable.

Characters of the pus.—The fluid is thin and watery (not thick and white as in acute abscess) and contains little curdy masses. It is not really 'pus', as pus corpuscles are almost entirely absent, and only fragments of the dead tissues are found under the microscope.

Treatment.—When a child presents such an abscess of small size, and showing no sign of redness of the overlying skin, an attempt may be made to bring about its absorption without operation by placing the child in as healthy surroundings as possible. Seaside or country air, sunlight, sleep in well-ventilated rooms, and plenty of good, nourishing food, make for this object. Cod-liver oil, or other liquid fat, has a special action in this, as in other forms of tuberculosis, also syrup of the iodide of iron. Absolute rest to the part is all-important, and this is attained by splints, bandages, and various similar appliances, depending on the position of the abscess. Further details will be found under GLANDS and JOINT DISEASES. Absorption is aided by the application of various forms of counter-irritation to the skin over the abscess, *e.g.* tincture of iodine, ichthyol soaks, etc. Hypodermic injections of tuberculin over a long period have also been tried.

If the abscess be larger, say, of the size of a walnut or over, but show no signs of bursting or of getting larger, the injection of iodoform often brings about absorption. This is usually injected finely powdered and suspended in glycerin or oil. Of course this is done under the strictest aseptic precautions, or a sinus with 'mixed infection' may result.

When these means are unavailing, the abscess must be opened; if small the whole abscess is often removed with a little of the healthy tissue around, when an aseptic wound is left which heals in a few days. If larger it is opened under strict aseptic precautions, the diseased membrane lining the cavity thoroughly scraped away, and then the wound closed or packed with iodoform gauze according to its size. Such a wound also heals rapidly if aseptic. If the abscess has unfortunately burst of itself, or been merely opened and not scraped out, it is almost certain to become infected with the organisms which produce acute abscesses and dirty wounds (staphylococci, etc.), and then a discharging sinus results which may take months to heal, and which, if large, may produce serious deterioration of health.

Special varieties of chronic abscess:

ABSCESS OF THE LIVER.—This is one of the exceptions to the statement that chronic abscesses are tuberculous in origin. It occurs in persons who have been the subject of dysentery (*see* DYSENTERY), frequently after returning in apparently fair health to a temperate region where dysentery does not occur. The liver becomes enlarged and tender, and there is a degree of ill-health and slight jaundice. When threatening, it is treated by rest and low diet; and when it has formed should be at once operated on lest it burst into lung or peritoneal cavity.

ISCHIO-RECTAL ABSCESS.—This forms at the side of the rectum. Whether it bursts or is opened it is very difficult to keep clean, from its position, and so forms a sinus; or if it open into the bowel, a fistula. (*See* FISTULA.) It is a frequent occurrence late in a case of consumption.

RETROPHARYNGEAL ABSCESS.—This is due generally to disease of the spinal column in the neck. It is opened from the side of the neck; otherwise it bursts into the mouth, and the discharges from it being constantly swallowed, lead to rapid falling-off in health, and to death.

ILIO-PSOAS ABSCESS.—This is a common form of large chronic abscess. It arises generally from tuberculous

disease of the spinal column in the lumbar region, and though this may cure itself, the abscess bursts into the sheath of the psoas muscle and passes along the muscle through the iliac region into the thigh, on the inner side of which it generally 'points'. Its early symptoms very much resemble those of hip-joint disease. (*See* JOINT DISEASES.) The opening and scraping of such an abscess often requires large incisions in the thigh, groin, and lumbar region, and if, unfortunately, the wound become the seat of 'mixed infection' the resulting sinus may last months or years.

ACTINOMYCOTIC ABSCESS.—This is another form of chronic abscess not due to tubercle bacilli (*see* ACTINOMYCOSIS) about the jaws or mouth.

ABSINTHISM.—Absinthe is a liquor prepared by steeping several herbs, especially anise and wormwood, in alcohol for several days. It is greenish in colour. It was first introduced into France by soldiers stationed in Algiers between 1830 and 1850, for whom it had been prescribed as a febrifuge, and its employment spread thence into other countries. Its use becomes a habit like that of alcohol, but its effects are more demoralising. Its habitual use brings on tremors and paralysis in the arms especially, with delusional insanity.

ABSORBENT VESSELS (*see* LYMPHATICS).

ABSORPTION (*see* DIGESTION).

ABSTRACT.—This is a dry powdered extract produced by extracting the active principles from a crude drug with strong alcohol, mixing with sugar of milk, and drying. Abstracts are standardised so as to be twice the strength of the crude drug.

ACACIA GUM, or GUM ARABIC, is a gummy exudation from various species of the acacia tree, which, dissolved in water to form mucilage, is largely used in coughs and sore throat and in states of irritation of the stomach and bowels. The dose of mucilage of acacia is one to four teaspoonfuls. Gum acacia, 6 per cent in normal salt solution, is injected into the veins after severe hæmorrhage to make up for loss of blood.

ACANTHOSIS NIGRICANS is a rare disease in which pigmented warty growths appear on the skin in different parts of the body and in the mouth.

ACAPNIA (ἀ, neg.; καπνός, smoke) means a condition of diminished carbon dioxide in the blood.

ACARUS (ἀκαρί, a mite) is the cause of the skin disease known as Itch. (*See* ITCH.)

ACCOMMODATION is the faculty possessed by the eye of altering its refractive power so that rays of light, whether from a near or distant point, are brought accurately to a focus on the retina. (*See* EYE.) It is effected by means of the elasticity of the crystalline lens. If the eye be directed towards a distant object the rays of light entering it should be focussed exactly on the retina; if now the eye be turned towards an object a few inches off, the elastic circular ligament, in the centre of which the lens is suspended, is drawn together by the circular ciliary muscle, allowing the lens to become more globular, as it constantly tends to do. The lens becomes, therefore, a lens of higher power, and the diverging rays from the near object are still brought to a focus on the retina. The amount of power possessed by the eye of thus suiting itself for objects far off and near at hand is known as 'range of accommodation'. At the age of forty-five the lens has lost much of its elasticity, though this change has been gradually proceeding throughout life; and by the age of sixty, even though it be quite clear, it is incapable of this accommodative change in shape; consequently a natural change with advancing years is that persons become unable to read, sew, or do other fine work near at hand without glasses, though for distant vision no such assistance is necessary. This natural change is known as 'presbyopia'.

In addition to this, there are three errors in the refractive power of the eye which may be either present at birth or come on early in life and persist through life, and in which these movements of the lens are not always sufficient to focus the rays of light accurately on the retina. These are astigmatism

(*see* ASTIGMATISM), hypermetropia (*see* HYPERMETROPIA) or long sight, in which the eyeball is too short, and myopia (*see* MYOPIA) or short sight, in

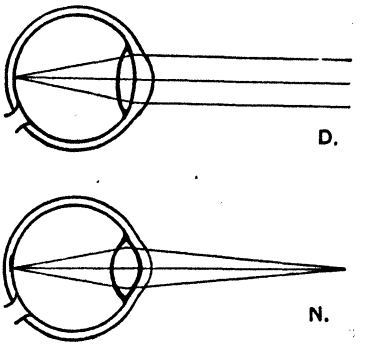


FIG. 5.—Diagram illustrating resting position of eye for distant vision (D), and increased convexity of lens for vision of a near object (N).

which the eyeball is too long. (*See also* SPECTACLES.)

ACCOUCHEUR is a physician who specializes in the practice of midwifery.

A.C.E. MIXTURE is an anæsthetic mixture containing one part of alcohol, two of chloroform, and three of ether.

ACETABULUM (*acetabulum*, a cup) is the cup-shaped socket on the pelvis in which rests the head of the femur or thigh-bone, the two forming the hip joint. (*See* HIP JOINT.)

ACETANILID, or ANTIFEBRIN, is a white crystalline powder given for neuralgia and rheumatism in doses of 2 to 10 grs.

ACETIC ACID (*acetum*, vinegar), also called pyroligneous acid, is prepared in large quantities by the distillation of wood and subsequent separation from tar. In the pure form it is solid, being then known as glacial acetic acid. It is the active principle of vinegar, which is prepared from wine by the action of a peculiar ferment discovered by Pasteur. This grows on the surface of the wine, taking from the air oxygen which it gives up to the alcohol of the wine, so producing acetic acid. Weak acetic acid has all the actions of vinegar, and is less expensive. Strong acetic acid is a caustic and irritant poison.

Uses.—In strong solution acetic acid is used to destroy warts or raise blisters. In cases of great and weakening sweating it is most useful, because, sponged over the skin, it checks perspiration and produces a sense of grateful coolness; for this purpose a few tablespoonfuls of vinegar may be added to a quart of water. Used similarly it is good for headache.

ACETONE is a chemical substance found in the urine in wasting conditions like cancer, in diabetes, in prolonged vomiting, and in acute fevers—especially in children. With it occur in the urine β-hydroxy-butyric and aceto-acetic acids, particularly in severe cases of diabetes. A large quantity of these acids and of acetone in the urine in diabetes indicates approaching coma. Acetone is sometimes administered as a remedy against intestinal worms and is also used externally as an antiseptic. (*See also* ACIDOSIS.)

ACETYLCHOLINE is a substance constantly found in small quantities in the muscles and necessary for the transmission of nervous influences for their contraction. It appears to be responsible for the transmission of nervous impulses at the synapses and terminals of the parasympathetic nervous system. Various preparations of choline are used as stimulants of this system, causing vaso-dilatation, slowing of the heart, increased activity of the gastro-intestinal tract. Acetylcholine is rapidly destroyed by a ferment present in the blood.

ACETYL-SALICYLIC ACID (*see* ASPIRIN).

ACHALASIA (ἀ, neg.; χάλασις, slackening) is another term for spasm, but indicates not so much an active spasm of muscle as a failure of it to relax.

ACHALASIA OF THE CARDIA is a condition in which there is a failure to relax of the muscle fibres round the opening of the oesophagus into the stomach.

ACHLORHYDRIA means an absence of hydrochloric acid from the stomach juice; it occurs in about 4 per cent of healthy people and in gastritis.

ACHOLIC STOOLS (ἀ, neg.; χολή, bile). (*See* STOOLS.)

ACHONDROPLASIA (ἀ, neg.; χόνδρος, cartilage; πλάσσω, I form) is the name of a form of dwarfing in which the arms and legs are abnormally short and the head large.

ACHORION (ἀχωρ, dandriff) is the name of the micro-organism causing favus or honeycomb ringworm. (*See* RINGWORM.)

ACHYLIA GASTRICA (ἀ, neg.; χυλός, juice) means the complete absence of ferments and of hydrochloric acid from the gastric juice, so that in this condition the food is passed from the stomach in a state of incomplete digestion.

ACIDITY.—This is a vague term, more used in popular language than in scientific medicine, and meaning that the reaction of the blood, or of one or more of the secretions, is less alkaline or more strongly acid than normal, while a considerable number of symptoms is rightly or wrongly attributed to the condition.

The blood in health is alkaline, and an elaborate chemical mechanism keeps the degree of alkalinity remarkably constant. This mechanism hinges largely round the relative amounts in the blood of carbonic acid and sodium bicarbonate, $H_2CO_3/NaHCO_3$. By this and other mechanisms the acids formed in metabolism are neutralised and got rid of through the kidney and the lungs. These acids are the fixed acids such as lactic, sulphuric, phosphoric, etc., and carbonic acid, which is produced in large amounts daily as a result of tissue activity. The blood in disease never becomes actually acid, except in the last stages. But the blood may become *less alkaline*, and the patient in this state is said to have acidæmia—although the blood is not acid.

ACIDOSIS is a condition in which there are present in the urine acetone, β-hydroxy-butyric acid, and aceto-acetic acid.

Causes.—The presence of these substances is due to a defect in the chemistry of the body, which is unable completely to oxidise the proteins and fats of the dietary, so that poisonous substances are formed. The condition occurs much more readily in some persons than in others, and it is brought on in a severe degree by wasting diseases, diabetes, septic conditions, and several poisons, of which the most noteworthy is prolonged administration of chloroform. (*See also* ACETONE.)

Symptoms. — General lassitude, vomiting without apparent cause, and the presence of the above-mentioned substances in the urine form the slightest manifestations of the condition; in some children these attacks appear periodically, but the tendency to them passes off about the age of twelve or fourteen. In diabetes a state of coma may ensue and the disease end fatally.

Treatment.—Persons liable to acidosis should adopt a diet in which fats and protein substances are restricted while sugar and starchy bodies predominate. Alkalies such as sodium or potassium citrate, tartrate, acetate, carbonate, or bicarbonate may also be given. These are present to a large amount in green vegetables, lime juice, lemons, oranges, and similar fruits; or may be taken in such a draught as those described under CITRIC ACID. The acidosis of diabetes is lessened when insulin is administered and the carbohydrates of the diet are increased.

ACIDS.—These are substances which combine with alkalies to form salts. Most are oxygen compounds, have a sour taste, and turn blue litmus red. They are divided into (*a*) mineral or inorganic, and (*b*) vegetable or organic. In strong solution the mineral acids act upon stomach and bowels as irritant poisons, but small quantities in weak solution aid digestion, diminish the alkalinity of the blood, are excreted in the urine, whose acidity they increase, act as mild astringents and refrigerants, and check excessive sweating. The action of the organic acids varies, but the best known, viz. acetic, citric, lactic, tartaric, while in strong solution acting like mineral acids, in weaker solution after absorption into the blood become decomposed into carbonates, and have precisely the opposite actions, *i.e.* those of alkalies.

Varieties commonly used.—(*a*) *Inorganic*: boracic or boric, chromic, hydrochloric, hydrobromic, nitric, nitrohydrochloric, phosphoric, sulphuric, sulphurous. (*b*) *Organic*: acetic, carbolic, carbonic, chrysophanic, citric, gallic, hydrocyanic or prussic, lactic, salicylic, tannic or tannin, tartaric.

Uses.—The strong mineral acids, especially chromic and nitric, with pure acetic and carbolic from among the organic acids, are used as caustics to remove outgrowths such as corns, warts piles, and also to destroy diseased tissue in poisoned wounds and spreading sores. In using them, care must be taken not to let the action extend too far and destroy healthy tissue; they are usually applied on a glass rod, and an alkali, oil, or glycerin should be at hand to apply in case a drop falls on the healthy surface.

Weak acids are given in dyspepsia (*see* DYSPEPSIA), usually after meals, to stimulate the stomach wall. For this action hydrochloric acid (the acid naturally present in the gastric juice), or nitrohydrochloric acid, is chiefly used.

The astringent action is utilised by giving them, especially dilute sulphuric acid, or tannic or gallic acid, in diarrhœa, hæmorrhages from the bowel or lungs, and sweating. (*See also* ACETIC ACID.) When the urine is very alkaline there is a tendency to the formation of phosphatic calculi, and catarrh of the bladder is often present; these are relieved by acids among various other substances.

In fevers, and in cases where an increase in the output of urine is desirable, the vegetable acids or their acid salts are given, *e.g.* citrate, tartrate, or acetate of potash, because they lessen dryness of the mouth and thirst, cause a feeling of refreshment, stimulate the kidneys and sweat glands, and lower the temperature. In general acidity (*see* ACIDITY) the vegetable acids are used as indirect alkalies.

For the use of special acids see under ACETIC ACID, CARBOLIC ACID, SALICYLIC ACID, etc.

ACIDS, POISONING BY.—Although most acids have an extremely sour and burning taste, which warns a person drinking one of his error before very much is swallowed, still several are so much used in commercial processes, and so easily obtained, that accidental and intentional poisoning by acids is not uncommon.

Symptoms. — The symptoms produced are destruction of the skin and mucous membrane about the mouth, great pain in the mouth, throat, and stomach, and sometimes fainting or collapse. There is also later a risk of scarring and contraction of the throat. These are especially the symptoms of poisoning by strong mineral acids, or by citric or tartaric in large quantities, while several, such as prussic and carbolic, have symptoms peculiar to themselves and not due to irritation.

Treatment.—Give large quantities of water by mouth, and if possible add alkalies to it—such as bicarbonate of soda, baking soda, plaster from the ceiling, whitewash from the walls, or finely powdered egg shells. These neutralise the acid taken and form harmless salts, and also soothe the irritated mucous membrane. On no account must emetics be given. The patient must be treated for shock. Also, one must give soothing or demulcent substances, such as milk, oil, or barley water.

ACINUS (*acinus*, a grape) is the name applied to each of the minute sacs of which secreting glands are composed, and which usually cluster round the branches of the gland-duct like grapes on their stem.

ACNE is a chronic skin disease affecting the sebaceous glands of the forehead, nose, chin, chest, back of the shoulders, and outer side of the thighs, or one or more of these regions.

Causes.—It is found especially in young persons of both sexes between about fourteen and twenty years of age, especially in those who suffer from cold hands and feet, chilblains, and slow circulation. Constipation makes it worse, and in many cases it is associated with dyspepsia or other irregularities. Any local irritation, such as a rough or soiled hat-band on the forehead, may bring out a crop of acne pimples in those who suffer from the disease. Want of effective washing, with insufficient exercise and perspiration, causing sluggish action of the skin glands, renders it much worse. The suppuration has been attributed to various bacteria.

Symptoms. — There are various general symptoms, such as constipation, dyspepsia, bad circulation, which act as causes. The eruption itself consists of little black spots which indicate the mouth of small sebaceous ducts choked with dust or dirt, from which a long, wormy-looking, fatty mass can be squeezed; hard pimples generally showing one of these 'black-heads' on the top; little pustules surrounded by a slight degree of inflammation, which gradually grow, burst, and then heal; and hard lumps, sometimes half an inch across, which last for weeks or months, slowly suppurate, and leave a permanent hardness or scar.

Treatment.—The general health must be looked to, and dyspepsia, constipation, and similar errors treated. If the general health and physique be poor, cod-liver oil is very useful, or various other tonics may be taken. Sometimes anæmia needs treatment by iron. If the subject of the disease lead a sedentary or inactive life, active exercise should be taken, and the hygiene of the whole skin should be attended to by cold baths, rough towels, etc. The most important point in treatment is the daily washing of the affected areas with soap and *hot* water; after which they should be quickly immersed in cold water. The soap should be plain, or sulphur soap, or, if the skin be very fine, a superfatted soap. After washing, the skin should be well rubbed with a flesh-brush or towel. Lathering on the sulphur soap with a shaving-brush is a good plan. The contents of the sebaceous glands, wherever a 'black-head' shows, should be regularly squeezed out, by gentle pressure with a fine tube or 'comedo-extractor', after washing.

ACNE ROSACEA is a condition in which chronic congestion of the face, especially of the nose, leading to enlargement of the minute blood-vessels, lumpiness, and a red or dusky-copper colour, is associated with dyspepsia.

Causes.—It may occur in the subjects of chilblains and dyspepsia, and often breaks out about the age of forty-five. Severer forms, due to abuse of alcohol, are popularly known as 'grog-blossoms'.

Symptoms.—In the milder forms, associated with chilblains or dyspepsia, there is simple redness, burning, and tingling of the nose, the redness lasting at first only for a few hours every day, but later tending to become permanent, and also to appear upon the cheeks. This form occurs especially in women from thirty to sixty years of age. In the severer form the nose becomes very red and the skin thick and lumpy, while the openings of the sebaceous glands are seen as quite wide pits.

Treatment.—The mild form is lessened by attending to the dyspepsia, or the bad circulation which is its cause; avoiding exposure to cold winds, and the irritation of a veil resting on the nose; and by painting with Goulard's water, or calamine lotion. The severer form is only to be treated by avoiding alcohol, and by electrolysis of the enlarged veins here and there, to cause scarring and contraction, or by the actual removal of pieces of skin.

ACONITE (also known as 'Wolf's-bane', or 'Blue rocket', or 'Monk's-hood') is an extremely poisonous plant found in different species all over the world, and largely grown for its appearance in gardens. All parts of the plant are poisonous. The root has been mistaken for horse-radish, although the resemblance, to those who know horse-radish by sight, is not very great; and an unfortunate case occurred in Scotland some years ago, in which several clerics were poisoned at dinner, owing to a servant-girl having hastily dug up in the garden what she believed to be horse-radish. The root of the horse-radish is long, whitish outside, when scraped remains white, and has the well-known pungent odour. Aconite root is short and stumpy, brown, and when scraped the white cut surface speedily turns pinkish; if it be chewed the tongue in a few minutes tingles, then becomes numb and swollen and a burning sensation is felt in the mouth. The action of aconitine, its active principle, is produced by smaller doses than in the case of any other drug, accordingly aconite is a very favourite homœopathic remedy. Small doses have a paralysing action on muscle and nerve, slowing movements and deadening pain; large doses have in addition an irritant action. The *modus operandi* of the drug is very little understood.

Uses.—Aconite is chiefly used in

three forms—tincture of aconite, given internally, and ointment of aconitine and liniment of aconite applied locally. The ointment is used principally in neuralgia, a piece the size of a pea being rubbed into the painful place ; it is very effective. Liniment of aconite is much used to relieve pain in sprains, bruises, and rheumatism. Tincture of aconite is kept in many households, and used especially as a remedy for children's ailments, and this is very remarkable when one considers how very powerful its action is ; it should not be used without the sanction of a medical man. In all feverish states in children, such as tonsillitis, it is a favourite remedy, and a drop or two drops diluted with water is given in small doses spread over two hours or more ; it often cuts short the attack. In cases of pain accompanying fever, a single large dose of ten drops is often given to adults.

ACONITE POISONING.—This may occur, as stated above, by mistaking the root for horse-radish, by children eating parts of the plant, or by the administration of too large a dose.

Symptoms.—There are characteristic symptoms in the mouth (*see* ACONITE) after chewing parts of the plant. If a large amount of the poison has been taken into the stomach vomiting and purging follow after some time. Numbness is felt all over the body. The pulse becomes weak, the breathing laboured, and the face livid. Convulsions may come on, but consciousness is retained.

Treatment.—Give plenty of warm water to drink. The poison must be got rid of at once by an emetic, one of the handiest being a tablespoonful of mustard in a cupful of cold water ; or, best of all, one or two tablespoonfuls of sal volatile in water, this being also a stimulant. Stimulants, such as ether, may be hypodermically injected, or brandy may be given by the mouth with black coffee or strong tea after the vomiting has stopped. Artificial respiration may be necessary.

ACRIDINE is a colourless crystalline compound occurring in coal-tar. Its formula is $C_{13}H_9N$. From this are derived the valuable acridine dyes or flavines, used as antiseptics.

ACRIFLAVINE is an aniline derivative, the hydrochloride of diaminomethylacridine chloride. It is an orange-red crystalline powder, readily soluble in water, which gives a rich yellow colour to substances brought into contact with it, and in a solution of 1 in 1000 of water, possesses strong antiseptic powers.

ACROCYANOSIS is a condition, occurring especially in young women, in which there is persistent blueness of hands, feet, nose, and ears.

ACRODYNIA (*see* ERYTHRŒDEMA).

ACROMEGALY (ἄκρον, an extremity ; μέγας, large) is a chronic disease characterised by increased massiveness of the bones, most noticeable in the jaws, hands, and feet. The bones of the chest and elsewhere are also lengthened and thickened so that the whole person becomes more massive. It was first described in 1886, but is not uncommon. It is associated with tumors or other disorders causing increase in size of the front part of the pituitary gland inside the skull on the base of the brain. The condition is apparently due to an excessive secretion by this gland of a substance which has the effect of stimulating the growth of bones, so that if it begins in early life great stature results ; if later, a thickening of the bones, most noticeable in the hands and feet. Treatment has little or no effect, but the disease advances very slowly, and frequently it stops its progress after the bones are slightly enlarged. Often asthma is present with the bone enlargement and a disorder of vision, involving limitation of the field of vision at its outer sides, is apt to be caused by interference with the optic tracts through the increase of the gland in advanced stages of the disease.

Treatment.—Removal of the front portion of the pituitary gland through the nasal cavity is sometimes practised in advanced cases when the vision is seriously affected.

ACROMION (ἀκρώμιον) is the bone forming the tip of the shoulder and giving its squareness to the latter. It projects forward from the scapula or shoulder blade, and, with the clavicle

or collar-bone in front, forms a protecting arch of bone over the shoulder joint.

ACROPARÆSTHESIA is a disorder occurring in middle-aged women in which there are numbness and tingling of the fingers.

ACTINOMYCOSIS (ἀκτίς, a ray; μύκης, a fungus) is a chronic suppurative disease affecting cattle, in which it is known as 'Woody Tongue', and sometimes found in man.

Causes.—The direct cause is the ray-fungus or actinomyces, which lives in the tissues, reproduces itself there, and by its irritation causes hard swellings, abscesses, and ulcers, in the pus of which the fungus is found in little yellow balls of a size which can just be made out by the naked eye. These little balls are found to consist of masses of thread-like material matted together, and of club-shaped bodies radiating from a common centre, hence the name of ray-fungus. It used to be thought that the human infection arose from the chewing of straw or grain, or was caught from cattle. But this now appears not to be the case, *Actinomyces bovis* being a distinct species from the *Actinomyces* causing human actinomycosis. It may occur in any organ, but chiefly about the mouth.

Symptoms.—These are general bad health, the presence of hard fibrous masses about the mouth or tongue, or in other organs, and the development sooner or later in these masses of abscesses which after bursting form sinuses or ulcers that will not heal.

Treatment.—One must attend, first of all, to the general health by giving good food, cod-liver oil, tonics, etc. Potassium iodide is given, and has a special effect in causing absorption of the hard masses, and probably stimulating the bodily tissues to destroy the fungus. Surgical means, however, are generally necessary, consisting in the free opening and scraping out of all diseased tissue, irrigation with strong antiseptics, and leaving the wound open so that discharge containing the fungus may readily escape.

ACTIVE PRINCIPLES.—These are the portions of a drug which produce its effect, being administered for convenience, or of necessity, with the water, oils, vegetable fibre, etc., which make the bulk of the drug. They are of various chemical nature, but in general alkaloids. (*See* ALKALOIDS.)

ACTUAL CAUTERY is the method of burning by a heated body, as distinguished from caustics or potential cauteries, which have a chemical action. (*See* CAUTERY.)

ACUPUNCTURE (*acus*, a needle; *punctum*, a prick) is a method of treatment by puncture of a part with needles two to three inches long. It is little used, but in obstinate sciatica is often very successful. The needles are pushed into the sciatic nerve and left in for twenty to thirty minutes. Their insertion causes very little pain.

ACUTE DISEASE.—A disease is said to be acute in contradistinction to chronic when it comes on rapidly and produces death rapidly, or goes on to speedy recovery, *e.g.* acute bronchitis; or the word is used, though less often, in the sense of severe or sharply painful, *e.g.* acute sciatica, acute neuralgia.

ADDISON'S ANÆMIA is another term for pernicious anæmia. (*See* ANÆMIA.)

ADDISON'S DISEASE.—This disease, described by Addison of Guy's Hospital, London, in 1855, is not uncommon. It consists of a state of anæmia, extreme weakness, low blood pressure, dyspepsia, wasting, pigmentation of the skin and mucous membranes, and subnormal temperature. It is due to disease of the suprarenal bodies (*see* ABDOMEN) or of the structures near them.

Causes.—Men, and especially young adults, suffer oftener than women in the proportion of two to one. The condition found after death is generally a tuberculous condition of the suprarenal glands, causing their destruction to a greater or less extent, or disease of this nature in the tissues near the glands, and involving the nerves and lymphatic vessels connected with the glands, so as to interfere with their proper functions. More rarely it is caused by other diseases, such as atrophy or cancer of, or hæmorrhage into, the glands. There are two methods in which the effect may be produced. Either the disease destroys the secreting tissue of the

glands and so checks the formation of the very powerful secretion which these glands have been shown to produce in health, and which is necessary for the proper functions of the body, as for example for the maintenance of the blood-pressure and the contractile power of the muscles; or the disease produces its effect by interfering with the tissues in which lie the nervous and vascular connections of these glands.

Symptoms.—In the words of Addison, the main symptoms are: 'Anæmia, general languor or debility, remarkable feebleness of the heart's action, irritability of the stomach, and a peculiar change of colour in the skin'. The colour ranges from yellow to dark brown, or even black, and though at first marked on the exposed surface (*i.e.* face and hands), and on regions where pigment occurs naturally (groins, armpits, etc.), it gradually increases in area and in depth of tint. The next most prominent symptom is weakness on the least exertion, with giddiness, noises in the ears, or even faintings when efforts are made. Nausea, vomiting, occasional diarrhœa are also symptoms, and there is palpitation of the heart and feebleness of the pulse. The sufferer in general gets gradually worse, though there may be periods of betterment lasting some months. The disease rarely lasts longer than three or four years, and it may prove fatal within some months. Sometimes recovery may occur.

Several other diseases cause a limited pigmentation, especially of the face, so that this symptom must not always be taken as a sign of Addison's disease. Such conditions are disordered liver with constipation, abdominal cancer, menstrual irregularity, exophthalmic goitre; while pregnancy brings on the so-called 'masque des femmes enceintes', which fades after delivery.

Treatment.—A cure can seldom be looked for. The sufferer should be kept in bed, or at all events should rest as much as possible. Cod-liver oil, tonics, and iron if the anæmia is marked, are given. For the treatment of the diarrhœa and vomiting see under these headings. The diet should be light and nutritious, consisting especially of milk. Marked temporary improvement results from suprarenal gland administration. Cortin, an extract from the cortex of suprarenal glands, may be administered daily or several times weekly by hypodermic injection, and has the effect of improving the patient's condition and prolonging life. Or the synthetic hormone, desoxycorticosterone acetate (*q.v.*), may be given. In some cases the administration of common salt is very beneficial.

ADENITIS (ἀδήν, a gland) means inflammation of a gland. (*See* LYMPHATICS.)

ADENO- (ἀδήν, a gland) is a prefix denoting relation to a gland or glands.

ADENOIDS (ἀδήν, a gland; εἶδος, form). (*See* NOSE, DISEASES OF.)

ADENOMA (ἀδήν, a gland; *oma*, a termination adopted to signify tumor) means a tumor composed of glandular tissue. It may be simply an overgrowth of tissue in a position where a gland is naturally found (simple adenoma), or may be an invasion and destruction of surrounding tissues by a growth starting in a gland, or by glandular tissue in a position where no such gland naturally exists (malignant adenoma). (*See* TUMORS.)

ADHESION.—This means the uniting together of structures which should normally be separate and freely movable. It is the result of acute or chronic inflammation. The medium by which the attachment takes place may at first be fibrin (as a result of acute inflammation), but later is, in every case, fibrous tissue either in masses or in bands.

Causes.—The most important adhesions are those taking place in serous and joint cavities. When one of these structures becomes inflamed there is a great exudation of fluid into the cavity. From this fluid a solid material separates and becomes deposited upon the smooth surface of the cavity. This solid 'fibrin' should, in the course of recovery, be reabsorbed; but, if the inflammation be very severe, or if there be repeated attacks of it, this absorption does not completely take place, and the two layers of fibrin on the opposing surfaces of the cavity stick together, and the united mass is 'organised' into the

less absorbable fibrous tissue. (*See* FIBROUS TISSUE.) As a result there is restricted movement in the parts concerned; thus in the case of a joint there is ankylosis (*see* JOINT DISEASES); if the inflammation has been pleurisy the lung becomes adherent to the chest wall; if peritonitis, bands are formed between stomach, bowels, and other abdominal organs.

Symptoms.—It is generally difficult to tell, except from the history of an inflammatory attack and from the presence of disordered function of internal organs, that adhesions are present. (*See* PLEURISY, PERITONITIS.) Sometimes adhesions between the bowels may be very serious and cause obstruction, if an old-standing and rigid fibrous band become twisted round a loop of bowel. (*See* INTESTINE, DISEASES OF.) Very many of the special diseases of women are due to old adhesions affecting the ovaries, womb, etc.

Treatment.—While the adhesions are still *fibrinous* one expects complete absorption if the inflammation be speedily subdued. If the adhesions are *fibrous*, and show their presence by interference with the function of the organs concerned, one can seldom expect their complete absorption. Some drugs, *e.g.* potassium iodide, act as absorbents when given internally, and counter-irritation (*see* BLISTERS) is the means generally applied locally over the site of the adhesion. Sometimes, *e.g.* when obstruction of the bowels is due to an adhesion, an immediate operation is necessary, and the adhesion is then divided.

ADHESIVE PLASTERS.—These are made by spreading upon cotton cloth, linen, or leather some sticky substance containing drugs of various sorts. The sticky material, which may consist either of resin, beeswax, pitch, or lead-soap (diachylon), or generally of two of these mixed, becomes more adhesive by the action of gentle heat. Rubber plasters which are highly adhesive are also obtainable usually in a long strip on a spool. 'Court plaster' is a thin silk tissue.

Varieties commonly used.—Belladonna plaster, cantharides plaster (blistering plaster), colophony plaster (resin plaster), lead plaster (diachylon), mercury plaster, menthol plaster, capsicum plaster, zinc oxide plaster.

Uses.—Plasters are generally useful on account of their power of gripping a part and exerting steady pressure on it. In cases where a part is weak, such as the muscles of the back after a slight injury, a large plaster, 8 inches by 12, gives great support; ordinary lead or resin plaster, or iron plaster, is much used in this way, and may be worn for a fortnight or so till the plaster wrinkles up and gets loose. Such large plasters are spread on leather or strong linen and have numerous holes for evaporation of moisture (porous plaster). One of these plasters, or preferably mercury plaster, is often used to obtain the absorbent effect of steady pressure combined with warmth and moisture, for example over enlarged glands, syphilitic swellings, and chronic callous ulcers. (*See* ULCERS.) In this case the plaster is put on in strips, each of which overlaps the last, and has no holes; it must be changed every few days if it cover an unclean ulcer. Belladonna plaster is used for soothing pain. To support a sprained joint, *e.g.* the ankle, a plaster is often applied in overlapping strips passing round the leg and instep. Cantharides plaster is used as a counter-irritant by its blistering action. Capsicum plaster is used as a milder form of counter-irritant. Menthol plaster is applied to soothe headache and other pains. Plasters of felt are employed to protect corns, bunions, and small sores from abrasion; and 'corn plasters', containing salicylic acid in various strengths, are used to soften and remove corns. (*See* BLISTERS.)

Mode of application.—Most plasters with a rubber basis stick by simply

FIG. 6.—Diagram showing the method of slitting an adhesive plaster: *a*, to support the breast; *b*, for the back.

laying the plaster with the adhesive side next the skin, but the cheaper ones must be warmed. If the plaster be wide, or the surface to be covered be rounded, it is necessary to cut deep notches into

the plaster before heating (*see* diagram), and the edges so formed are allowed to overlap or separate. In applying a plaster for support to the back, the person must bend backwards as far as possible; then when he tends to stoop forwards the plaster is a real support. On the other hand, in applying it for support to the breast, the breast must be lifted as high as possible, and the skin which the plaster is to cover stretched, slits having been cut in the plaster beforehand. Plaster strips used to support the ankle or leg should be applied like a bandage (*q.v.*).

ADIE'S SYNDROME is the term now given to the condition described by the late W. J. Adie in 1931 in which absence of tendon reflexes is associated with pupils which do not react to light in a person who has not had syphilis.

ADIPOCERE (*adeps*, fat; *cera*, wax). (*See* PUTREFACTION.)

ADIPOSE TISSUE or FAT (*adeps*, fat) is a loose variety of fibrous tissue, in the meshes of which lie cells, each of which is distended by several small drops, or one large drop of fat. This

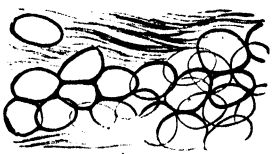


FIG. 7.—Adipose tissue. Fat cells lying in loose fibrous tissue. Magnified by about 100. (Turner's *Anatomy*.)

tissue replaces the fibrous tissue when the amount of food taken is in excess of the bodily requirements. (*See* DIET, CORPULENCE.)

ADIPOSIS DOLOROSA, also known as Dercum's disease, is a condition in which painful masses of fat develop under the skin. It is commoner in women than in men and is thought to be caused by some disturbance of the pituitary gland.

ADRENAL GLANDS, also known as SUPRARENAL or EPINEPHRIC GLANDS. (*See* SUPRARENAL GLANDS.)

ADRENALINE is an extract derived from the suprarenal glands of animals. (*See* SUPRARENAL GLANDS.)

It was first prepared by Takamine in 1901. Similar extracts are made under such names as epinephrine, renaglandin, hemisine, suprarenin, etc.; and the substance is now prepared synthetically. It is generally used in the form of liquor of adrenaline hydrochloride, a solution of 1 part in 1000 of water, and is also employed dissolved in oil, added to ointment, etc. The liquor is applied directly to wounds on gauze or lint to check hæmorrhage, and injected along with some local anæsthetic it permits of painless bloodless operations being performed on the eye, nose, etc. It is injected hypodermically to relieve asthma, to stimulate the heart in collapsed conditions, etc., the dose being 2 to 8 minims. It is also injected as an antidote in the condition of hypoglycæmia, when too large a dose of insulin has been given.

ADULTERATION OF FOODS.—Objects of adulteration.—The usual object is to mix with the food a heavier or cheaper article so that greater profit may be gained; the substance added may be harmless, and be itself a food, or may be hurtful; for example, chicory is added commonly to coffee, which is worth about six times as much. Another reason is to preserve the food, so that it may be carried longer distances for sale, or kept longer without risk, thus milk has salicylic acid, boric acid, etc., added.

Means of detection.—This is effected by microscopic examination in the case of solids, while fluids may be examined microscopically or subjected to chemical tests. Most of the latter are complicated. When a person is dissatisfied with an article of diet, he may buy a sample, then after paying for it he must, before removing it from the shop, announce to the seller his intention of having it analysed, and divide it into three portions, which he places in bottles and seals. One of these is given to the seller, the second submitted to the public analyst, and the third retained. If he fail to observe these rules no conviction can be obtained against the seller.

Articles commonly adulterated.—MILK.—Water is sometimes added or cream skimmed from milk before sale. Water is tested for by taking the

specific gravity of the milk, which ought to be 1029 to 1032; if it is less, water has been added. Also the milk is allowed to stand in a narrow graduated tube till the cream rises; the cream must not be less than one-tenth of the volume of the milk; otherwise the milk has been skimmed. Various preservatives, as salicylic acid, boric acid, borax, are added, especially in summer, and are very irritating to the stomach. Even more important than these considerations is the question of the conveyance of infectious diseases by dirt and water in the milk. (*See* MILK.) As a general rule cows' milk should have not less than 12.5 per cent solids, of which 3.5 per cent should be fat. The specific gravity should be nearly 1032, and the percentage of cream by volume should be 10 per cent. In Britain the minimum legal standard for milk is 8.5 per cent of solids other than fat, and 3 per cent of butter fat by weight, and the addition of preservatives is prohibited.

BUTTER is sometimes adulterated by mixture with other animal and vege-

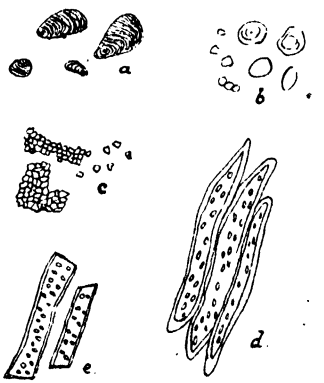


FIG. 8.—Starch grains and vegetable cells magnified by about 150. *a*, Potato starch; *b*, wheat starch; *c*, rice starch; *d*, coffee cells; *e*, chicory cells. (After Parkes.)

table fat, cotton seed oil, etc., or more commonly by incorporation of excessive amounts of water. Not more than 16 per cent of water is permitted by the legal standard. The other fats are little inferior in nutritive qualities to butter although somewhat less digestible.

BREAD is usually fairly pure. When the flour is dark-coloured alum is often added to give it whiteness. This interferes greatly with its digestibility, and so is important to detect. If an infusion of logwood in distilled water be poured over a slice, the bread turns bluish if alum be present, pink if pure. Whole-meal flour, which is brownish in colour, is produced by grinding the entire wheat grain, and in some respects is superior in nutritive qualities, though somewhat less digestible than the whiter 70 per cent flour commonly used, from which the germinal part, bran, and cellulose have been almost entirely removed in milling. Wheat flour is sometimes adulterated with flour of other grains, such as barley, potato, maize, rye, etc., but then only in small quantities because these lack sufficient cohesion. These other starchy grains can be easily recognised from wheat starch under the microscope. (*See* BREAD.)

ALCOHOLIC BEVERAGES.—*Whisky* is only occasionally mixed with water to an illegal extent, but this is easily detected by taking the specific gravity. *Brandy* ought to be distilled from wine, but outside of France is rarely anything but a mixture of alcohol and water coloured with burnt sugar and flavoured with various agents, or a little real brandy. *Beer* may be accidentally contaminated, *e.g.* with arsenic, but as a rule is pure. Strychnine is never used as a bitter flavouring agent, though there is a popular idea that it is. *Wines* should be manufactured from the fermented juice of the grape, but cheap wines are largely made from other fruits, and even grape juice wine is subject to being 'fortified' by the addition of spirit and various forms of adulteration; for example sugar, various ethers, colouring agents such as logwood, alum, and sulphate of lime, are added for various purposes. The addition of sulphate of lime is known as 'plastering' the wine. This improves its colour, but by leading to the formation of potassium sulphate in the wine it often produces a purgative effect. Home-made wines and ciders stored in earthenware vessels are liable to become contaminated by lead and to produce lead poisoning.

COCOA may be mixed with other starch, but this is easily detected microscopically. Sugar is also added some-

ADULTERATION OF FOODS

times to conceal the presence of excessive fat in poor cocoa.

COFFEE, unless purchased as beans, is very liable to be adulterated with chicory, which is much cheaper, has a coarser microscopic structure, and gives a blacker infusion than pure coffee. Chicory has not the stimulating power of coffee, although it is supposed by some to give the latter an improved flavour.

TEA was formerly adulterated to a considerable extent with exhausted leaves mixed with gum and dried. It should contain 2 to 3 per cent of the stimulating alkaloid, theine, and this of course is absent from exhausted leaves. It is sometimes mixed with leaves from other sources, or poor green tea may be coloured or 'faced' with indigo, Prussian blue, or other mineral substances.

SUGAR is almost always pure. Sometimes flour is mixed with it, but this is easily detected by the presence of a sediment when the sugar dissolves.

MEAT cannot readily be adulterated except by the sale of unsound or diseased meat. Food poisoning is occasionally produced by such meat, especially when it has been canned. (*See* CANNED FOOD.) Apart from this, it has been demonstrated by the U.S. Department of Agriculture that preservatives such as formalin, boric acid, and salicylic acid, when added to the meat even in small quantities for the purpose of preservation, may exercise a harmful effect on digestion and so on general health.

OATMEAL when badly ground sometimes contains husks and threads which are irritating to the digestive canal. Such oatmeal is sometimes mixed with barley meal, which gives it a better appearance, but which is somewhat inferior in nutritive value.

HONEY is frequently made from potato flour by the action of sulphuric acid with a little real honey added to flavour.

MUSTARD is generally adulterated with turmeric (yellow dye) and flour. This is harmless, but the resulting product is weak.

PICKLES AND BOTTLED PEAS are frequently artificially coloured to retain their green appearance. This should be done with vegetable dye, but frequently copper sulphate is used. The latter is harmless except for the constipating effect which it induces, but it can readily be detected by dipping a polished steel knife for some minutes in the bottle, when it comes out covered with a film of metallic copper.

VINEGAR may be adulterated with an excessive amount of sulphuric acid; or acetic acid distilled from wood may be fraudulently substituted for it.

SWEETS AND CONFECTIONERY should be, and generally are, coloured by burnt sugar (brown), saffron (yellow), cochineal (red), logwood (violet), and chlorophyll (green), which are quite harmless. Occasionally aniline dyes are used, which colour the urine but are also harmless. Sometimes metallic substances containing lead, copper, arsenic, etc., are used, and these can be recognised because they are not bleached, as are the vegetable colours, by sodium hypochlorite.

Preservatives in food.—Preservatives used to be added to many kinds of food so that they might be more readily brought to market or prevented from becoming bad after sale. Some of these preservatives were harmful, either by rendering the food less digestible, by causing a purgative action, or by producing a harmful effect on the constitution when taken for a long time. Others, such as sulphite of soda, which is driven off by heat in the process of cooking food, are harmless. The following foods very commonly contain preservatives. White bread is bleached by peroxide of nitrogen produced from the air by an electrical process which is harmless; phosphates and persulphate of ammonia and potassium are often used to improve the flour and give additional weight to the bread. These are relatively harmless. Raw meat, mince meat, sausages, etc., are almost always preserved by sulphite of soda, which is harmless, but used also to contain formaldehyde or borax in large quantities, which are irritating. Jams, fruit pulp, and fruit juice commonly contain sulphite of soda or benzoic acid, which are harmless. Egg powder, butter, cream, potted meat, and shrimps very often contain borax or boracic powder, which produce dyspepsia and irritation. Lemon squash, beer, wines, coffee extract, and generally speaking most non-alcoholic drinks, are very

liable to contain salicylic acid, which is highly productive of dyspepsia and intestinal irritation.

ADYNAMIC (ἀ, neg.; δύναμις, power) means a state of great depression of vital power in disease, *e.g.* in serious cases of typhoid fever.

AËDES ÆGYPTI (or STEGOMYIA FASCIATA) is the scientific name of the mosquito which conveys to man (by biting) the viruses of yellow fever and of dengue or 'breakbone fever'.

ÆGOPHONY (αἴξ, a goat; φωνή, voice) is the bleating or punchinello tone given to the voice as heard by auscultation, when there is fluid in the pleural cavity, because of either pleurisy or dropsy.

ÆROPHAGY means air-swallowing, and is a common cause of gastric flatulence. It is a nervous habit.

ÆROSOL is a germicidal spray, or antiseptic mist, discharged mechanically into the atmosphere in very fine particles of mist, having each a diameter of $\frac{1}{1000}$ millimetre or less. The substances used in ærosols include sodium hypochlorite, resorcinol, chloramine-T, and propylene glycol. The spraying of these into, for example, hospital wards has controlled the spread of droplet or airborne infection. They might be used for stopping the spread of influenza or colds in schoolrooms, factories, etc.

ÆSTHESIOMETER is an instrument for measuring the sensation of touch in a person.

ÆTHER (*see* ETHER, ANÆSTHETICS).

ÆTIOLOGY (αἰτία, cause; λόγος, discourse) is the part of medical science dealing with the causes of disease.

AFFUSION is a method of treatment by pouring water upon the body. (*See* BATHS; COLD, EFFECTS OF; DOUCHES.)

AFTERBIRTH, or PLACENTA, is the name given to the thick, spongy disc-like cake of tissue which connects the embryo with the inner surface of the womb, the embryo otherwise lying free in the amniotic fluid. (*See* AMNION.) The placenta is mainly a new structure growing with the embryo, but, when it separates, a portion of the inner surface of the womb, called the maternal placenta, comes away with it. It is mainly composed of loops of veins belonging to the embryo, lying in blood-sinuses, in which circulates maternal blood. So that, though no mixing of the blood of embryo and mother takes place, there is ample opportunity for the exchange of fluids, gases, and the nutriment brought by the mother's blood. The width of the full-sized placenta is about eight inches, its thickness one inch. One surface is rough and studded with villi, which consist of the loops of fœtal veins; the other is smooth, and has implanted in its centre the umbilical cord, or navel string, which is about as thick as a finger and 20 inches long, contains two arteries and a vein, enters the fœtus at the navel, and forms the sole connection between the bodies of mother and fœtus. The name 'afterbirth' is given to the structure, because it is expelled from the womb in the third stage of labour (*see* LABOUR).

AFTERPAINS are pains similar to but feebler than those of labour, occurring in the two or three days following childbirth.

Causes are generally the presence of a blood-clot or retained piece of placenta which the womb is attempting to expel.

AGAR is a gelatinous substance prepared from Ceylon moss and other East Indian seaweed. It is used in preparing culture-media for use in bacteriological laboratories. It is sometimes given for relieving constipation.

AGE, NATURAL CHANGES IN.—The tissues, as age advances, become more rigid and less elastic. The bones become more brittle. The ligaments are stiffer, so that contortions of the body and limbs, as in gymnastic feats, become impossible. Fat is deposited beneath the skin in middle life and absorbed again in old age, leaving the skin wrinkled. Fat becomes later formed in internal organs, *e.g.* the heart, weakening their activity. The skin becomes thin, is less well lubricated, and its vessels do not react properly to heat and cold, so that the cold is acutely

felt. The chief change is in the blood-vessels, whose walls become first thicker, then more brittle, so that hæmorrhage (*e.g.* into the brain, with apoplexy) more readily occurs. This change is hastened by alcoholic excesses and some diseases, and the extent to which it has occurred is the measure of the interference with the employments of active life, so that it has been said, 'A man is as old as his arteries'. This thickening of the arteries in the brain and consequent narrowing of their calibre, causing a poorer blood-supply to the brain, is one of the chief reasons of mental feebleness in old age. The menopause occurs in women between forty-five and fifty (*see* MENSTRUATION), and men sometimes about the age of sixty have some months' illness and feebleness, after which strength again returns. Loss of elasticity in the lens of the eye brings about the need of spectacles for reading from forty upwards. Another eye-change occurs after fifty in the appearance of a whitish ring (arcus senilis) round the cornea near its edge. After sixty the teeth, if still good, begin to fall out, and the hair whitens. (*See also* CLIMACTERIC.)

AGENESIA, or AGENESIS, means incomplete development or the failure of any part or organ of the body to develop normally.

AGGLUTINATION (*agglutino*, I cause to adhere) is the adherence together of small bodies in a fluid. Thus, blood corpuscles agglutinate into heaps (rouleaux) when added to the serum of a person belonging to an incompatible blood-group. Bacteria agglutinate into clumps and die when exposed to the presence of antibodies in the blood. This is important in regard to diagnosis of certain diseases due to bacteria. In typhoid fever, for example, the blood of an animal is 'immunised' against typhoid bacilli by repeated injections of these. The blood-serum of the animal, known now as anti-typhoid serum, is issued to laboratories for use when bacilli are found in the excretions of a patient who is possibly suffering from typhoid fever. The bacilli are exposed to the action of a drop of the serum; if the serum shows the power of agglutinating these bacteria, this forms evidence that the bacteria in question are typhoid bacilli. The reaction may also be carried out in the contrary manner; that is to say, the serum from the blood of a patient, who may be suffering from typhoid fever, but in regard to whom the diagnosis is still a matter of doubt, is added to a drop of fluid containing bacteria known to be typhoid bacilli; if these are agglutinated into clumps by the patient's serum, the patient is then known to be suffering from typhoid fever; if they do not agglutinate, his symptoms are due to some other condition. This reaction for typhoid fever is known as 'Widal's reaction'. It is also used with an appropriate serum for the diagnosis of many other diseases such as dysentery, cerebro-spinal fever, etc., and, with appropriate bacteria, for the diagnosis of epidemic jaundice, etc.

AGNOSIA is the term given to the condition in which, in certain diseases of the brain, the patient loses the ability to recognize the character of objects through the senses—touch, taste, sight, hearing.

AGONY (ἀγών, struggle) is excessive pain associated with struggling.

AGORAPHOBIA (ἀγορά, market place; φόβος, fear) means a sense of fear experienced in crossing large open spaces, such as public squares, and is a symptom of psychological disorder.

AGRANULOCYTOSIS is a condition in which the white corpuscles in the blood of the polynuclear or granular variety become greatly lessened in numbers or disappear altogether. This change is found accompanying long-standing suppurative conditions, especially about the throat and mouth, and is a very fatal one. It is also caused in some cases by taking such drugs as amidopyrine, benzol, sulphanilamide, and sulphapyridine.

AGRAPHIA (ἀ, neg.; γράφω, I write) is the loss of power to express the ideas by writing. (*See* APHASIA.)

AGUE (*see* MALARIA). The term Ague is also sometimes applied to neuralgia (brow ague) and to a state of tremor of the muscles found in various diseases (such as Brass Founders' Ague).

AGUE CAKE is a large, hard swelling in the left side, due to increase in the size of the spleen through malaria.

AIR is of very uniform composition both in towns and country as regards its general constituents. These are :

Oxygen	20·94 per cent
Nitrogen	78·09 ,,
Argon	0·94 ,,
Carbonic acid . . .	0·03 ,,

Besides these there are always ozone, minerals and organic matters in small and variable amounts and more or less water vapour according to the weather. In the air of towns, sulphurous acid and sulphuretted hydrogen are important impurities derived from combustion. After air has been respired once, the oxygen falls by about 4 per cent and the carbonic acid rises to about 4 per cent, while organic matters and water vapour are greatly increased and the air rises in temperature. The cause of the discomfort felt in badly ventilated rooms and crowded halls is associated with the increase in the temperature and moisture of the air, but a high percentage of carbonic acid may be present without causing any noticeable discomfort or appreciable quickening of the respiration. Microbes are found especially in dusty air, and during coughing, sneezing, and loud talking they are expelled from the air passages on droplets of moisture. When epidemic diseases such as influenza are rife, infection is apt to be conveyed through the air by these means, especially in badly ventilated and overwarmed rooms. When the amount of carbonic acid present in the air exceeds 0.1 per cent there is usually a distinct sense of 'stuffiness', which forms the best guide as to the necessity for increased ventilation. The continued breathing day after day of 'stuffy' atmosphere is apt to produce headache, drowsiness, depression, inability to concentrate on work, dryness of the throat, and a tendency to 'catch cold' easily, thus resulting in a gradual deterioration of health. Impure air has much to do with the onset of consumption as well as with infection by more acute diseases. Thus among soldiers, sailors, and persons whose sleeping-places are well ventilated there is comparatively little phthisis; and gardeners, agricultural labourers, and other open-air workers show a death-rate from this disease amounting to only half of that among the general population. (*See* CONSUMPTION *and* VENTILATION.)

Uses (*see* CLIMATE, INHALATIONS, RESPIRATION, VENTILATION).

CONDENSED AIR is used in certain respiratory disorders such as early phthisis, spasmodic asthma, chronic bronchitis, and collapse of the lung from pleurisy, and also in dilatation of the heart. Often it is a most valuable remedy. A course of treatment lasts over one or two months, the patient spending half an hour or so every day, sometimes twice a day, in the air chamber.

RAREFIED AIR is sometimes used for treatment of emphysema, bronchitis, and asthma, the patient breathing in natural air and breathing out into a partial vacuum. The lungs are more fully emptied, the circulation in them improved, and the heart stimulated.

AIR PASSAGES.—These are the nose, pharynx or throat (the large

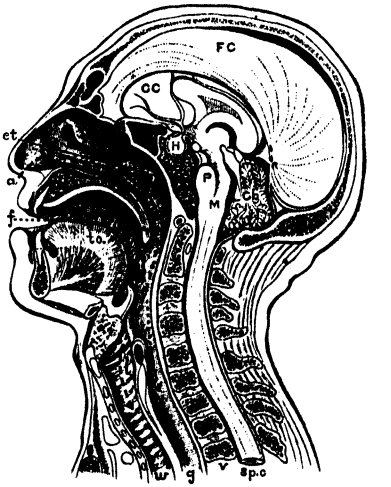


FIG. 9.—Vertical section through the middle of the head and neck, showing the upper air passages. The passages for air, *a*, are indicated by a heavy dotted line, those for the food *f*, by a fainter line; *et*, Eustachian tube; *l*, larynx; *w*, windpipe; *t*, tonsil; *to*, tongue; *g*, gullet. For other letters see Brain. (After Braune.)

cavity behind the nose and mouth), larynx, trachea or windpipe, and

bronchi or bronchial tubes. The air, on entering the nose, passes through a high narrow passage on each side, the outer wall of which projects along three lines (the turbinate processes), so as almost to touch the dividing 'septum' between the nostrils, thus making on each side three passages or meatuses, in which the air is warmed, moistened, and relieved of particles of dust. Mouth-breathing is, accordingly, a bad habit because the air is not prepared for entrance to the lungs. In the pharynx the food and air passages meet and cross. The larynx lies in front of the

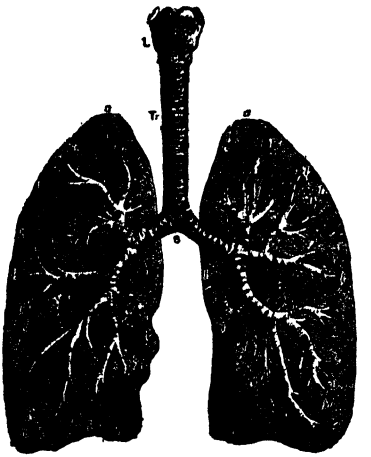


FIG. 10.—The lower air passages, consisting of *L*, the larynx; *Tr*, the trachea; and *B*, the bronchial tubes. *C*, Cricoid cartilage; *T*, thyroid cartilage. For other letters see under Lungs. (Turner's *Anatomy*.)

lower part of the pharynx and is the organ where the voice is produced (*see* VOICE) by aid of the vocal cords. The opening between the cords is called the 'glottis', and shortly after passing this the air reaches the trachea or windpipe, a tube four to five inches long, and ¾-inch wide. This leads into the chest and divides above the heart into two bronchi, one of which goes to each lung, in which it splits into finer and finer tubes. (*See* LUNGS.) The larynx is enclosed in two strong cartilages, the thyroid (of which the most projecting part, the Adam's apple, is a prominent point on the front of the neck) and the cricoid (which can be felt as a hard ring about an inch below). Beneath this, the trachea, which is stiffened by rings of

cartilage, so that it is never closed in any position of the body, can be traced down till it disappears behind the breast-bone.

ALASTRIM, or VARIOLA MINOR, is a form of smallpox which differs from ordinary smallpox in being milder and having a low mortality.

ALBINISM (*albus*, white) is a state of poverty or absence of pigment in the superficial tissues of the body, producing a pale pink colour of the skin, whiteness of the hair, and redness of the iris and interior of the eye. A person showing these peculiarities is called an 'albino'. It may also occur only in patches.

Causes.—It is generally congenital, existing from birth, though the parents of an albino are not necessarily subjects of albinism. It is most marked amongst the dark races, such as the negroes of West Africa, and is said to be due, in some cases, to poor food and unhealthy surroundings of the mother.

Symptoms.—An albino may show nothing remarkable beyond white hair, delicate skin, and pink eyes, but many are physically and mentally feeble. Usually the absence of pigment to screen the eye from bright light gives rise to trouble, and the person has a tendency to inflammation of the eyes. (*See* EYE, DISEASES OF.)

Treatment.—There is no remedy. The eyes should be protected in bright light by wearing smoked glasses.

ALBUMINS (*albus*, white) are proteins. They enter into the composition of all the tissues of the body. Their characters are that they are soluble in pure water; can be dried into a light, flaky, non-crystalline powder; are coagulated by heat, and precipitated by various agents like nitric acid, tannin, alcohol, or perchloride of mercury.

Varieties.—Albumins are generally divided according to their source of origin, as muscle-albumin, milk-albumin, blood- or serum-albumin, egg-albumin, vegetable-albumin, etc. These differ both in chemical reactions and also physiologically, for though serum-albumin occurs in the blood, some albumins, *e.g.* egg-albumin, injected direct into the blood are highly poisonous.

Uses.—When taken into the stomach

they are all converted into a soluble form by the process of digestion, and, being in this state absorbed into the blood, go to build up the tissues gradually worn out in the activity of the body. (*See* ALBUMINURIA, BRIGHT'S DISEASE.)

ALBUMINURIA means a condition in which albumin is present in the urine. It is of immense importance, both because it is itself a drain upon the health, and because it is often a symptom of serious heart or kidney disease.

Varieties.—Albuminuria is generally divided into two great groups: (*a*) true albuminuria in which serum-albumin, the albumin of the blood, is excreted by the kidney, thus causing a loss of body substance; and (*b*) false albuminuria, in which either a substance resembling serum-albumin in its reaction to some chemical tests is excreted, or in which albumin is present in the urine from some other source than the kidneys. True albuminuria is again divided into two important classes: (1) functional albuminuria, in which some other organ than the kidney is at fault, causing the kidney, though not apparently diseased, to excrete albumin; and (2) the albumin of Bright's diseases of the kidneys. (*See* BRIGHT'S DISEASE.)

Causes.—(*a*) **True albuminuria.**—FUNCTIONAL ALBUMINURIA, although not associated with any discoverable disease of the kidney, is not a trivial matter, because the constant loss of albumin produces a deterioration in health, and if the causes producing it be not removed, Bright's disease may appear later. Almost all fevers, and indeed exposure to external heat, such as working long periods in the sun or before an oven, may bring on the excretion of albumin, which, however, passes off with the end of the fever, after protection from the heat of the sun, etc. Diseases of the blood, such as scurvy, anæmia, leucæmia, and poisoning by lead or mercury, also produce it, and during pregnancy a transient form may come on, due probably to changes in the blood, which passes off in the later months. When occurring in pregnancy the case must be most carefully watched lest a severer condition be the cause. (*See* BRIGHT'S DISEASE, ECLAMPSIA.) Diseases of the heart, especially mitral disease (*see* HEART DISEASE), may cause a very great drain on the strength by albuminuria due to congestion of the kidneys. Epilepsy may cause it in the same way. In young persons albuminuria often comes on independent of disease, and different authorities state that this occurs in from 3 to 10 per cent of all apparently healthy young people who present themselves for life assurance; the albumin may appear only in the morning, or only after taking food. In both the British and German armies it has been found that many soldiers show it after long marches, and it occurs in athletes and others after matches or stiff climbs. It may also occur periodically, and after taking cold baths. All these forms are probably due either to a too highly animal diet (*see* ACIDITY, DIET), and an attempt by the kidney to relieve the system from a surplus of nitrogenous material, or to a want of tone in the vessels of the kidneys, which allows congestion of these organs to occur.

BRIGHT'S DISEASES show albumin in the urine as their most important symptom. (*See* BRIGHT'S DISEASE.)

(*b*) **False albuminuria.**—Albumoses and peptones may appear in the urine in disorders of digestion and absorption, and in some serious diseases. Egg-albumin may be found when eggs have been eaten in too large quantities for digestion. It must always be remembered too that the albumin may come from some other part of the urinary passages, as in inflammation of the bladder and in spermatorrhœa.

Symptoms.—There may be no symptoms whatever, and the albumin may be found only accidentally, as when the person becomes an applicant for life assurance. When, however, its loss has lasted over a considerable period, anæmia, weakness, and a vague feeling of ill-health come on. There are many symptoms due to the want of tone of the blood-vessels, which is first of all the cause of, and then is kept up by the albuminuria. These are puffiness of the skin about the eyes and ankles, pallid complexion, dry skin, derangements of the digestion, palpitation of the heart, also vague pains, headache, languor, and weariness on slight exertion.

Albuminuria and Life Assurance.—Most good companies will not issue a

life policy to any one with permanent albuminuria lest this be due to Bright's disease. Even cases in which no serious disease manifests itself have, if the albuminuria persists, a shorter expectation of life than other people, and so require a higher premium. In cases of doubt tests to measure the function of the kidney may be carried out. If the tests show normal function, then the albuminuria takes on a much less serious aspect.

Treatment.—The treatment for albuminuria in other diseases is given elsewhere. (*See* BRIGHT'S DISEASE, HEART DISEASE.) When functional albuminuria occurs a change of diet is necessary; eggs should be avoided, and all highly albuminous food, such as meat, beans, peas, partaken of very sparingly. The chief cause being want of tone in the blood-vessels, general tonics, especially iron tonics and vascular tonics, like digitalis, are given. Unless bathing be found distinctly injurious (cold baths form the cause in some cases), a cold plunge followed by rapid friction with a towel should be taken daily, and a warm or Turkish bath weekly. Alcohol, which has a special action in weakening the tone of the blood-vessels, must be absolutely avoided in every form. Early rising and moderate exercise are important; and too much sleep on the one hand, and feats of endurance on the other, must be avoided. Most important of all is daily movement of the bowels.

ALBUMIN WATER is very frequently used for administration as a light form of nourishment to patients with weak digestion or suffering from diarrhœa or some condition in which only very small amounts of food can be borne. To prepare albumin water a raw egg is broken in two on the edge of a cup. The white is allowed to escape by passing the yolk from one half of the shell to the other. The white is then whisked for 10 minutes to a stiff froth; ½ pint of cold water is added; and it is allowed to stand for an hour to dissolve. Lemon juice may be added to flavour and a cupful may be given at one time.

ALBUMOSE is the term applied to the products of digestion of protein foods, differing from albumin in not being coagulable by heat. Albumose is further converted by digestion into peptone.

ALCOHOL (Arabic word), more correctly ETHYL ALCOHOL, is a liquid obtained by the action of yeast on solutions of sugar, especially of grape sugar or glucose. Carbonic acid gas is also formed in the process and escapes. After fermentation of the sugary fluid has taken place, the alcohol is separated from the water by distillation and from the last traces of water by the action of lime, which absorbs the latter. Absolute (or water-free) alcohol is very expensive owing to the difficulty of complete separation. It is a powerful irritant, and even in moderate quantities a poison. Rectified spirit, or spirit of wine, contains 90 per cent of alcohol by volume, and is used to make essences, tinctures, and weaker spirits of 80, 70, 60, 50, 45, 25 and 20 per cent strength. The alcohol dilutum of the U.S Pharmacopœia contains 64.5 per cent of alcohol by volume. Proof spirit contains 57 per cent (by volume) of alcohol. It is called 'proof' spirit, because an old test of its strength was to drench gunpowder with it, set fire to it, and if the gunpowder was ignited the alcohol stood the proof. If stronger, a spirit is over-proof—if weaker, under-proof. Alcohol freezes at a very low temperature, and so is used for thermometers for the Arctic regions. It dissolves many things which water does not dissolve, such as fats, oils, and resins; and mixed with wood-spirit, forms methylated spirit, and is used as a solvent, duty free, but is, of course, unfit for drinking. It coagulates the tissues, and so has a hardening effect upon skin, wounds, etc. Like several substances closely related to it chemically, such as chloroform and ether, alcohol causes, when taken internally, first of all a gentle stimulation of the bodily and mental functions, in larger doses excitement, then loss of feeling, and, finally, paralysis with unconsciousness; but the interval between these is wider with alcohol, and far larger quantities of the drug are necessary than in the case of the others. Alcohol taken into the body is almost all used up. The amount of alcohol used in Great Britain has decreased greatly in

recent years. This is shown by a comparison of the amounts of beer, wine, and spirits consumed in 1897 and in 1917 respectively in the United Kingdom:

	Total Consumption in Gallons. 1897.	1917.
Beer	1,208,916,000	933,228,000
Wine	15,810,000	8,929,000
Spirits	47,927,000	23,996,000

	Consumption in Gallons per Head of Population. 1897.	1917.
Beer	30·2	21·5
Wine	0·4	0·2
Spirits	1·2	0·5

Varieties of alcoholic liquors.—Spirits and wines sold under various names differ very much in the amount of alcohol contained in different samples under the same name, but the following table gives a general idea of the percentages of alcohol present in the various forms of beverage Many of the stronger forms are sold commonly in a more diluted state than that indicated in the table. Some of the weaker wines on the other hand are 'fortified' by the addition of spirit to confer on them more stimulating properties.

Rum, Brandy, Whisky	over 50 or 60 per cent
Gin and Liqueurs	about 50 ,,
Port, Sherry, Madeira	about 20 ,,
Champagne	12 ,,
Claret, Burgundy, Moselle, Hock	about 10 ,,
Strong ale, Cider	about 8 ,,
Porter, Beer	2 to 5 ,,
Ginger beer	1 to 3 ,,

Various wines, manufactured or home-made, are produced by fermenting mixtures of fruit and sugar, *e.g.* cowslip wine, ginger wine, orange bitters, raisin wine, raspberry wine, red currant wine. In a report issued by the Ministry of Health on an analysis of these British wines, it appears that the percentage of alcohol of these is usually in the neighbourhood of 10 or 12, rising in some of the stronger forms to over 20 per cent.

SPIRITS, including *rum* from molasses, *brandy* from wine, *whisky* from malted grain, and *gin* from grain and juniper berries, are prepared by fermentation followed by distillation. They contain in their raw state more or less 'fousel oil', an oily substance consisting of amyl and butyl alcohols, which have a more harmful effect upon the nervous system than ethyl alcohol. These, however, are slowly converted to ethers, which give to long-kept spirit its prized flavour and aroma, and are harmless. Spirits are by law prohibited from being delivered for consumption in Britain until they have been warehoused for at least three years.

LIQUEURS are spirits in which have been steeped various spices, leaves, and fruits, and which have, in addition to the properties of alcohol, those of the various ingredients.

PORT, SHERRY, MADEIRA, and other Portuguese and Hungarian wines, are known as *'fortified wines'*, because spirit is added to them for preservation. They are therefore stronger, and containing much unchanged grape-juice have more 'body' and bouquet than those in which the alcohol is simply derived from the grape-juice, which is completely used up in fermentation. They improve by keeping, as the tannin and other harsh-tasting substances separate out gradually as a 'crust', and then they become specially valuable as tonics in weakness with feeble digestion.

CHAMPAGNE and other effervescent wines are white wines to which much sugar has been added after bottling, so that fermentation goes on and carbonic acid gas is produced, which becomes, on long keeping, intimately blended with the wine, and adds greatly to its effect. Hence champagne is far more stimulating and its effects more rapid than in the case of other wines much stronger in alcohol. It has, therefore, a special value in cases of collapse when a rapid stimulant is needed, and in cases of vomiting, when the carbonic acid soothes the stomach wall.

CLARET, BURGUNDY, MOSELLE, HOCK, and other wines from the northern vineyards, are thin and acidulous from cream of tartar, and so form refreshing drinks with no special virtue beyond the stimulating effect of the alcohol they contain. They are, how-

ever, less harmful in gout, etc., than the wines with much ' body ', and there is not the same necessity for keeping them many years before using.

BEER, in addition to being weakly alcoholic, contains an infusion of hops which gives it bitterness. In those who do heavy labour (like navvies) it is beneficial at meals, because, by lengthening digestion, it ensures thorough and gradual absorption of the food, and, taken in the evening, it produces sleep by virtue of the hops it contains.

Effects of alcohol. — Alcohol when taken as a food is very quickly and completely absorbed. About one-fifth of any dose taken is absorbed from the stomach and almost the whole of the remainder is absorbed in the upper part of the small intestine within two or three hours of having been taken. Very little is excreted by the breath, urine, and other channels. This never amounts to more than one-tenth of the quantity swallowed and may be as little as one-hundredth. The remainder is completely used up within twenty-four hours, being oxidised mainly to produce heat. Atwater and Benedict have shown that the body can derive one-fifth of the total energy it requires from alcohol, and in this way alcohol spares carbohydrates and fats taken in the food. There is a tendency, therefore, for both of these to be deposited in the tissues as superfluous fat when alcohol is habitually added to the diet without a decrease of the other food. It is important also that such an interval should elapse between the times when alcoholic beverages are drunk as will prevent the persistent presence of a harmful amount of this substance in the body.

With regard to the mental effect of alcohol, this is dependent partly upon its effect on the circulation and partly on its anæsthetic action on the nervous system, dulling small pains and the sense of worry and anxiety. Owing to a similar dulling action upon the higher intellectual faculties, self-criticism and self-control are also to a considerable extent lessened. If a larger dose be taken, the functions of sense perception and skilled movement are to a certain extent dulled and deteriorated, with the result that there is a certain clumsiness of behaviour. The person now begins to make ill-adjusted movements, shows some slurring of speech, and becomes less quick and less capable in performing acts which require decision and promptitude, *e.g.* avoiding a collision when driving a motor-car. In a further stage the intellectual processes of judgment, self-criticism, and self-control are largely suspended and the functions of sense perception and skilled movement become very greatly impaired until ultimately a heavy sleep supervenes which lasts until the alcohol absorbed by the nervous system has been oxidised and consumed. The effects of alcohol on the performance of muscular acts are of great importance in relation to the individual's capacity for work and for action of a responsible nature. A dose of alcohol not exceeding 40 c.c., or about as much as would be taken in 2¼ oz. of whisky at proof or in 1¼ pints of beer in an adult accustomed to moderate use of alcohol, exerts very little effect on the performance by him of muscular acts not demanding great precision, although even smaller doses than these may to a certain extent diminish the speed and nicety with which very delicate actions can be carried out. There does not seem to be any proof that alcohol in any dose improves the efficiency with which either skilled or unskilled work can be carried out during the few hours whilst the alcohol acts.

With regard to the action on digestion, moderate doses of alcohol increase the secretions of the stomach and thus may aid digestion in persons in whom these secretions are defective. At the same time wines appear to slow the process of digestion, although this has the effect of rendering absorption of the food slower and thus making it of greater nutritive value. Different wines have very varying effect on different persons in this respect, probably on account of the substances other than alcohol which they contain. When alcoholic beverages are taken habitually over long periods, and especially in the more concentrated form of spirits, they exert a very pronounced effect of irritation upon the mucous membrane of the stomach and thus lead to chronic indigestion.

With regard to the action of alcohol on respiration and circulation of the

blood, moderate doses have practically no effect upon the breathing, although very large doses have a paralysing effect, and when death occurs from alcohol it is brought about by stoppage of the respiration. As to its stimulating action on the circulation, this is in part brought about by its effect in the blood when swallowed, and in part to the lessening of mental strain brought about through its narcotic and sedative action. It is also due in part to its action in dilating the small blood-vessels, and thus reducing the blood-pressure and relieving strain on the heart.

The popular reputation of alcohol as a means of 'warding off cold' is due largely to its power of dilating the superficial blood-vessels and of dulling the sensory nerves of the skin so that the skin actually becomes warm while external impressions are not felt. If at the same time as the alcohol is administered, warmth is applied to the surface of the body by hot blankets, hot bottles, etc., the skin becomes more capable of absorbing the external heat and thus the alcohol acts as a restorative.

The effect of alcohol on length of life has been much disputed. The official statistics issued by the Registrar-General, however, indicate a very heavy mortality among persons occupied in the liquor trade, who are known to consume more than the average amount of alcohol. The experience of insurance companies has made them adverse to admitting on ordinary terms persons who are habitual users of alcoholic beverages in large amount.

Uses of alcohol.—*Externally* it is used in the cheap form of methylated spirit to cleanse the skin of oily, fatty, or resinous substances, which water will not remove. Also to harden the skin of the feet before a long walk, or that of the back in persons confined to bed for long periods, and so prevent bed-sores.

A whisky pack or brandy pack has been used to stimulate infants reduced to a state of collapse by diarrhœa or bronchitis.

As a food alcohol may be taken with benefit by the feeble, the aged, the dyspeptic, and especially those suffering from exhausting diseases. But to the young, the healthy, and the vigorous it is unnecessary and generally harmful. For general debility port is usually prescribed at meals. For dyspepsia in convalescence from acute disease, if wine be necessary, one of the light French or German wines is best; and for the feeble digestion and weak circulation of age, a little spirit is very useful, especially in producing sleep when taken at night-time. In cases of weakening disease with irritability of the stomach, champagne or brandy well diluted with soda water is specially efficacious. Although tissues are not formed from alcohol, yet a certain amount can be used by the system to form the animal heat necessary to the body, and so spare other tissue. In health the equivalent in spirit, wine, etc., of one and a half ounces of absolute alcohol can be daily so used up, and in such diseases as consumption with high temperature several ounces may advantageously be taken.

As a so-called stimulant to the heart and respiration, alcohol is employed in disease; but its value in this connection is exaggerated.

The popular habit of taking spirits 'to keep the cold out' is a delusion. Alcohol gives a sense of warmth to the skin by bringing the blood there; but, as the blood is rapidly cooled in cold air, the risk of frost-bite and even death by freezing is increased, so that experienced hunters and mountaineers will on no account touch spirits on biting days or at high altitudes.

In health, as stated, there is no necessity for alcohol, and, as so many persons contract the alcohol habit, it would be well for every one to consider the question well before embarking on its habitual use. Even far short of drunkenness its constant use in large quantities certainly shortens life. (*See* ALCOHOLISM, CHRONIC.)

ALCOHOLISM, ACUTE.—This is the condition produced by taking excessive quantities of alcohol over a short period. The effects vary greatly according to the hereditary and nervous constitution of the person concerned, his or her age and social surroundings, and to a great extent with the kind of liquor taken, whether it is taken with food, and whether it has been taken for a long time previously.

Varieties.—There are many curious

effects produced and phases of character brought to light by the disturbance of mental balance, but the three important forms are ordinary drunkenness, alcoholic mania, and 'delirium tremens'.

Symptoms. — ORDINARY DRUNKENNESS is too common to need much description. First the person is brightened, his spirits rise, his conversation is witty, the skin becomes flushed and there is a general sense of well-being. As he becomes really drunk a phase of depression-excitement comes on; one person becomes angry, resents fancied affronts, and tries to pick quarrels, another becomes melancholy and lugubrious, a third grows maudlin, and weepingly recounts the secrets of his family to perfect strangers, while a fourth type assumes a regal manner and gives away his money and valuables or makes promises which he cannot possibly fulfil, and all lose the controlling power of reason. A third stage is that in which all feeling of shame is lost, and there is dullness of sense and loss of power, the drunk man or woman reeling or falling and rising with difficulty. The fourth stage is popularly known as 'dead drunk'; the person lies in a state of insensibility, with stertorous breathing and dilated pupils.

ALCOHOLIC MANIA is the form which often affects neurotic young men or women with a family taint of insanity. A state of excitement and fury, leading sometimes to attempts at murder or suicide, comes on after, it may be, only a few glasses of spirits or wine, and lasts some hours or days, without any tendency to dullness or sleep. Some persons who are liable to epileptic attacks have a fit when alcohol is taken even in moderate amount.

DELIRIUM TREMENS is the most serious form, and is popularly known as 'blue-devils', because of the hallucinations accompanying the state. It follows on a long course of drinking which has ended in a bout, or may be brought on by an injury or business worries in a heavy drinker; but it does not follow a single 'spree'. Tremors all over the body, but especially in the hands and tongue, are the first sign of its onset, then complete loss of appetite, sickness, rise of temperature, weak pulse, and constant purposeless movements. Finally hallucinations come on; spiders, flies, mice, rats are described on the clothes or floor, or disgusting objects like snakes, toads, and demons, or the bystanders are taken for policemen, hangmen, etc., and the furniture distorts itself into weird shapes. Lastly, delirium of a terrified or raging type comes on, in which there is more or less danger of suicide or homicide. Pneumonia of a serious type is apt to ensue, and if these two be combined the case is usually fatal. When a case of delirium tremens follows upon a very prolonged course of chronic alcoholism the mental state sometimes passes into one of permanent mental feebleness due to organic changes (œdema) in the brain.

Treatment.—Ordinary drunkenness is best treated by letting the person sleep it off, or, if great quantities of alcohol have been rapidly taken, the stomach should be washed out with the stomach-tube. In the second or excited stage, and in alcoholic mania, if the person be uncontrollable, he is to be treated as in *delirium tremens*. In the latter, careful nursing and constant watching are necessary. The food should be light, fluid, and stimulating, such as milk and potash water, beef-tea, bovril, meat juice, and chicken soup. Often complete rest and this type of food will in a few days ward off a threatened attack. Sometimes when the heart is very feeble alcohol may be given, but its use is seldom necessary. Sedatives are necessary. Of these the prolonged tepid bath is safe and effective, the patient being allowed to remain in the water for several hours if necessary. A mixture of chloral (twenty grains) and potassium bromide (thirty grains) may be given, and repeated several times in the course of a day if not effectual at first. Sulphonal, trional, chloralamide are also used but are not so effective. If the patient be in a state of raging mania, hyoscine will quiet him, but it is so powerful a drug (the dose being one-hundredth of a grain) that it should not be used but by a medical man. The delirious person should not be held down, but, if very violent, may be fastened by a sheet or by wrists and ankles to the bed, when he soon becomes tired and quiet.

ALCOHOLISM, CHRONIC

ALCOHOLISM, CHRONIC.—This is the condition of mind and body produced by taking too much alcohol over long periods. It has been calculated that 1½ ounces of alcohol, representing a wineglassful and a half of spirit, or a pint of light wine or two pints of beer, is the utmost that a large-sized, healthy, hard-working man can daily dispose of without damage to health and mental powers; but even this, in cases of debility, bad heredity, etc., may be too much.

Causes.—The alcoholic habit is of two kinds: (*a*) *vicious*, in which people, often in the lower strata of society, drink because their associates do, because they have little sense of their duties to society and love the stimulating and soddening effect of drink, though they have no absolute craving for it, or because they are driven by misery and worries to find the only relief from their woes in drunkenness; and (*b*) *diseased*, in which persons, often of fine mental and moral feeling, are driven, sometimes irresistibly, to satisfy a craving for the effects of alcohol, regardless of consequences. 'Dipsomania' is the name given to the latter, and it has been ascribed in different cases to (1) a weak mental heredity with family history of insanity, epilepsy, etc.; (2) the fact that father or mother was under the influence of alcohol at the time of conception; (3) long-continued vicious drinking causing almost a necessity for alcohol in the system; (4) injuries to the head, or sunstroke; (5) the use of alcohol when the system was in a weak state as in pregnancy, or after influenza; (6) its use for the first time at one of the critical periods of life, as at puberty, or the menopause. Many persons who drink habitually to excess have contracted the habit so gradually that they are quite unaware of it, though it is evident even to a casual acquaintance.

Symptoms.—MENTAL SYMPTOMS.—One symptom occurs only in the dipsomaniac form of alcoholism, which is that though the person is perfectly aware that his habit is shortening his life, blunting his finer feelings and impulses, and even leading him to ruin and crime, and, though he struggles sincerely and vehemently against it, the craving repeatedly overpowers him. This may occur constantly, or the victim may have long intervals with no desire for drink, till at definite periods the craving comes, either with some warning of headache and malaise, or absolutely suddenly, and the dipsomaniac rushes, as if possessed, to the nearest bar or saloon to pour alcohol down his throat. This type is found specially in young people, but many of these cases develop into constant drinkers. Among chronic drinkers the first symptoms are mental. There may be no drunkenness, in fact the most vicious alcoholics are those who are constantly having 'drams' or 'nips' and 'cocktails' the whole day and every day, with seldom a real 'bout' or 'spree'. The drinker becomes lazy, dyspeptic, untrustworthy, forgetful. Later he, or she, grows tremulous, suspicious, bad-tempered, and develops a special dislike for those who were before nearest and dearest, and, as the case advances still farther, develops fixed delusions that his friends are attempting to rob, poison, or otherwise injure him. Many revolting crimes, such as murders of wife and children, followed by suicide, are committed by chronic drinkers who are passing into delirium tremens. (*See* ALCOHOLISM, ACUTE.) Or, if the mental balance be more stable, the result is a gradual loss of all intellectual power, till the tippler, between forty and fifty, becomes weak, silly, and demented, entering on his dotage soon after fifty. (*See also* KORSAKOFF'S SYNDROME.)

BODILY SYMPTOMS are produced as a result of tissue changes from the irritation of the alcohol. The mental changes noted above are the result of inflammation in the brain, followed by adhesions to its enveloping membrane, thickening of the arteries with lessened supply of blood to the brain, and consequent degeneration of the nerve cells. The nerves all over the body undergo chronic inflammation (*see* NEURITIS), producing paralysis of limbs, blindness, etc., which is especially the case in female drinkers. Catarrh of the stomach, causing dyspepsia and vomiting (*see* DYSPEPSIA), comes on early. Cirrhosis of the liver (*see* LIVER, DISEASES OF), with dropsy, is a very frequent complication. The body, with almost all the internal organs, becomes covered

with fat, which interferes with all organic functions, and, in the case of the heart, may lead to sudden and premature death. The most serious changes occur owing to atheroma in the vessels throughout the body (*see* ARTERIES, DISEASES OF), of which alcohol is one of the chief causes. The fiery visage (*see* ACNE ROSACEA) and the bloodshot and bleary eye are also well-known signs. The body is rendered by alcoholic excess more liable to the ravages of other diseases, especially syphilis and tuberculosis, and chronic alcoholics succumb to serious acute diseases like pneumonia much more readily than do non-alcoholic persons.

Treatment.—The first thing to do is to give up alcohol entirely. For the person with a dipsomaniac craving or vital organs damaged by excess there is no question of moderate drinking. The treatment of symptoms such as vomiting, dyspepsia, paralysis, is given under these heads. All sorts of drink-cures are advertised and sold; some contain drugs, such as bromides, cocaine, opium, Indian hemp, caffeine, which tide the drinker over the depression caused by an attempt to shake off his habit; others, such as hypnotism, Christian science, religious revivals, active crusades against drunkenness in others, rouse up in unstable persons dormant powers of resistance; but, though a few veritable cures take place when the habit is once broken, in general, relapses occur, and, if drugs be injudiciously given, more pernicious drug habits (*see* DRUG HABITS) may be learned in addition. The idea that some drug may be given without the drunkard's knowledge, to cure him, is fallacious. The person must, as in the case of any bad habit, gradually and often painfully work out his own cure. To this end, retirement to some quiet place under friendly but strict supervision, or to an inebriates' retreat, is desirable for six months or a year. For admission to such a Home, certain formalities are prescribed by Act of Parliament in Britain. These are: (1) the signing by the inebriate himself, before a magistrate, of a *Request for Reception*, giving power to the authorities of the Home forcibly to detain him for a certain period; and (2) the signing of a *Statutory Declaration* by any two friends to prove that the person concerned is an inebriate. The principles of such treatment are (*a*) removal from bad habits and surroundings, (*b*) enforced total abstinence for months, during which the longing for drink is gradually lost, (*c*) recovery of impaired mental and bodily health.

ALEXIA (*ἀ*, neg.; *λέξις*, word) is another name for 'word-blindness'. (*See* APHASIA.)

ALGESIMETER (*ἄλγησις*, sense of pain; *μέτρον*, measure) is the name of an instrument used in measuring the sensitiveness of areas of the skin.

ALGID (*algidus*, cold) stage of cholera and ague, is that in which extreme coldness of the body occurs. (*See* CHOLERA, MALARIA.)

ALIENATION (*alienatio*) means insanity or mental derangement.

ALIENIST means an expert in the treatment of insanity.

ALIMENT (*see* DIET).

ALIMENTARY CANAL is the passage along which the food passes, in which it is digested (*see* DIGESTION), and from which it is absorbed by lymphatics and blood-vessels into the circulation. The canal consists of the mouth, pharynx or throat, œsophagus or gullet, stomach, small intestine, and large intestine, in this order. For details see articles under these heads. The total length of the alimentary canal is about 30 feet in a man.

ALKALÆMIA means an increase in the alkalinity of the blood, or, more accurately, a decrease in the concentration of hydrogen-ions in the blood. It occurs, for example, in patients who have had large doses of alkalies for the treatment of gastric ulcer. Another, but now less used, term for this condition is alkalosis.

ALKALI (Arabic word) is a substance which neutralises an acid to form a salt, and turns litmus and other vegetable dyes blue. Alkalies are generally oxides or carbonates of metals.

Varieties.—Ammonia, lithia, potash, and soda are the principal; the carbonates of these act as weaker alkalies, and

their bicarbonates still weaker. Lime, magnesia, baryta, and strontia are called alkaline earths, and act as alkalies. Further, substances which in the body are converted into alkalies, such as acetates, citrates, and tartrates, are called 'indirect' alkalies. In the

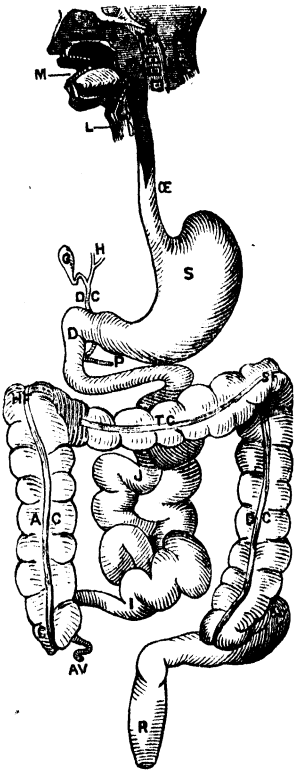


FIG. 11.—Alimentary canal. *M*, Mouth; *Ph*, pharynx; *L*, larynx; *Œ*, œsophagus; *S*, stomach; *D*, *J*, *I*, small intestine; *AV*, *AC*, *HF*, *TC*, *SF*, *DC*, *Sg*, *R*, parts of large intestine. For further details see Intestine. (*Ency. Brit.*)

body protein substances also act as alkalies, absorbing acids and thus preventing the development of general acidosis.

Uses.—In poisoning by acids, one at once administers dilute alkaline solutions. (*See* ACIDS, POISONING BY.) Caustic, *i.e.* undiluted, alkalies are used to destroy warts. Bee-stings and insect-bites cause irritation because of an acid injected by the insect, and consequently are relieved by weak alkaline applications. Very weak solutions of soda and potash or their bicarbonate are given internally for bronchitis, when the phlegm is thick. In heartburn, bicarbonate of soda is taken after a meal, to soothe irritation and spasm of the stomach. In gout and general acidity (*see* ACIDITY) they are much used. The dose of bicarbonate of soda (baking soda) or of potash is 20 grains (or as much as can be heaped on a sixpence or dime-piece), and of carbonate of ammonia 5 grains, or, in the form of sal volatile, a small teaspoonful, well diluted in water.

ALKALIES, POISONING BY.—Persons may drink soap-lye, ammonia, caustic soda, caustic potash, washing soda, pearl ash, spirit of hartshorn, by mistake, and, when this has been done, plenty of water should be given to drink, to which should be added, if available, weak acids such as vinegar, lime juice, or lemon juice. Oily substances, such as olive oil, may thereafter be administered. On no account must any attempt be made to make the patient vomit.

ALKALOIDS are substances found commonly in various plants. They are natural nitrogenous organic bases and combine with acids to form crystalline salts. Among alkaloids, morphine was discovered in 1805, strychnine in 1818, quinine and caffeine in 1820, nicotine in 1829, atropine in 1833. Only a few alkaloids occur in the animal kingdom, the outstanding example being adrenaline (or epinephrine), which is formed in the medulla of the suprarenal, or adrenal, gland. Alkaloids are often used for medicinal purposes. They are slightly soluble in water but readily dissolved by alcohol, which is therefore used in their extraction from the plants containing them. Most alkaloids have a bitter taste and have a strong action on the body. The name of an alkaloid ends in '*ine*' (in Latin *ina*).

NEUTRAL PRINCIPLES are crystalline substances with actions similar to those of alkaloids but having a neutral reaction. The name of a neutral principle ends in '*in*', *e.g.* digitalin, aloin.

Most alkaloids are obtained pure from their plants by a complicated process involving extraction with alcohol, the formation of a salt by addition of an acid and solution of this in water, which is subsequently driven off by evaporation. The following are the most important active principles with the plants from which they come :

Aconitine, from Monk's-hood.
Atropine, from Belladonna (juice of Deadly Nightshade).
Cocaine, from Coca leaves.
Hyoscine, from Henbane.
Morphine or *Morphia*, *Codeine*, *Thebaine* } from Opium (juice of Poppy).
Nicotine, from Tobacco.
Physostigmine, from Calabar bean.
Pilocarpine, from Jaborandi leaves.
Quinine, *Quinidine* } from Cinchona or Peruvian bark.
Strychnine, from Nux Vomica seeds.

ALKALOSIS (*see* ALKALÆMIA).

ALKAPTONURIA (*see* OCHRONOSIS).

ALLANTIASIS (ἀλλᾶς, sausage) is a name for sausage-poisoning. (*See* PTOMAINE POISONING.)

ALLANTOIN is a crystallisable substance obtained from allantoic fluid, fœtal urine, etc., and also prepared by the oxidation of uric acid. It is used in the treatment of ulcers to stimulate the formation of the surface epithelial layer of the skin.

ALLANTOIS (ἀλλᾶς, sausage ; εἶδος, form) is a vascular structure, which, very early in the life of the embryo, grows out from its hind-gut. The end becomes attached to the wall of the womb. It spreads out at the end, becomes stalked, and develops later into the placenta and umbilical cord (*see* AFTERBIRTH), which forms the only connection between the mother and embryo.

ALLERGEN is the term applied to any substance, usually a protein, which, taken into the body, makes the body hypersensitive or 'allergic' to it. Thus in hay-fever the allergen is pollen.

ALLERGY (ἄλλος, different ; ἔργον, reaction) means special sensitiveness of an individual to certain foods, pollens or other products of plants, animal emanations, insect bites, etc., so that in such an individual conditions like asthma, dyspepsia, nettle-rash, hay fever, eczema and headache are produced. The term anaphylaxis is given to a similar serious reaction following the injection of serum. (*See* ANAPHYLAXIS.) The substances that produce allergy are generally of protein nature and include such ordinary foods as eggs, milk, flour and potatoes ; also strawberries, tomatoes, cauliflower, walnuts, pork, shell-fish, salmon, coffee, etc. ; it may also be caused by inhalation of dust from feathers (in pillows), of the hair of horses, dogs or cats, of face powder containing orris root, and of pollen, especially from grasses and certain flowers.

Symptoms.—The reaction in sensitive persons usually appears within a few minutes, but may be delayed for hours. One of the most common effects is nettle-rash or dropsical swellings in various parts ; hay fever is another common result ; sometimes there is swelling in a joint. Another type of reaction consists in spasmodic contractions of unstriped muscle so that the person affected may become urgently ill with asthma, or may develop spasms in the stomach with painful dyspepsia and vomiting, or in the intestine with symptoms resembling obstruction or severe diarrhœa, or may be troubled by irritability of the bladder. In other cases, neuralgia, headache or attacks of giddiness may come on.

Treatment.—It is important to find out the food or other substance to which the individual is sensitive. Sometimes this has been discovered by long personal experience. Skin testing may also be carried out by inoculating into a series of scratches extracts of various foods, etc., likely to cause allergy, and the substance responsible produces a wheal surrounded by redness within a few minutes. When the substance is discovered, it should in future be carefully avoided, or, if it is an ordinary food, the sensitiveness can sometimes be abolished by taking this food constantly in small quantities very gradually increased. Severe symptoms, as in asthma, may be relieved by an injection of adrenalin (5-10 minims).

ALLOCHEIRIA (ἄλλος, another ; χείρ, the hand) is the name for a dis-

order of sensation in which sensations are referred to the wrong part of the body.

ALLOPATHY (ἄλλος, another; πάθη condition) is a term applied sometimes by homœopathists to the methods used by regular practitioners of medicine and surgery. The term literally means curing by inducing a different kind of action in the body and is an erroneous designation.

ALOES is the dried juice of a plant which grows in the West Indies (*Aloe vera*) and East Africa (*Aloe Perryi*). It acts as a purgative, and taken in the evening it acts next morning. The dose is 2 to 5 grains of aloes, or 4 to 8 grains of aloes pill. Since it tends to cause griping it is usually combined with other drugs. (*See* CONSTIPATION.

ALOIN is an extract from aloes much used in pills; the dose is from ½ to 1 grain

ALOPECIA (ἀλώπηξ, a fox) is another name for baldness. (*See* BALDNESS.)

ALOPECIA AREATA is the term given to the disorder in which the hair comes out in patches, resulting in shiny, smooth, bald areas.

ALPENSTICH (German word) is a term applied to pneumonia which is apt to affect persons exposed to the cold of high regions.

ALTERATIVES.—This term, which is vague and not much used now, means substances which, in some way, alter the composition of the tissues, so that the renewal of the tissues, which is always in progress, goes on more rapidly, and their functions are better discharged. The chief alteratives stand chemically between metals and non-metals.

Varieties.—Antimonial salts, arsenic, iodides, mercurial salts, nitrohydrochloric acid, phosphorus, sulphur. Also some vegetable substances, as colchicum, guaiacum, sarsaparilla.

Uses.—They are given in conditions of ill-health where no special organ is evidently at fault, and must be given in small doses over a long time. Now, physicians trust more to a visit to seaside or mountains, a long sea voyage, exercise, simple food, and drinking large quantities of water, which have the same effect.

ALUM is the sulphate of aluminium and potassium. Ammonia alum is the sulphate of aluminium and ammonium. Alum is an astringent, and may be used in powder to rub into wounds, *e.g.* of the head, when bleeding will not stop of itself. As an emetic, a teaspoonful of powdered alum may be given in water. A valuable use is in an eye-wash for inflamed, painful, and bloodshot eyes, the strength being about 4 grains to the ounce of water. It is also used sometimes in about double that strength to form an astringent douche.

ALUMINIUM is a light whitish metal which is very malleable and ductile and is much used for the manufacture of surgical instruments and as a base for artificial dentures. It is quickly destroyed by exposure to salt, iodine, and some other substances commonly used as antiseptics. Aluminium acetate is used in solution as an astringent and antiseptic. Aluminium hydrate is used internally as an anti-acid and absorbent in dyspepsia in doses of 3 to 15 grains.

ALVEOLAR ABSCESS (*see* GUM-BOIL).

ALVEOLUS (*alveoli*) is a term applied to the sockets of the teeth in the jaw-bone. The term is also applied to the minute divisions of glands and to the air sacs of the lungs.

ALYPIN is a white crystalline powder used as a local anæsthetic especially in eye operations.

AMAUROSIS (ἀμαύρωσις) is the term applied to blindness in which there is no obvious lesion of the eye, the blindness being caused by disease of the optic nerve, retina, or brain, or being due to hysteria.

AMBIVALENCE is the term applied to the psychological state in which a person concurrently hates and loves the same object or person.

AMBLYOPIA (ἀμβλυωπία) means defective vision for which no recognisable cause exists in any part of the eye. It may be due to such causes as defective development, hysteria, excessive use of tobacco or alcohol, etc.

AMBRINE is a preparation of paraffin, resin and wax used as a dressing in treating extensive burns, upon which it is sprayed and subsequently solidifies.

AMBULANCE (*ambulo*, I move about) is a vehicle for conveying stretchers upon which sick persons, or wounded in time of war, are laid for removal. Ambulances are to be found in most large towns, at railway stations, factories, etc., for speedy and easy removal of injured persons to hospital. They can be used, as a rule, by private persons at a charge somewhere about that of an ordinary hired vehicle. There are many Ambulance Societies supported, partly by charity, partly by their earnings; and, of these, the chief in England is the St. John's Ambulance Association, and in Scotland the St. Andrew's Ambulance Association. Both support ambulance carriages in large towns, and conduct ambulance classes to instruct members of the general public in the giving of 'first aid' to the injured.

Ambulance classes.—As to the formation of such a class the rules of the St. Andrew's Association may be taken as typical. The number must be between twenty and thirty. Any medical practitioner may be got as teacher, adhering to a definite syllabus of six lectures and four practical meetings. The course is occupied partly with elementary anatomy and physiology, partly with first-aid for fractures, hæmorrhages, fits and the like, partly with bandaging, and partly with stretcher-drill. Sick nursing classes are also held. A small fee is charged to each member of the class, and goes to the funds of the Association. At the end of the course the Association sends an examiner to test any members of the class who wish examination, and those who pass receive a certificate. Particulars can be obtained from the Secretary of the Association.

For subjects connected with first-aid see under INJURED, REMOVAL OF; BANDAGES, BURNS, CONVULSIONS, DROWNING, FAINTING, FRACTURES, HÆMORRHAGE, NURSING, POISONING, WOUNDS.

AMBULATORY FEVER (*ambulo*, I move about) is one in which the attack is at first so mild that the person keeps on going about as usual. It occurs especially in typhoid fever, and then the sick person forms a source of infection.

AMENORRHŒA (ἀ, neg.; μήν, a month; ῥέω, I flow) is the absence of the menstrual flow during the time of life at which it should occur. (*See* MENSTRUATION.)

AMENT is an idiot or mentally deficient person—one having no mind.

AMENTIA is the state of being an ament: mental deficiency from failure of the mind to develop normally.

AMETROPIA (ἀ, neg.; μέτρον, proportion; ὄψις, sight) means an error in the refractive power of the eye so that images are not properly focussed on the retina. It may occur as long-sightedness (hypermetropia), short-sightedness (myopia), or astigmatism, or as a combination of either of the first two with astigmatism. It is corrected by appropriate lenses.

AMIDOPYRINE, or PYRAMIDON, is an analgesic and antipyretic remedy acting similarly to antipyrin. It is given in doses of 5-10 grains. (*See* ANTIPYRIN.) One of its dangers is that it may cause agranulocytosis (*q.v.*).

AMINO-ACID, or AMIDO-ACID, is the name given to substances which are derived from the ultimate products of digestion of protein foods and from which the protein materials of the body are again built up. They are organic acids in which one or more hydrogen atoms have been replaced by the chemical group NH_2.

AMINOPHYLLINE is the name given to a combination of theophylline and ethylene diamine. Aminophylline is a drug given in heart disease. It stimulates the excretion of urine and dilates the coronary arteries. It is sometimes given in asthma.

AMMONIA is a pungent gas formed by heating a mixture of sal-ammoniac and quicklime. Dissolved in water it forms the well-known spirits of hartshorn, or liquor ammoniæ. It is given off slowly from carbonate of ammonia, which is used as smelling salts. Carbonate of ammonia is the chief ingredient in aromatic spirits of ammonia

or sal volatile. In chloride of ammonia or sal-ammoniac it is fixed. (For ammonia poisoning see ALKALIES, POISONING BY.)

Uses.—Externally strong ammonia produces blistering. For bee-stings, weak ammonia is applied locally to relieve the pain. (*See* ALKALI.) Internally it is a powerful stimulant of the heart and respiration, and, therefore, a teaspoonful of sal volatile in water is given, or smelling salts are applied to the nose, when fainting threatens. Chloride of ammonia is used in liver disorders, and lozenges of this salt, or a little sal volatile, relieve an irritating barking cough and enable mucus to be coughed up.

AMMONIAC is a resinous gum obtained from *Dorema ammoniacum*, and possessed of a slightly irritant action. It is now little used.

AMMONOL is a coal-tar derivative with antiseptic and analgesic properties, used especially in nervous headaches in doses of 5 to 20 grains.

AMNESIA (*ἀμνησία*, forgetfulness) means forgetfulness of words or names. (*See* APHASIA.)

AMNION (*ἀμνίον*) is the tough fibrous membrane which lines the cavity of the womb during pregnancy, and contains from one to two pints of fluid in which the embryo floats. It is formed from the ovum along with the embryo, and in labour the part of it at the mouth of the womb forms the 'bag of waters'. (*See* LABOUR.) When a child is 'born with a caul', the caul is a piece of amnion.

AMNIOPLASTIN is the name given to the membrane prepared from the AMNION (*q.v.*) and used in surgery to prevent, for example, the brain adhering to the skull after operations on it. The amnioplastin is placed between the skull and the brain. It is also wrapped round nerves which have been operated on, to prevent their being bound down by scar tissue.

AMŒBA is the name applied to a minute protozoan animal consisting of a single cell, in which is a nucleus surrounded by protoplasm that changes its shape as the animal progresses or absorbs nourishment. Several varieties of this organism are found under different conditions within the human body, these forms being known as entamœbæ. One variety, *Entamœba coli*, is found in the large intestine of man without any associated disease;

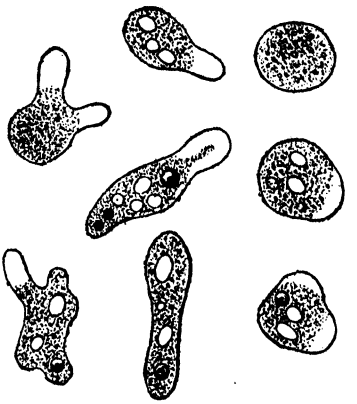


FIG. 12.—Amœba assuming various shapes. Magnified by 330. (Thoma's *Pathology*.)

another, *Amœba dentalis*, is found in the sockets of the teeth associated with pyorrhœa; another, *Entamœba histolytica*, is found in the large intestine associated with a form of tropical dysentery. Other forms are found in the genital organs.

AMPHORIC is an adjective denoting the kind of breathing heard over a cavity in the lung. Amphoric breathing is common in advanced cases of pulmonary tuberculosis, and the sound is like that made by blowing over the mouth of a narrow-necked vase.

AMPULE is a small glass container having one end drawn out into a point capable of being sealed so as to preserve its contents sterile. It is used for containing solutions for hypodermic injection.

AMPUTATION (*amputo*, I prune) means the severing of any limb or part completely from the body. In the case of organs other than limbs the word 'excision' is generally used. An amputation through a joint without sawing of bone is called a 'disarticulation'.

Objects of amputation.—In the great majority of cases a limb is amputated because it has been damaged beyond the hope of recovery. It is not always

easy to say at once that a limb should, or should not, be removed after an injury, but the three chief points are, as to whether (1) extensive portions of muscle, skin, and bone are so crushed and torn as to make their death and separation inevitable; (2) the great nerves and blood-vessels are divided so as to destroy the vitality of the limb; and (3) the laceration is so extensive, or involves joint cavities so as to render cleaning of the wound impossible and endanger the patient from blood-poisoning due to septic absorption. (*See* BLOOD-POISONING.) Often after gunshot wounds, crushes in machinery, or railway accidents, where a decision cannot be made at once, the injured limb is cleaned (vessels tied, sinews stitched, etc.), and then is put in a weak antiseptic bath for some days to see if healing will take place. This is done, especially in the case of the hand, where every fragment of tissue is valuable because of the delicate movements the limb executes, and where fortunately circulation by anastomosis is good. (*See* ANASTOMOSIS.) But in the lower limbs, the chief point is to have a small scar and a sound stump, so that the weight of the body can be borne, and therefore a few inches of length are, if necessary, sacrificed and amputation oftener performed.

Not infrequently, when bones or joints are diseased, especially with weakening discharges, or when gangrene has taken place, amputation of part of a limb is necessary. Another object of amputation is to remove malignant tumors entirely, such as those in the foot. Still another case for amputation is where a limb is paralysed completely, and a more useful artificial substitute can be fashioned. Owing to improvements in surgery which have taken place in recent years, many injured limbs can now be saved which previously would have required to be amputated.

Methods of amputation.—When a limb is to be amputated, it is elevated to empty it of blood as far as possible, then a tight or elastic band called a tourniquet is applied, to prevent bleeding; and, the limb being cut off by one of the following methods, the cut ends of the blood-vessels are ligatured, the tourniquet removed, the muscles and sinews stitched over the bone, and finally the edges of the skin stitched together. Thus there may be almost no blood lost. The *circular method* is one in which skin, muscles or flesh, and bone are cut or sawn at successively higher levels, so that the skin meets afterwards over the other tissues. It is an old method, and, being rapid, was used before the days of chloroform. In the *elliptical method* the tissues are divided in the form of an oblique circle, so that one side of the cut is much lower down the limb than the other. This has the advantage of bringing the resulting scar over to one side of the limb, and thus providing a better covering for the end of the sawn bone. The *flap method* is one in which a large flap of skin and fibrous tissue is carefully dissected up from the underlying muscles, and, after the limb is removed, laid across the cut surface and stitched at its sides and end. Only one flap may be made, or more often two, which meet end to end and side to side. Sometimes the flap consists of muscle as well as of skin, and occasionally a slice of bone with its covering membrane is included in the flap so as to produce a broad surface of bone when the flap is turned into its final position, and thus to form a better support in the case of lower-limb amputations. The flap method is that most frequently used, partly because with it the scar does not fall opposite the end of the bone, and also because a limb seldom being injured at the same level all round, the formation of a flap enables a larger part to be saved. The *'racquet' method* consists of a circular cut running round the limb and a long cut, like the handle of a racquet, up its side; the two edges are drawn apart, the bone divided high up, and then the sides of the racquet stitched together.

The wound is generally healed completely in three weeks and an artificial limb can be fitted at the end of three to six months. (*See* ARTIFICIAL LIMBS.) The avoidance of suppuration in an amputation following an injury is of great importance. Sometimes a 'conical stump' forms, owing to the bone continuing to grow, and thus tending to stretch the other parts over its end. In such a case an operation must be performed later to remove part of the bone.

AMYL NITRITE is a volatile, oily liquid prepared by the action of nitric and nitrous acids upon amylic alcohol. It resembles other nitrites in its power of relieving spasms and dilating blood-vessels, and it acts with great rapidity, producing its effects in a few seconds. (*See* NITROGLYCERIN.)

AMYLOCAINE (*see* STOVAINE).

AMYLOID (*see* WAXY DISEASE).

AMYLOID BODIES (ἄμυλον, starch; εἶδος, form) is the collective name for starch, dextrine, glycogen or animal starch, and similar substances.

AMYLOSE is the name applied to any carbohydrate of the starch group.

AMYLUM (ἄμυλον) is another name for starch.

AMYOTROPHIC LATERAL SCLEROSIS is a disease of the nervous system in which, as a result of degeneration of nerve cells in the spine and brain, there is progressive wasting of the muscles of the body, with spastic paralysis.

AMYOTROPHY means atrophy or loss of substance of a muscle.

ANÆMIA (ἀ, neg.; αἷμα, blood) means literally absence of blood, and is a term used to cover the symptoms due to an impoverishment in quantity or quality of the corpuscles or fluid of the blood. The term is most commonly applied to changes in the red blood corpuscles and may concern the number and form of the corpuscles or the amount of colouring matter (*hæmoglobin*) that they contain. A diminution in the number of white corpuscles is named 'leucopenia'.

Anæmia may be the result of some other condition which causes loss of blood and is then called 'secondary' anæmia. In other cases the cause is very obscure, being a disease that operates in the blood itself as a result of which other organs are involved; or there may be a defect in the organs by which the blood is formed. Such cases are known as 'primary' anæmia. The chief varieties of primary anæmia are chlorosis and pernicious anæmia, while aplastic anæmia is a form related to the latter, and splenic anæmia is a less common variety.

SECONDARY ANÆMIA.—**Causes.**—The simplest form of secondary anæmia is that due to loss of blood from a wound, from rupture of a blood-vessel, from ulcers of the stomach or other part of the alimentary canal, or from hæmorrhoids; certain diseases such as scurvy and hæmophilia, as well as bleedings from the nose, from the kidneys or from the womb are also frequently followed by anæmia. Another group of causes is found in want of proper food, the presence of albuminuria in Bright's disease, chronic septic conditions such as prolonged suppuration, in prolonged suckling of a child and in the long-continued action of such poisons as lead in the water supply, coal gas leakage, and chronic diseases like malaria and syphilis.

Symptoms.—The most noteworthy sign is pallor of the skin and lips. If the condition is very acute there may be giddiness, faintness, a feeling of anxiety, and weakness of the pulse and fainting. In more chronic cases the appetite is greatly impaired and the digestive power feeble, the heart's action is feeble and may be irregular, and very frequently there are dropsy about the ankles and general signs of neurasthenia.

Changes in the blood.—When blood has been lost by hæmorrhage it shows a special disposition to clot. The blood begins almost immediately to be restored and new small red corpuscles can be found in the circulation, some of them still retaining a nucleus.

When the anæmia has been gradually produced by septic and infective conditions, there is a similar diminution of the red corpuscles and especially of the hæmoglobin, while the white corpuscles after septic conditions usually show considerable increase. Certain special changes in both the red and white corpuscles are characteristic of various causes of anæmia.

Treatment is directed towards relieving the disease to which the anæmia is secondary and iron tonics are specially administered.

CHLOROSIS, also known as GREEN SICKNESS, is a disease affecting especially young women from 14 to 25 years of age.

Causes.—The disease usually begins between the ages stated, and when it

has once occurred it may return later in life following debilitating causes. Heredity to a certain extent plays a part, and the type of girl who is affected is generally small and of poor physique. Work and sleep in badly ventilated rooms may bring it on, as also unsuitable diet and irregularity of meal-times producing dyspepsia and constipation. Menstrual disorders appear to be the cause in some cases. Various theories have been advanced to explain this form of bloodlessness. There appears in many cases to be a defective development of the heart, blood-vessels, and blood-forming organs; other cases are attributed to defective development of the ovaries and of their internal secretion; in still other cases, indigestion and constipation, or some infectious condition is present and the anæmia is secondary to this. It is a remarkable fact that this disease has decreased very greatly in all countries during the last twenty years.

Symptoms.—The sufferer is a young woman. Her first complaint is usually either dyspepsia or breathlessness, while her friends notice the increasing pallor of her face, which assumes a peculiar greenish-grey tinge, and they often fear she is in a decline. The breathlessness comes on especially after exertion, such as going up a hill or stairs, and is generally accompanied by palpitation of the heart. There may even be a tendency to fainting, owing to temporary dilatation of the heart, and, for the same reason, the pulse is weak, there is throbbing in the arteries, often very disagreeable to the sufferer, and cardiac murmurs develop. There is often also dropsical swelling of the feet, most noticeable towards nightfall. Dyspeptic symptoms are almost always present, taking the form of flatulence after meals, or heartburn, and there is a tendency to the formation of a gastric ulcer. Constipation is so regularly present that it has been regarded as a cause of the condition. Menstrual disorders are frequent, either pain, irregularity, or, most often, stoppage.

Changes in the blood.—There is in this disease no actual destruction of blood but a diminution of quality. The number of corpuscles is not greatly diminished and may not fall below 3½ or 4 million per cubic mm. of blood even in markedly anæmic cases; the hæmoglobin, however, falls in amount and may reach only 30 or 40 per cent of its normal amount, so that the blood becomes pale in colour. The corpuscles are very pale in colour, diminished in size and misshapen (*poikilocytosis*). The white corpuscles are also diminished.

Treatment.—The prevention of chlorosis in girls liable to the disease is effected by good food, sufficient exercise and the provision of sunlight and fresh air; rest and a holiday are of great importance when the disease is threatening to develop. When the changes in the blood have actually appeared, the patient should be treated in bed, and thus the strain on the heart and other organs is avoided. Rest in bed for two or three weeks may be necessary. Constipation must be carefully treated by some regularly administered aperient such as liquid extract of cascara or a daily aloin pill. Menstrual irregularity should be disregarded, as this is merely a symptom and stoppage of the menses is beneficial by preventing further loss of blood, while this function becomes natural as the anæmia lessens. The drug which has a specially beneficial action in this disease is some preparation of iron. The commonest form of iron employed is Blaud's pills, of which one to three are taken after every meal. The iron must be taken over four or five weeks at least, and it is well, after severe cases, that small doses should be taken off and on for several months. In addition to these remedies, simple food, fresh air, daily exercise and an abundance of time for sleep must be added. In every case recovery is to be looked for, although the case may require several months' treatment.

MICROCYTIC ANÆMIA is a condition resembling chlorosis and appears especially in middle-aged women.

Symptoms.—The patient is pale and complains of breathlessness and increasing weakness and indigestion, and is generally in a poor state of health. Two striking symptoms are frequently present which do not show an apparent connection with the anæmia; these are difficulty in swallowing and a defective formation of the finger-nails, which are thin and spoon-shaped. The blood shows a slight decrease in the number of corpuscles, which, however,

are generally smaller than the normal size, and the hæmoglobin of the blood is greatly reduced. If the gastric juice is examined, this is found to show diminution or absence of hydrochloric acid.

Treatment.—This is similar to that for chlorosis, consisting of rest for a time, a diet of simple easily digested food, and especially the administration of some preparation of iron in large doses for a long time.

PERNICIOUS ANÆMIA, or ADDISONIAN ANÆMIA, is a severe form of bloodlessness occurring usually in middle life.

Causes.—Pernicious anæmia comes on so gradually that its causes are difficult to determine. It appears to have increased greatly during recent years. Men are more frequently affected than women and the commonest age for its appearance is between 35 and 60. Heredity seems to have some bearing on its onset, and several cases are frequently to be found in one family. Occasionally the disease develops in persons suffering from the results of malaria, dysentery, syphilis, intestinal parasites, and other chronic diseases. Severe loss of blood such as that following childbirth, or prolonged loss as from hæmorrhoids, in some cases precedes the onset of the anæmia, and other cases occur in persons who at work have been for a long time brought into contact with certain chemical poisons. Dyspepsia or intestinal disorders accompanied by an atrophic condition of the mucous membranes of the mouth, tongue, stomach and intestinal canal frequently precede the appearance of anæmia, but these should rather be regarded as a part of the disease than as its cause.

The direct cause of the bloodless state is a failure on the part of the blood-forming tissues, which are situated chiefly in the red marrow of the bones, to produce new blood corpuscles to take the place of those which become worn out and broken down. A substance necessary for this constant formation of new blood corpuscles is produced by the mucous membrane of the stomach and intestine, and is stored in the liver. The occurrence of the anæmia may be brought about by defect of this substance (intrinsic factor) and this in turn may be caused by

certain deficiencies in the diet (extrinsic factor), while most of the causes mentioned above probably contribute merely by weakening the blood-forming tissues.

Symptoms.—The anæmic person is in general elderly. The onset is so very gradual that the illness may have lasted for many months before pallor, which gives to the skin a lemon-yellow colour, and general languor and feebleness call attention to it. The muscles become flabby, although there is seldom any sign of wasting, and the person becomes increasingly indisposed to exert himself, with a feeling of faintness and breathlessness when he makes any effort. Palpitation of the heart is readily produced, the pulse is weak and swelling of the ankles appears if the patient is still going about. Indigestion, vomiting and diarrhœa are common symptoms. The indigestion and loss of appetite, which are usually present, are connected with a failure of the gastric

FIG. 13.—Red blood corpuscles from a case of pernicious anæmia, showing two large corpuscles above and various abnormal shapes below. Magnified by 900. (Thoma's *Pathology*.)

juice. This is an important feature of the disease, and when a test meal is given to the patient and the material withdrawn from the stomach is examined for the presence of hydrochloric acid, this is almost invariably found to be absent. Nervous symptoms of various kinds are present in a large number of cases, and may appear before the anæmia becomes very evident; these include especially tingling or numbness in the feet and hands with staggering walk or stiffness of the legs caused by degeneration in the spinal cord (subacute combined degeneration). Mental peculiarities not infrequently appear as the disease progresses, and may take the form of mental dullness and stupor, or of delusions. There is a tendency to a deposit of fat under the skin, and also to fatty degeneration of the internal

organs, together with a deposit in them of iron granules derived from the red corpuscles which have been destroyed. In the case of the heart, this fatty change leads to dilatation and feebleness of action which still further incapacitates the patient for exertion and produces an unusually low blood pressure. In some cases, rises of temperature occur for a time, and small haemorrhages may frequently be seen under the skin ; such hæmorrhages into the retina occasionally cause impairment of vision.

Many patients recover rapidly under suitable treatment, and thereafter continue in good health so long as a certain amount of liver extract is administered. Generally speaking, the prospect of recovery is better in younger persons. Even in untreated cases a natural remission of the disease for several years may take place, but it is always liable to recur unless systematic treatment is adopted and continued.

Changes in the Blood.—In addition to lessened production of new corpuscles, there is an increased destruction of the circulating corpuscles, which are badly formed. Consequently their number may fall very much below normal. By the time the anæmia attracts attention the red corpuscles have usually fallen from the normal 5 million or more to about 1½ million per c.mm. of blood, although, since the diminution has taken place gradually, persons with pernicious anæmia often continue to lead an active life with little complaint save breathlessness, even when the corpuscles have fallen so low as 2 million. The hæmoglobin is proportionately less affected, and many of the corpuscles being larger than normal, the quantity of this pigment contained in each corpuscle is often over the normal amount (high colour index). The process of production of new corpuscles is hurried, often to an extreme degree, so that defective and immature forms escape from the bone marrow into the blood, and in consequence many are misshapen or show unusual staining reactions or have the immature character of possessing a nucleus (normoblasts and megaloblasts). The white corpuscles are also somewhat diminished in numbers. As improvement takes place under treatment, the number of red corpuscles rises and may reach normal figures in a few weeks. An important early sign of recovery may be found, a few days after treatment has begun, by the presence of new corpuscles, which can be recognised by their showing a fine network (reticulocytes) when the blood is stained in a special manner and examined under the microscope.

Treatment.—It is very important to place the anæmic patient under healthy conditions with regard to proper food and especially rest. At first the patient should be kept for some time in bed, as this both improves the digestion and relieves the heart from strain. The diet should contain a considerable amount of animal food and fresh fruit and vegetables, which must, however, be given in an easily digested form ; meat should be finely minced, while fish and chicken may be made into creams ; liver and kidney are specially suitable and may be lightly cooked. The administration of dilute hydrochloric acid and bitter tonics after meals often aids digestion greatly. Since a septic condition of the mouth and teeth is often an aggravating factor in the disease, the teeth should be carefully put in order and a mouth wash regularly used. Careful regulation of the bowels as well as sunshine and fresh air are also very important.

The essential feature of treatment is the administration of an extract of liver, or of a preparation made from the mucous membrane of hog's stomach. These may be taken by mouth along with meals, or the liver extract is more conveniently administered by injection into a muscle or vein. In severe cases, administration by injection is essential in the early stages, and later, when recovery has taken place, it is sufficient, in order to keep the blood in a healthy state, to give an injection of liver extract in suitable amount once a fortnight or once a month. The liver extract supplied by different manufacturers is known by various names such as hepatex, pernæmon, campolon, anahæmin, etc., or simply as liver extract. The dose that is necessary for any given case is controlled by periodic examination of the blood.

In specially severe cases, it is sometimes necessary to begin treatment by transfusion of blood from a healthy person, and this is often followed by immediate and marked im-

provement, which, however, is only of temporary nature. Care must be taken before transfusion to ascertain that the blood of the "donor" is compatible with the blood of the patient. Arsenic, usually in the form of Fowler's solution, is frequently used in addition, and when the blood corpuscles have risen to normal numbers, it is often necessary to administer iron in some form to increase their hæmoglobin. When the blood has been restored to a normal state, it is essential that the treatment with a certain amount of liver extract should be continued in order to keep it in a healthy state and to prevent a return of symptoms.

APLASTIC ANÆMIA is a disease in which the red blood corpuscles are very greatly reduced and in which no attempt appears to be made in the bone marrow towards their regeneration. The disease occurs in young persons under forty years of age and in some cases is caused by such poisons as benzol, radium, and mercury. The patient becomes very pale with a tendency to hæmorrhages under the skin and mucous membranes, and the temperature may at times be raised. The blood is pale and the corpuscles fall off steadily in numbers with changes in form, etc., similar to those of pernicious anæmia. The remedies found useful in pernicious anæmia do not appear to have much influence over the progress of this condition, and death usually occurs within one year of its discovery.

SPLENIC ANÆMIA, also known as BANTI'S DISEASE, is a condition in which the spleen becomes enlarged, and the liver cirrhotic, and in which jaundice and anæmia appear. The condition is a very chronic one, affecting young adults, and sometimes follows malaria. Dyspepsia, accompanied with swelling of the abdomen due to an enlargement of the spleen and liver, vomiting with diarrhœa, jaundice and a certain amount of dropsy, are the most prominent symptoms. The blood corpuscles, both red and white, are often reduced to about half their normal numbers. Sometimes the patient gradually recovers and benefit is found to follow the administration of arsenic and of quinine. The application of X-rays or radium to the spleen causes its diminution in size and improvement of the anæmia. In cases strong enough to stand a severe operation, the removal of the spleen has been followed by a successful result.

ANÆROBE (ἀ, neg.; ἀήρ, air; βιόω, I live) is the term applied to bacteria having the power to live without air. Such organisms are found growing freely, deep in the soil, as, for example, the tetanus bacillus.

ANÆSTHESIA (ἀναισθησία) means loss of the power of feeling. The word is applied either to loss over a limited area of skin produced by certain nervous diseases, by freezing, by cocaine, etc., or to a total loss of feeling and consciousness, in the state produced by chloroform, ether, and similar drugs. When only loss of the sense of pain is meant, without loss of the sense of touch, the proper word is analgesia.

ANÆSTHETICS are drugs and other measures which produce insensibility to external impressions.

The artificial induction of anæsthesia by the use of drugs or the inhalation of vapours is a subject of great interest, both historically and from its practical application to the relief of suffering and the treatment of disease. Although it is mainly owing to the researches of distinguished chemists and physicians of last century that the employment of anæsthesia has come to occupy a foremost place among remedies, there is abundant evidence to show that it is a practice of great antiquity. Besides the mention by Homer of the anæsthetic effects of nepenthe, and the reference by Herodotus to the practice of the Scythians of inhaling the vapours of a certain kind of hemp to produce intoxication, the employment of anæsthetics in surgery by the use of mandrake is particularly noted by Dioscorides and Pliny. It also appears, from an old Chinese manuscript, that a physician named Hoa-tho, who lived in the third century, gave his patients a preparation of hemp, whereby they were rendered insensible during the performance of surgical operations. Mandrake was extensively used as an anæsthetic by Hugo de Lucca, who practised in the thirteenth century. The soporific effects of mandrake are remarked by Shake-

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speare, who also makes frequent mention of anæsthetising draughts, the composition of which is not specified.

In 1800 Sir Humphry Davy, experimenting on nitrous oxide gas, discovered its anæsthetic properties, and described the effects it had on himself when inhaled with the view of relieving local pain. He suggested its employment in surgery, but his suggestion remained unheeded for nearly half a century.

The inhalation of sulphuric ether for the relief of asthma and other lung affections had been employed by Dr. Pearson, of Birmingham, as early as 1785; in 1818 Faraday showed that the inhalation of the vapour of sulphuric ether produced anæsthetic effects similar to those of nitrous oxide gas; and this property of ether was confirmed by the American physicians, Godman (1822), Jackson (1833), Wood and Bache (1834).

These observations, however, appear to have been regarded as mere scientific curiosities till December 1844, when Dr. Horace Wells, a dentist of Hartford, Connecticut, underwent in his own person the operation of tooth extraction while rendered insensible by nitrous oxide gas. On September 30, 1846, Dr. Morton, a dentist of Boston, employed the vapour of sulphuric ether to procure general anæsthesia in a case of tooth extraction, and thereafter administered it with complete success in cases requiring surgical operation. This great achievement marked a new era in surgery. Operations were performed in America in numerous instances under ether inhalation, the result being only to establish more firmly its value as a successful anæsthetic. The news of the discovery reached England on December 17, 1846. On December 19, Mr. Robinson, a dentist in London, and on the 21st, Mr. Liston, the eminent surgeon, operated on patients anæsthetised by ether; and the practice soon became general both in Great Britain and on the Continent.

Sir James Y. Simpson, of Edinburgh, was the first to apply anæsthesia by ether in midwifery practice. This he did on January 19, 1847, and he subsequently employed ether inhalation in numerous cases of both easy and difficult parturition, an account of which he published, containing much important information.

These observations excited great interest in the medical world, and led to the extensive employment of ether inhalation till November 15, 1847, when Simpson announced his discovery of the anæsthetic properties of chloroform (the trial of which had been suggested to

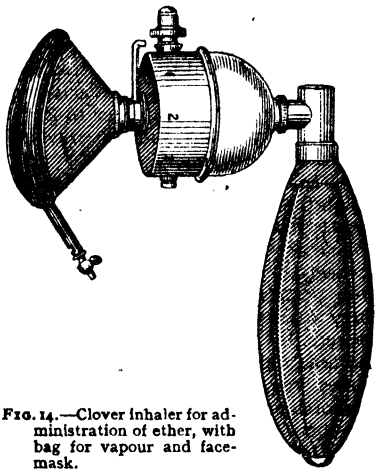


FIG. 14.—Clover inhaler for administration of ether, with bag for vapour and face-mask.

him by Mr. Waldie, a chemist of Liverpool). He proposed it as a substitute for sulphuric ether, which became for a time almost completely displaced by chloroform for anæsthetic purposes in Britain. In America, however, ether has remained the favourite drug for this object throughout. In 1858 Dr. Snow published a work, *On Chloroform and other Anæsthetics*, which was the first attempt to place the whole subject on a scientific basis. The number of fatalities which took place during the administration of various anæsthetics had by this time begun to attract attention, and mechanical inhalers designed to prevent the administration of too concentrated a vapour were invented by Clover in 1862 and Junker in 1867, modifications of which are still in use. Experiments with various other drugs were made by other men, and during the period 1860–70 a movement, starting in the United States, took place in favour of nitrous oxide or 'laughing-gas' for dental work, and this anæsthetic, firmly installed towards the end of the decade for tooth

extractions and other short operations, has never gone out of use, being reckoned one of the safest anæsthetics we possess. In 1876 Clover introduced an apparatus whereby nitrous oxide and ether could be inhaled in succession, and as the initial stages of ether administration are difficult and unpleasant, and are obviated by beginning with the gas, this instrument and method have proved of great usefulness. A combination of nitrous oxide gas and oxygen administered by special inhalers has also been introduced and found very useful, its use being admissible even for long operations. Recently the intratracheal method, by which ether vapour mixed with air is blown by a special pump in safe proportions, has been used for prolonged operations; the vapour is introduced directly into the lower air passages by a narrow tube passed through the mouth and larynx.

Other gases such as ethylene and acetylene have also been used as anæsthetics, and in mixtures with oxygen have proved safe and unirritating. Their action is similar to that of nitrous oxide, but they share with ether the disadvantage of being highly inflammable.

Of late, ethyl chloride and ether are often used in sequence, and ethyl chloride is used by itself for brief operations, *e.g.* removal of adenoids from the throat. Ethyl chloride, being very volatile, is usually administered by a mask, to which a small vial to contain 3 to 5 c.c. of ethyl chloride and a rubber bag to contain its gas are attached. About one minute is required to render the patient unconscious, but the insensibility only lasts about one and a half minutes.

Instead of administration by inhalation, certain anæsthetics can be used by injection into the rectum, and others by injection into a vein. Ether is sometimes employed, mixed with olive oil, by injection into the rectum; about 1 ounce of the mixture is used for each 20 pounds of the patient's weight, deep sleep ensues in about 20 minutes, and full anæsthesia may be obtained if necessary by inhalation of a further small amount of ether. Avertin is another anæsthetic used in a similar way, deep sleep occurring some 15 minutes after its injection into the rectum, and deep anæsthesia continuing for about an hour; for full anæsthesia it is in most cases necessary to supplement it by inhalation of ether or nitrous oxide. Paraldehyde is sometimes used in a similar manner to induce sleep before inhalation anæsthesia. Among drugs used by intravenous injection are various derivatives of barbituric acid, such as nembutal and sodium evipan, which are generally employed to induce sleep before inhalation anæsthetics, or as anæsthetics for minor operations. Morphine and scopolamine have long been used in this way. (*See* TWILIGHT SLEEP.)

A controversy took place in the end of the nineteenth century, especially in England, as to which is the safest anæsthetic. Undoubtedly nitrous oxide gas has been responsible for fewest deaths, and it is said that no death has been recorded as due to the mixture of this gas with oxygen. This anæsthetic is, however, applicable only to very short operations, and for long operations chloroform or ether, or some mixture containing one of them, must be chosen.

Statistics have been published by various authorities, which vary within wide limits, but putting together the figures collected by Julliard in Geneva and Ormsby in Dublin, we find that out of over 1,000,000 cases the deaths due to chloroform were at the rate of about 1 in 3000, while those due to ether amounted to only 1 in 16,000. These statistics go to prove that, speaking generally, ether is five times as safe as chloroform. Nevertheless there are certain classes of cases for which chloroform is better suited, and it may be said that though ether is, deservedly, more generally used for prolonged operations in hospital practice, each drug has its own field. Thus ether is very irritating to the air passages of children, of the aged, and of those suffering from lung diseases, so that its use is responsible for many deaths that take place some days after a prolonged operation; it cannot be given without cumbersome apparatus, and is therefore not suited for the battlefield, for childbed, or for cases in which the surgeon has no trained assistant, in all of which cases chloroform is more suitable.

Ether is, however, specially chosen in cases where the heart-muscle is weak.

Another great danger, which can however be avoided, lies in vomiting. If food, and particularly masses of solid food or curdled milk, be brought up into the mouth of an unconscious person, they are very liable to be drawn into the larynx, and so cause asphyxia. To prevent this risk, no food should be taken within three or four hours before administration of the anæsthetic.

Stages of anæsthesia.—Whatever be the anæsthetic employed, the effects are much the same, though some symptoms are more prominent with one anæsthetic, others with another, and in the case of nitrous oxide the initial stages are hurried over and the patient plunged almost at once into deep unconsciousness.

STAGE I.—There is great rapidity of thought, but disturbance of judgement and power of control. Giddiness, tingling, and other peculiar or pleasant sensations are felt. The patient may be emotional, or may sing, shout, or struggle, and then passes off into a dreamy state, with partial loss of sensation. The heart's action becomes stronger and the pupils dilate.

STAGE II.—There is complete loss of consciousness. The speech becomes unintelligible, changing to a mere muttering. There may be muscular spasms of various sorts, also coughing, retching, and possibly vomiting. The pupils become small.

STAGE III.—There is absolute unconsciousness and complete muscular relaxation, and in this stage surgical operations are performed. The heart's action is weakened, most reflex movements abolished, and the pupil dilates again but is still capable of contracting when the eyelid is raised so that light enters the eye.

STAGE IV.—This is the stage of danger, the breathing becomes shallow, the face pallid or livid, the heart weak and irregular, and the pupils widely dilated. If the anæsthetic be not at once removed, breathing and pulse then stop and the person dies.

Uses of anæsthetics.—The most evident use of anæsthetics is to relieve the pain of surgical operations and of convulsive diseases. Their use has made possible much more prolonged and delicate operations than could be performed upon the conscious and suffering body. An anæsthetic is also in many cases a great aid in diagnosis, particularly of abdominal conditions, producing muscular relaxation and allowing the free handling of painful regions. Anæsthetics are also used in medical practice to quiet violent spasmodic states, as in the uræmia of Bright's disease, in a succession of epileptic fits, in lock-jaw, and in strychnine poisoning. For the use of local anæsthetics see ANALGESICS.

ANALEPTIC (ἀναλῃπτικός) means a restorative or strengthening medicine, for example sal volatile, strychnine.

ANALGESIA (ἀ, neg.; ἄλγος, pain) means loss of the power to feel pain without loss of consciousness, *e.g.* in some nervous diseases or due to some drugs.

ANALGESICS are drugs or other measures which cause temporary loss of the sense of pain without unconsciousness and without necessarily loss of the sense of touch. Some act generally on the brain or the nerves to dull pain which is already present (*see* ANODYNES); others act locally, such as cocaine, eucaine, stovaine, and the process of freezing, which are used to prevent pain which would otherwise necessarily be caused by operations. In a position between that of a general anæsthetic and a local analgesic stand drugs such as morphine and scopolamine which are used for the production of a torpid, semi-insensible state like that sometimes used in childbirth. (*See* TWILIGHT SLEEP.)

Uses.—Local insensibility to pain may be produced in a considerable variety of ways, but most of these fall into one of four classes: (1) infiltration of the region to be operated upon by a solution of the analgesic drug; (2) injection of the solution into or near the nerve trunks which convey the sensations of the part; (3) painting, spraying, or rubbing the surface, especially of mucous membrane, with the drug; and (4) the application of intense cold.

The first drug to be used for local anæsthesia or analgesia in operations

was cocaine, which has certain disadvantages in that it is destroyed by boiling and that it readily causes symptoms of poisoning so that it cannot be safely used in doses over ½ grain. Procaine, also known as ethocaine, planocaine and novocain, which is an artificially prepared substance, has largely displaced cocaine because it is many times less poisonous and so can be used in larger doses. Tropacocaine can either be extracted from the coca plant or prepared artificially, and is largely used for spinal analgesia. Stovaine is another artificial preparation with similar action, which, however, has been largely abandoned because of its somewhat irritating properties. Eucaine is another artificial compound devoid of irritating properties which is much used for application to the eye, especially combined with adrenalin, which, by its constricting effect on the blood-vessels, diminishes congestion and bleeding in operations. Quinine-and-urea-hydrochloride has been employed as an analgesic in cases where a prolonged effect is desired, as its results last for several days.

When *infiltration analgesia* is employed, a weak solution of novocain is generally used to which a small amount of adrenalin is added. A long hypodermic needle is used to inject this solution in large quantity (several ounces) into and especially around the part upon which the operation is to be performed. By this means tumors can be removed, the abdomen opened, and similar serious operations, which do not involve great shock to the patient and in which general unconsciousness is not desirable, can be performed.

When general loss of sensation in a region is to be brought about by injecting a nerve trunk or its neighbourhood stronger solutions (*e.g.* novocain 2 per cent) are used in similar quantities. The large nerves of a limb are sometimes treated in this way for the prevention of the shock caused by a severe operation, even when a general anæsthetic is also employed. This method is much used for painless tooth extraction. The two methods of infiltration and regional analgesia are often combined, for example, to perform amputations below the knee or elbow or in removal of a goitre. A special method of applying the injection method is by *spinal analgesia* in which sensation is abolished temporarily in the lower limbs by injection of the drug into the spinal canal.

The *surface application* of analgesics is in general only useful in cases where operations are to be performed upon mucous membranes, such as those of the nose or throat where cocaine and eucaine can readily be applied by painting or spraying.

A transitory analgesia is produced by *freezing* the skin. This is usually effected by spraying a small area with ethyl chloride, which very quickly evaporates with the production of intense cold.

ANALYSIS (ἀνάλυσις) means a separation into component parts by determination of the chemical constituents of a substance. The process of analysis is carried out by various means, *e.g.* colorimetric analysis by means of various colour tests; densimetric analysis by estimation of the specific gravity; gasometric analysis by estimating the different gases given off in some process; polariscopic analysis by means of the polariscope; volumetric analysis by measuring volumes of liquids. Analysis is also sometimes used as an abbreviation for psychoanalysis.

ANAMNESIS (ἀνάμνησις) is the term applied to the statement of the past history of some particular case of disease.

ANAPHYLAXIS (φύλαξις, guarding) is a condition of excessive sensitiveness exhibited by certain persons or animals to the injection of foreign material into their tissues. A common example is the pain, swelling, eruption, feverishness, and general prostration which occasionally follow the injection of serum containing the diphtheria or tetanus antitoxin. An example of a slighter form of anaphylaxis is afforded by persons who suffer from nettle-rash, asthma, and similar symptoms when they take some food of which their system is intolerant, or of other persons who present similar symptoms when exposed to the emanations of certain

animals, *e.g.* horses, cats, or fowls. (*See* ALLERGY.)

ANAPLASIA means the state in which a body cell loses its distinctive characters and takes on a more primitive form; it occurs, for example, in cancer, when cells proliferate rapidly.

ANASARCA (ἀνά, up; σάρξ, the flesh) is a condition of general dropsy.

ANASTOMOSIS (ἀναστόμωσις, an outlet) is a term describing the means by which circulation is carried on when large vessels are narrowed or closed, as by pressure. In the limbs, especially around joints, and in internal organs, small arteries open freely into their neighbours to form a network from which the smallest vessels carry off the blood. By this means pressure from one side, or even the ligature of the main artery to a limb, is prevented from stopping the flow of blood to any part, because so soon as one artery is closed, the other arteries of the limb dilate, through relaxation of their muscle fibres, and the supply of blood passes on as before, but by new channels. Anastomosis is also a term describing the joining together (by operation) of any two parts of the alimentary tract, so that an artificial communication is formed between them.

ANATOMY (ἀνατομή) is the science which deals with the structure of the bodies of men and animals. Brief descriptions of the anatomy of each important organ are given under the headings of the various organs. It is studied now by dissection of the bodies of those who die in hospitals and workhouses unclaimed by relatives.

ANATOXIN, or FORMOL TOXOID, is a preparation of diphtheria toxin which has been made non-toxic by heat or by formalin. Injected into a person, it makes him immune to diphtheria.

ANDROGEN is the general term for any one of a group of hormones which govern the development of the sexual organs and the secondary sexual characteristics of the male.

ANENCEPHALY is the term given to the condition in which a child is born with a defect of the skull and absence of the brain.

ANETHUM (*see* DILL).

ANEURIN is another term for Vitamin B_1.

ANEURYSM, or ANEURISM (ἀνεύρυσμα), means a dilatation upon an artery, due to yielding of the vessel-

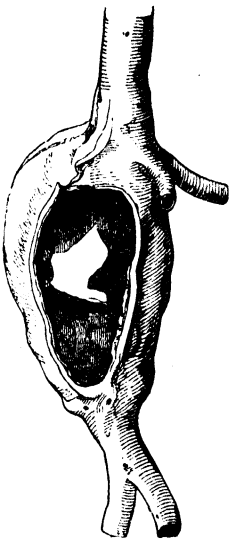


FIG. 15.—Aneurysm of fusiform type, on the abdominal aorta. The aneurysm has ruptured. (Miller's *Surgery*.)

wall and gradual stretching by the pressure of the blood.

Varieties.—There are several ways of classifying aneurysms. With reference to structure, they have been separated into *true aneurysms*, in which the vessel-wall is merely thinned and stretched but still intact, and *false aneurysms*, in which the wall has been thinned away with the increase of the hollow, till all the coats of the artery (*see* ARTERIES) have given way, and the blood is enclosed only by the greatly thickened fibrous tissues surrounding the artery. This distinction is useless, because all aneurysms of any considerable size fall into the latter class. With reference to shape, they are called *fusiform* when the artery is dilated all round for some distance, this form being common on the thoracic aorta; *sacculated* when a spot on one side has been pushed out gradually to form a sort of pouch, which is the usual

form when medium-sized arteries are affected ; *dissecting* when the inner coat has given way somewhat suddenly and blood has passed between the coats and torn its way some distance along the vessel ; *miliary* when the aneurysm is very small and looks like a millet seed on the side of the vessel, which is a form often found on the vessels in the brain. With reference to treatment, they are divided into *internal*, affecting the great vessels in the chest and abdomen, which are amenable only to general treatment; and *external*, on the vessels of the limbs and neck, which can be treated also by surgical means. Further, they are called after the regions in which they occur—*abdominal, thoracic, gluteal, popliteal, axillary*, etc.

Causes.—Within the blood-vessels there is always a great pressure, which would speedily tear the arteries were it not for their great elasticity. They stretch as the blood is forced into them, and, quickly regaining their proper size, drive the blood on and equalise the pressure at the beats and rests of the heart. As age advances the arteries gradually lose their elasticity to some extent, but, as old men cannot make the vigorous efforts of youth, the arteries still seldom give way. Some diseases, of which alcoholism, syphilis, and gout are the chief, hasten the production of this senile change, and the inner coat of the arteries becomes here and there diseased, the change being known as ' atheroma '. (*See* ARTERIES, DISEASES OF.) At these spots the elasticity is much lessened, and consequently the cause predisposing to aneurysm is present. Another predisposing cause is injury of the vessel from without by constant pressure, as by a tight garter behind the knee, or by actual wounding, but these are rare. Even a person suffering from extensive and advanced atheroma may go through life without the development of aneurysm if an exciting cause be not present. This is furnished by arduous labour, or a single great strain in lifting a weight, running after a train, and the like. Accordingly, aneurysm occurs in men (seldom in women) who have had, for some years, one or more of the diseases mentioned, and who are still in the active period of life, namely, in men about forty years of age. It affects specially men of arduous employment, *e.g.* iron workers, dock labourers, and soldiers.

Symptoms.—These vary greatly with the size and position of the aneurysm, but there are some which are characteristic of all forms. The *type of person* who suffers is a man, in eight cases out of nine, about forty years of age, who has had an arduous or irregular life, or who has been fond of athletic exercises and high living. There may be other signs of arterial disease, such as cirrhotic Bright's disease (*see* BRIGHT'S DISEASE), or a previous apoplexy. If the aneurysm be in a limb, a round *swelling* is noticed, perhaps as large as a walnut or Mandarin orange, which expands and diminishes with each heart-beat, and this peculiarity is still more evident when the hand is laid on it. The swelling is generally painless, and the skin over it is unchanged (unlike an abscess). Aneurysms rarely occur farther from the trunk than elbow or knee. If the aneurysm be internal it is situated upon a great vessel, and is often very large in size before it causes any very marked symptoms, which are mainly due to interference with surrounding organs. *Pain* is felt only when the swelling presses upon the nerves, upon the air passages, causing great breathlessness, or upon bone, wearing it gradually away. In the latter case pain may be agonising, although in early cases it is not infrequently taken for mere rheumatic pain. *Breathlessness* or *difficulty in swallowing* may occur where there is a large thoracic aneurysm, from pressure on the windpipe or gullet, also *cough* of a barking, irritating nature, and changes in the voice, from irritation or paralysis of the left recurrent laryngeal nerve. In thoracic and abdominal aneurysm, though the swelling itself cannot be seen, there is a *bulging* in the upper part of chest or abdomen, as the case may be, which can be felt to throb when one hand is placed on it in front and the other on the back ; in a later stage pulsation can also be seen. In early cases this bulging may cause the subject of an aneurysm to feel his coat too tight, especially in the left armpit, and to have it let out, though there is no other symptom to make him imagine he has any serious disease. The *aneurysmal tippet* is the name given to a network of dilated veins which appears

upon the chest and shoulders, owing to obstruction of the circulation through the great veins, by a thoracic aneurysm. *Swelling of the skin* or œdema is found with all aneurysms sooner or later from the same cause. Many other signs, such as inequality of the pupils, differ-

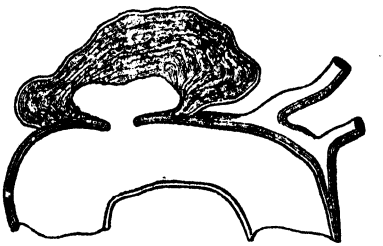


FIG. 16.—Aneurysm of sacculated form on the arch of the aorta. The aneurysm is undergoing natural cure, and is almost filled by firm clot deposited in layers. (Miller's *Surgery*.)

ence in the pulse on the two sides of the body, and murmurs heard over the swelling are present in different aneurysms, but can be appreciated only by the trained observer. Aneurysm is a serious disease, alike because it is apt to cause great interference with other organs; because it may at any time burst and cause sudden death from bleeding into the loose tissues or cavities of the body; and because it is a sign that the arteries are extensively diseased, and the person unfit for active work. The duration of life is generally only a few years, though it may be prolonged for twenty if the aneurysm fills up with clot, which forms a natural method of cure.

Treatment. — (*a*) MEDICAL. — Although the aneurysm tends constantly to increase, another tendency is for the blood in contact with the unhealthy wall to clot. If this be encouraged, the aneurysm may become a solid mass, which practically may be looked on as a cure, because there is no more tendency to grow or to burst. To this end the circulation must be quieted by rest in bed, freedom from business or worry, very spare diet without any stimulants, and depressant drugs like iodide of potash. Further, the tendency of the blood to clot is increased by taking salts of lime, and possibly by gelatine, and also by drinking as little fluid as possible, which has the other benefit of lessening the bulk and pressure of the blood. The regime prescribed by Tufnell consisted of absolute rest, with a diet of only 10 ounces of solid food and 8 ounces of fluid in the day.

(*b*) SURGICAL.—Surgical means are applicable only when the aneurysm is on an artery traversing the limbs or neck. The ancient method was to open the aneurysm, clear out the contained blood and clots, and tie the vessel above and below it; but this has been found both dangerous and unnecessary. The principal methods now employed are the following. *Pressure* on the artery between body and aneurysm, kept up for many hours or some days, so as to diminish the force of the blood stream and allow a clot to form in the aneurysm; this method is not very successful, and is very tedious. *Ligature* of the artery, either on the side next the body, when the circulation to the limb is carried on by anastomosis (*see* ANASTOMOSIS), and a clot forms in artery and aneurysm; or, beyond the aneurysm, when the artery, in consequence of a physiological law, dwindles, and a clot can form in the aneurysm. One of these is the most usual method. *Irritation of the wall* of the aneurysm by fine needles, which are pushed into it, and by which the inner surface is systematically scratched, so that clotting is started, or by the injection of various substances for the same purpose. With any surgical procedure the medical means are of course combined.

ANGINA (ἄγχω, I strangle) means literally choking, and is a term applied to swellings of the throat or other cause of difficulty in breathing, as *tonsillar angina* or quinsy, *laryngeal angina* or laryngitis, *membranous angina* or croup, *anginal scarlatina* or scarlet fever with abscesses round the throat.

ANGINA PECTORIS is a term applied to a violent paroxysm of painful sensations in the chest, arising for the most part in connection with disease of the coronary arteries.

Causes.—Angina pectoris is generally held to result from ischæmia of the heart muscle consequent upon narrowing of the coronary arteries. It seems occasionally to manifest itself where no organic heart disease is discoverable, either in life or after death, but in the great majority of cases some morbid

condition of the heart's structure is undoubtedly present. A diseased state of the coronary arteries, the nutrient blood-vessels of the heart, has been found in a large proportion of the cases examined *post mortem*; but, on the other hand, these arteries may be found diseased where no paroxysm of angina had ever occurred; and further, it is well known that various other forms of heart disease may have angina pectoris associated with them as a prominent symptom, particularly disease of the aortic valve and aneurysm situated at the commencement of the aorta. Angina pectoris is extremely rare under middle life, and is much more common in males than in females. It must always be regarded as a disorder of a very serious nature.

Symptoms.—An attack of angina pectoris usually comes on with a sudden seizure of pain, felt at first over the region of the heart, but radiating through the chest and frequently extending down the inner side of the left arm. A feeling of constriction and of suffocation accompanies the pain, although there is seldom actual difficulty in breathing. When the attack comes on, as it often does, in the course of some bodily exertion, the sufferer is at once brought to rest, and during the continuance of the paroxysm experiences the most intense agony. The countenance becomes pale, the surface of the body cold, the pulse feeble, and death appears to be imminent, when suddenly the attack subsides, and complete relief is obtained. The duration of a paroxysm rarely exceeds two or three minutes, but it may last for a longer period. The attacks are apt to recur on slight exertion, and even in aggravated cases without any such exciting cause. Occasionally the first seizure proves fatal; but more commonly death takes place only after repeated attacks.

Treatment.—In the treatment of the paroxysm much relief is obtained by the inhalation, under proper precautions, of anæsthetic vapours, such as ether, chloroform, and nitrite of amyl. Persons liable to suffer from attacks of angina should always carry with them the small glass 'perles' of nitrite of amyl, which are intended to be crushed in the hand and inhaled whenever needful. To prevent the recurrence of the attacks, something may be done by scrupulous attention to the state of the general health, and by the avoidance of mental or physical strain.

ANGIOMA (ἀγγεῖον, a blood-vessel) is a tumor composed of blood-vessels. (*See* TUMOR *and* NÆVUS.)

ANGIONEUROTIC ŒDEMA is a condition of localised dropsy, which is sometimes allied to nettlerash, and sometimes a symptom of neuritis. (*See* NETTLERASH *and* NEURITIS.)

ANGITIS, or ANGIITIS (ἀγγεῖον, a vessel), means inflammation of a vessel such as a blood-vessel, lymph-vessel, or bile-duct.

ÅNGSTRÖM UNIT, Å.U. (called after Swedish physicist), is a measurement of length and equals $\frac{1}{10000}$ micron, or one hundred-millionth of a centimetre. It is represented by the symbol λ and is used to give the length of electro-magnetic waves, light waves lying within the range of 4000 to 8000 Å.U.

ANHIDROSIS is the condition in which there is an abnormal diminution in the secretion of sweat.

ANHYDRÆMIA is the term used to describe an abnormal loss of water from the blood.

ANILINE is a substance derived from indigo by distillation, from coal-tar by extraction, or manufactured from benzene. It is a colourless liquid, with peculiar aromatic smell and burning taste. From it many vivid and beautiful dyes are made and extensively used, such as fuchsine or rosaniline, eosine, magenta, Congo red, methyl blue, Hofmann's violet. Aniline itself is a narcotic poison, though most of the colours are harmless in moderate amount. In some persons the dyes, when brought into constant touch with the skin, as in coloured stockings, scarves, etc. (especially red and black goods), cause excessive irritation and eruptions, such as eczema, boils, wheals, which are very difficult to get rid of. Probably these are due, not to the aniline, but to the presence of arsenic, which is used in the process of manufacture, and in cheap dyes not completely removed.

ANIMAL FOOD (*see* DIET, NITROGENOUS FOOD).

ANIMAL HEAT (*see* TEMPERATURE, SKIN, MUSCLES).

ANISE is the dried fruit of *Pimpinella anisum* or of *Illicium anisatum*, a Chinese plant, from which is obtained a volatile oil much used in the form of anise water and spirit of anise for a flavouring agent in some mixtures, and especially as a remedy for colic in children. (*See* OILS.)

ANKLE is the joint between the leg bones (tibia and fibula) above, and the astragalus (the Roman dice-bone or talus) below. It is a very strong joint with powerful ligaments binding the bones together at either side, many sinews running over it, and bony projections from the leg bones, which form large bosses on either side, called the outer and inner malleoli, extending about half an inch below the actual joint. It is therefore very seldom wounded or dislocated. Two common injuries near the ankle are a sprain, on the inner side, consisting of tearing of the internal ligament; and fracture of the fibula (Pott's fracture) on the outer side. (*See also* JOINT DISEASES.)

ANKYLOSIS (ἀγκύλος, crooked) is a term meaning the condition of a joint in which the movements are restricted by fibrous bands, or by malformation, or by actual union of the bones. (*See* JOINT DISEASES.)

ANKYLOSTOMA (ἀγκύλος, crooked; στόμα, mouth) is a parasitic worm. (*See* PARASITES.)

ANODYNES (ἀ, neg.; ὀδύνη, pain) are curative measures which soothe pain. They act by removing the cause of pain, by soothing the irritated nerves of the painful part, or by paralysing the part of the brain by which the painful impression is received. Substances which destroy the power of feeling altogether are called 'anæsthetics', those which destroy only the power of feeling pain are 'analgesics'.

Varieties.—Alkaline applications are anodynes to gouty joints, bee-stings, etc. Prolonged application of either cold or heat is an anodyne in inflammation. Aconite, belladonna, chloral, chloroform, cocaine, eucaine, camphor and menthol, and opium are local anodynes, while internally these drugs, as well as bromides, butyl chloral, Indian hemp, gelsemium, hyoscyamus, and various artificial products like phenacetin, exalgin, and antipyrine soothe pain in distant parts.

Uses.—Opium is the oldest and most powerful anodyne, but can only be used in cases of excessive pain, because it temporarily unseats the mind. Bromides and chloral dull pain, but with it the mental faculties, so that they also interfere with the performance of everyday duties. Phenacetin, exalgin, and antipyrine seem to have the power of dulling only that part of the brain which perceives the pain, and so are most suitable in slighter pains which do not incapacitate though they interfere with ordinary duties. Butyl chloral and gelsemium (derived from the jasmine plant) have a special soothing action in facial neuralgia. For further details see NEURALGIA, HEADACHE, INFLAMMATION, etc.

ANOPHELES is the generic name of a widely distributed group of mosquitoes, certain species of which transmit to man the infecting agent of malaria. *Anopheles maculipennis* and *A. bifurcatus* are both found in England and can both transmit the malaria parasite.

ANOREXIA (ἀ, neg.; ὄρεξις, appetite) means loss of appetite. (*See* APPETITE.)

ANOSMIA (ἀ, neg.; ὀσμή, smell) means loss of sense of smell. (*See* NOSE, DISEASES OF.)

ANOXÆMIA means deficient aeration of the blood in consequence of insufficient pressure of oxygen in the surrounding air, as, for example, at great elevations.

ANOXIA is the term applied to that state in which the body tissues have an inadequate supply of oxygen. This may be because the blood in the lungs does not receive enough oxygen, or because there is not enough blood to receive the oxygen, or because the blood stagnates in the body.

ANTACIDS are medicines which correct acidity, either general or stomachic. (*See* ACIDITY, ALKALIES, DYSPEPSIA.)

ANTAGONISM means the principle that certain drugs, whose actions are almost opposite to those of others, diminish the effect of these others when

the two are administered together. For example, the effects of strychnine are antagonised by chloral or bromides. (*See* ANTIDOTES.)

ANTE- (*ante*) is a prefix meaning before or forwards.

ANTEFLEXION (*ante*, before; *flexio*, a bend) means the abnormal forward curvature of an organ in which the upper part is sharply bent forward. The term is especially applied to an abnormal shape of the uterus.

ANTENATAL (*ante*, before; *natus*, born) is a term applied to conditions occurring before birth. It is used with reference both to mother and child. For Antenatal Clinics see MATERNITY AND CHILD WELFARE.

ANTEVERSION (*ante*, before; *verto*, I turn) is the term applied to the forward tilting of an organ, especially of the uterus.

ANTHELMINTICS (ἀντί, against; ἕλμινς, a worm) are substances which cause the death or expulsion of parasitic worms. (*See* PARASITES.)

ANTHIOMALINE. Lithium antimony thiomalate, in a 6 per cent solution. A drug which has been used in the treatment of lymphogranuloma inguinale, schistosomiasis, trypanosomiasis, filariasis, trachoma. In the first three of these conditions favourable results were reported in 1943. The drug has a low toxicity.

ANTHRACOSIS (ἄνθραξ, coal) is the change which takes place in the lungs and bronchial glands of miners, and others, who inhale coal dust or smoke constantly. The affected tissues change in colour from greyish pink to jet black, owing to loading with minute carbon particles. This fine form of dust appears to be almost devoid of any harmful effect.

ANTHRAX (ἄνθραξ, coal) is a name used for two diseases which resemble one another slightly, one being carbuncle (*see* BOILS), the other being known also as malignant pustule, woolsorter's disease, splenic fever, or murrain. The latter will be described here. It is a very serious disease occurring in South American and Australian sheep and cattle, and in those who tend them or handle the skins and fleeces, even long after removal of the latter from the animals. It has also broken out occasionally in epidemics among woolsorters or cattle-tenders. In 1880 the occurrence of several cases among woolsorters at Bradford led to an official inquiry by the Local Government Board in England, and an elaborate investigation into the pathology of the disease.

Causes.—The cause is a bacillus (*B. anthracis*) which grows in long chains and produces spores of great vitality. These spores retain their life for years, in dried skins and fleeces; they are not destroyed by boiling or freezing, nor by 5 per cent carbolic lotion, nor, like many bacilli, by the gastric juice. The disease is communicated from a diseased animal to a crack in the skin, *e.g.* of a shepherd or butcher, or, when it occurs in busy commercial centres, from contact with skins or fleeces. Nowadays skins are handled wet, but if they are allowed to dry, so that dust laden with spores flies off and is inhaled by the workers, an internal form of the disease results. Instances have occurred of the disease being conveyed on shaving brushes made from bristles of diseased animals.

Symptoms.—(*a*) EXTERNAL FORM.—This is the 'malignant pustule'. After inoculation of some small wound, a few hours or days elapse, and then a red, inflamed swelling appears, which grows larger till it covers half the face or the breadth of the arm, as the case may be. Upon its summit appears a bleb of pus, which bursts and leaves a black scab, perhaps half an inch wide. There is at the same time great prostration and fever. The inflammation may last ten days or so, when it slowly subsides and the patient recovers, if he has not died from the fever and prostration.

(*b*) INTERNAL FORM.—This takes the form of pneumonia with hæmorrhages, when the spores have been drawn into the lungs, or of ulcers of the stomach and intestines, with gangrene of the spleen, when they have been swallowed. It is usually fatal in two or three days.

Treatment.—Prevention is most important by disinfecting with superheated steam all contaminated fleeces, and all fleeces coming from a district

where the sheep have anthrax. All hides should be handled wet, so that spores cannot fly about in dust; for the internal form is four times as fatal as the external. The hands of workmen must be carefully washed before eating, and working clothes changed. By these means the number of deaths from anthrax, in the English woollen manufacturing districts, has been reduced to a tenth of the number that occurred fifty years ago, before the disease was understood. *The external form* is treated by opening up the pustule, or cutting it right out while it is small, and cauterising the wound or applying strong antiseptics. *The internal form* must be treated by supporting the strength and stimulating the vital powers, till it passes off or death occurs. An antitoxic serum can be used for treatment of severe cases.

ANTI- (*ἀντί*, against) is a prefix meaning against.

ANTIBODIES are substances in the blood which destroy or neutralize various toxins or 'bodies' (*e.g.* bacteria), known generally as antigens. The antibodies are formed, usually, as a result of the introduction into the body of the antigens to which they are antagonistic, as in all infectious diseases.

ANTIDIPHTHERITIC SERUM (*see* SERUM THERAPY).

ANTIDOTES (*ἀντί*, against; *δίδωμι*, I give) are remedies which neutralise the effects of poisons either (*a*) by changing the poisons into harmless substances through chemical action, or (*b*) by setting up an action in the body the opposite of that caused by the poison.

Uses.—(*a*) The first class, in which the poisons are acted on by the antidote in the stomach, includes most of the poisons except the very deadly vegetable alkaloids. Thus acids have alkalies as antidote and *vice versa*; arsenious acid has dialysed iron or magnesia; corrosive sublimate has white of egg, milk, or flour; oxalic acid has chalk or magnesia; sugar of lead has Epsom salts; tartar emetic has tannin. (*b*) Among the very deadly poisons (*see* ALKALOIDS) the antidote to one is generally a powerful poison itself, and the actions do not neutralise one another precisely in every respect. Calabar bean has for its antidote atropine; prussic acid also has atropine; muscarine (the poison of toadstools) also has atropine; opium and morphia, too, have atropine; strychnine has chloral or chloroform; chloral has strychnine; chloroform has nitrite of amyl; curare or Indian arrow-poison has strychnine; cocaine has morphia; and digitalis has aconite and nitrites.

ANTIFEBRIN (*see* ANTIPYRIN).

ANTIGEN is the term applied to a substance which causes the formation of antibodies, that is bodies which act in opposition to poisons formed in the body or introduced from outside.

ANTIKAMNIA is a remedy of antipyretic properties containing sodium, caffeine and acetanilid. It is administered in doses of 4 to 10 grs.

ANTIKETOGENIC is the term applied to foods and remedies which prevent or decrease the formation of ketones, *i.e.* bodies related to acetone.

ANTIMONY is the name applied to a metal and also to its sulphide, a black powder found in nature. The tartrate of potassium and antimony is commonly known as 'tartar emetic' in reference to its chief property. The preparations of antimony are all irritants, hence in large doses they are poisons, producing vomiting, purging, and also paralysis of the heart and nervous system. In moderate amounts they stimulate secretions from the bronchial tubes, intestine, and skin, and thus ease cough, move the bowels, and cause free perspiration.

Uses.—Antimonial wine, and antimonial or James's powder were formerly used in fevers with hot, dry skin to cause perspiration and fall of temperature. In bronchitis, especially in children, they were employed to reduce the cough and fever. The dose of antimonial wine is about half a teaspoonful for an adult, or 3 drops for a child one year old.

Tartrate of antimony and potassium and tartrate of antimony and sodium are much used in a dose of $\frac{1}{2}$ to 2 grains by intravenous injection against diseases caused by protozoan parasites.

ANTIPERIODICS are drugs which tend to prevent the repetition of attacks of diseases occurring at stated periods. The term is used generally with reference to malaria.

ANTIPERISTALSIS is a term meaning a movement in the bowels and stomach by which the food and other contents are passed upwards, instead of in the proper direction. (*See* PERISTALSIS.)

ANTIPHLOGISTICS (*ἀντί*, against; *φλέγω*, I burn) is an old term meaning remedies used against inflammation, fever, and similar conditions.

ANTIPYRETICS (*ἀντί*, against; *πυρετός*, a fever) are measures used to reduce temperature in fever.

Varieties.—Cold-sponging, wet-pack, baths, alcohol, aconite, diaphoretic drugs, antipyrine, antifebrin, phenacetin, quinine, salicylate of soda, and purgative drugs.

Uses (see under above headings).

ANTIPYRINE, or PHENAZONUM, is one of many drugs derived from coal-tar, which are of crystalline form, and possess the following properties. They reduce temperature, dull pain, and cause profuse perspiration by their action upon the nervous system.

Uses.—Antipyrine is rapid and certain in action and widely used. It produces, especially, the action of dulling pain and reducing temperature, and so is used for neuralgia, toothache, headache, and general conditions of pain with slight fever. It is also used in sea-sickness. The dose is 5 grains once or twice repeated.

When antipyrine has been taken in an over-large dose, it produces failure of the heart, with blueness of the lips and nails and threatened collapse. Skin eruptions also occur, and sometimes agranulocytosis.

ANTISCORBUTIC is the term applied to foods and remedies which have the power of preventing or curing scurvy.

ANTISEPTICS (*ἀντί*, against, and *σηπτός*, putrid, from *σήπω*, I make rotten) are substances which have the property of preventing or arresting putrefaction in dead animal or vegetable matter. The access of air, together with a moderate amount of warmth and of moisture, is necessary to the occurrence of the putrefactive changes, which consist essentially in the breaking up of the complex organic material, and the formation of new and simpler combinations among its constituent elements. During the process, various gases and vapours are evolved, and the lower forms of animal and vegetable life are observed to grow and multiply in the putrefying substance. The exciting causes of putrefaction formed, for centuries, a subject of scientific discussion, but the changes which take place are now known, as the result of Pasteur and Tyndall's labours, to depend upon the growth and activity of micro-organisms. (*See* BACTERIOLOGY.) The changes which take place in a wound when organisms gain entrance to it and flourish upon its discharges were first demonstrated by Semmelweiss in 1847 and are collectively known as sepsis or septic processes. (*See* ABSCESS.)

Varieties.—By exclusion of the air or even by covering from germ-laden dust, dead matter that does not already contain bacteria may be kept intact for an indefinite time, as shown in the method of preserving meat by hermetically sealing the jars, after destruction of all germs by heat. Again, the preservative influence of a low temperature is well known; and extreme cold is a powerful antiseptic, as proved in the case of the frozen mammoths of northern Asia. Furthermore, the abstraction of moisture will prevent corruption in dead material. In warm and dry climates, animal food may be preserved by exposure to the sun. In the ancient practice of embalming the dead, which is the earliest illustration of the systematic use of antiseptics, the moister portions of the body were removed before the preservative agents were added. The action of direct sunlight is highly destructive to bacteria, having more effect upon some kinds than upon others. All these agencies are detrimental to the growth of bacteria.

Reliance is chiefly placed for practical purposes on heat and chemical substances which destroy bacteria. Many substances which are strong antiseptics are of little practical use, either because they produce changes on the fluids with which they come in contact of such a

nature as to hinder their further action, or because they are too irritating or too destructive when they come in contact with tissues of the body. Further, some antiseptics act strongly upon certain organisms and less effectively upon others, so that the value of an antiseptic varies in different circumstances.

HEAT is one of the most effective antiseptics and may be applied at a temperature of 100° to 150° centigrade. Dry articles to be disinfected may be brought into contact with steam under pressure, or more simple articles to be preserved from decomposition or sterilised may be boiled for a short period. This method is, however, obviously inapplicable to the living body and to many fragile articles.

BORACIC ACID is a weak antiseptic which is much used because of its non-poisonous and unirritating qualities. It is also frequently added to food as a preservative. It may be used up to the full strength at which it dissolves in cold water, *i.e.* 1 part in 30 of water.

CARBOLIC ACID, originally introduced by Lord Lister, is a powerful antiseptic. 1 part in 100 of water will in the course of some hours kill most bacteria. Up to a strength of 1 part in 20 of water it may be brought in contact with tissues for a short time, but even this strength is dangerous for prolonged application.

MERCURIC SALTS are among the most powerful antiseptics. Perchloride of mercury may be used for washing the hands in strength 1 in 1000 of water. For lotions to be applied to the eyes, nose, and mouth, or for vaginal douching it may be used in strength 1 in 10,000. Even in the strength of 1 part in 100,000 of water it kills almost all bacteria in a few minutes. The biniodide and cyanide of mercury are also used either in lotions of similar strength or by saturating lint, gauze, or wool for application to wounds. The disadvantage of mercuric salts is that though very powerful they are highly irritating, and secondly, that they are precipitated and rendered useless by the albumens of discharges with which they come in contact.

CRESOL, TRICRESOL, or CRESYLIC ACID is a mixture of substances obtained from coal-tar, which is both stronger and less poisonous than carbolic acid. Various preparations sold under proprietary names, such as CREOLIN, CYLLIN, JEYES' FLUID, ACROSYL, and IZAL, are of similar nature and widely used. They are all dark oily liquids which form a white milky emulsion in water. LYSOL and some others contain fluid soap which aids their cleansing and penetrating action. For surgical purposes the usual strength is 1 part in 100 or 200 of water. For general disinfection these substances may be used weaker. TAR WATER is a popular antiseptic often used for the cresols and similar substances that it contains.

HYDROGEN PEROXIDE has the double merit of being a strong antiseptic and at the same time unirritating. It may be freely applied to mucous membranes in the full pharmacopœial strength, although, even when considerably diluted with water, it is still a powerful germicide. It is essential that it should be fresh, as it rapidly deteriorates by losing oxygen.

IODINE is a strong antiseptic and is specially used in the form of tincture of iodine (2½ per cent strength) or strong tincture of iodine (10 per cent strength). The strong tincture is usually applied to the skin, the weak tincture to mucous membranes.

IODOFORM has the power of checking septic changes when discharges come in contact with it, probably by its power of giving off iodine. It is sometimes used to impregnate gauze for filling abscesses and other cavities.

CHLORINE GAS is a powerful antiseptic often used to disinfect a room, while CHLORINATED LIME, which gives off chlorine gas, is much used to disinfect drains. Chlorine has the disadvantage of being very irritating and of bleaching and destroying many substances, *e.g.* cloth, leather, etc., with which it comes in contact. SULPHUR DIOXIDE GAS, obtained from burning sulphur, is highly antiseptic and is used in the same way.

FORMALDEHYDE is one of the most powerful antiseptics, and dissolved in water is used in spray for disinfection of walls and furniture. It is also used in throat lozenges. It is excessively irritating, and therefore cannot be used as an antiseptic for application to the tissues.

POTASSIUM PERMANGANATE is one of

the most commonly used antiseptics in strength of 1 part in 1000 of water or weaker as a gargle, douche, and as a wash for the hands, etc.

ACRIFLAVINE, PROFLAVINE, BRILLIANT GREEN, and other aniline dyes have a powerful action as antiseptics and have also a gentle stimulating action on the tissues. They can be used in strength of 1 part in 1000 of normal saline, and they can be mixed with various other antiseptics without detriment.

HYPOCHLOROUS ACID, under such names as EUSOL, DAKIN'S SOLUTION, etc., is much used and very effective for septic wounds.

ALCOHOL is a powerful antiseptic, and like ETHER is used for removing septic matter and grease from the skin.

NITRATE OF SILVER is a powerful antiseptic much used for lotions, eye drops, etc., in the strength of 1 part in 500 or 1000 of water. Other silver salts which are less irritating to the tissues are used in a similar way.

SALTS OF COPPER, SALTS OF IRON, SALTS OF LEAD, CHLORIDE OF ZINC, and compounds of most of the heavy metals act as strong antiseptics, but most of them, on account of their irritating or poisonous action, are not readily applicable for this purpose.

BALSAM OF TOLU, BALSAM OF PERU, and other aromatic substances are powerful antiseptics often used for application to surface wounds, but too expensive for general use.

Uses.—Antiseptics act in various ways. Some of them kill bacteria by drying them, *e.g.* common salt and syrup used as preservatives extract water from bacteria and thus kill them; other antiseptics kill bacteria by oxidation, *e.g.* hydrogen peroxide, potassium permanganate; others coagulate the fluids in and around bacteria, *e.g.* perchloride of mercury; and still others act as bacterial poisons, *e.g.* cresol. The practice of using antiseptics has been in vogue for thousands of years. Thus cedar oil, tar, and resins were in use among the Egyptians. Pitch, copper salts, vinegar, etc., were used for wounds by the Romans, while the fumes of sulphur for purification, and salt as a preservative of food have been employed from the earliest times. Many of the stronger and more irritating antiseptics are now used as disinfectants. (*See* DISINFECTION.) Lord Lister was the first after 1865 to place the subject upon a scientific basis, using particularly for surgical work carbolic and boracic acids. The technique of operations and surgical procedure has naturally advanced far since that time, but these two substances have retained their place as valuable antiseptics. The method of applying antiseptics in surgery is somewhat as follows: The surgeon's hands, and those of every one who is to handle the patient or any instrument or dressing, are purified by washing most thoroughly with soap and water, especial care being taken to clean the crevices about the nails. Then some use ethereal soap, and the majority complete the procedure by steeping the hands in solution of perchloride of mercury. The skin of the patient is cleansed by shaving and then washing in a similar manner, the cleansing being generally, if possible, performed on the day prior to the operation, after which the skin is covered by a dressing and often painted with iodine solution before the operation. Instruments are sterilised by boiling or by steeping in alcohol or cresol lotion, and all dressings are sterilised by steam or dry heat, or are impregnated before use with some antiseptic, such as salicylic acid, boracic acid, or cyanide or perchloride of mercury. By these means it is ensured that no substance which contains germs comes in contact with the operation wound. (*See also* ASEPSIS.)

ANTISPASMODICS (ἀντί, against; σπάσμα, a spasm) are remedies which diminish spasm. The majority act upon muscular tissue to relax it, or make its contractions regular, others dull the nervous system when its irritability is the cause of the spasm. Antispasmodics, which relieve the spasm of colic, are called carminatives.

Varieties.—Essential vegetable oils, such as oil of lavender, of peppermint, of cloves, and also valerian and camphor, diminish the sensitiveness of the nerve endings and so check irritable spasm of the heart and bowels. Alcohol, ether, chloroform, and nitrite of amyl have a powerful paralysing action on nerve endings and on muscle, and therefore are used, the last three especially by

inhalation, in cases of excessive spasm such as gall-stone and renal colic. Nitrite of amyl relieves instantaneously the spasm of angina pectoris. Opium, belladonna, Indian hemp, and hyoscyamus have an equally powerful, but not so rapid action, and are given in these conditions, or, in small quantity, with purgatives which cause griping, so as to diminish this unpleasant effect. Conium, lobelia, stramonium, and tobacco, in burning, give off sedative substances, and are used in the various 'asthma cures'. Bromides are general sedatives to the brain and nerves, and are used in epilepsy and convulsions generally.

ANTITOXINS, ANTITOXIC SERUM (*ἀντί*, against; *τοξικόν*, arrow poison). (*See* SERUM THERAPY.)

ANTIVENINE is a substance produced by the injection of snake venom into animals in small but increasing doses. In course of time the animal becomes immune to the particular venom injected, and the antivenine prepared from its serum is highly effective in neutralising venom injected by the bite of a snake of the same species. To be of any use, it must be administered within one hour of the snake bite.

ANTROSTOMY is the term applied to the operation in which an opening is made through the nose into the Antrum of Highmore. (*See* ANTRUM.)

ANTRUM (*ἄντρον*, a cave) means a natural hollow in a bone. *Antrum of Highmore* is situated in the upper jawbone between the eye and mouth and to the side of the nose, its dimensions being about one inch each way. (*See* NOSE, DISEASES OF.) It communicates by a small opening with the nose. The *mastoid antrum* is situated in the mastoid process, the mass of bone felt behind the ear, and is much smaller. The latter is very apt to become the seat of an abscess in cases of suppuration of the middle ear. (*See* EAR, DISEASES OF.)

ANURIA is a condition in which no urine, or very little, is voided for some time. (*See* BRIGHT'S DISEASE, URINE.)

ANUS is the opening at the lower end of the bowel. It is kept closed by two muscles, the external and internal sphincters. The latter is a muscular ring which extends about an inch up the bowel, is nearly ½ inch thick, and is kept constantly contracted by the action of a nerve centre in the spinal cord. Constipation is sometimes due to its failure to relax; while in disease of the spinal cord the muscle may be paralysed and inability to retain the motions results.

ANUS, DISEASES OF (*see* RECTUM, DISEASES OF).

AORTA (*ἀορτή*) is the large vessel which opens out of the left ventricle of

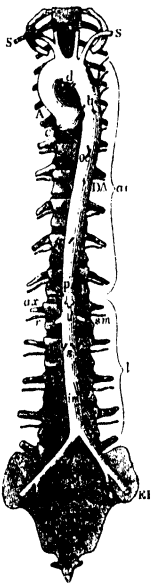


FIG. 17.—Aorta with its branches, showing its position in front of the spinal column. *A*, Ascending part of arch; *DA*, descending thoracic aorta; *AA*, abdominal aorta; *M*, middle sacral artery; *SS*, subclavian arteries; *C*, carotid arteries; *I*, common iliac, dividing into *EI*, external, and *II*, internal iliac arteries; *c*, coronary artery; *d*, obliterated ductus arteriosus uniting the aorta to the pulmonary artery; *b*, bronchial artery; *oe*, œsophageal artery; *ai*, series of aortic intercostal arteries; *l*, series of lumbar arteries; *p*, phrenic arteries to diaphragm; *ax*, opposite cœliac axis; *r*, renal arteries, with suprarenal arteries above; *s*, spermatic arteries; *sm*, opposite superior mesenteric artery lying between the renal arteries; *im*, inferior mesenteric artery. (Turner's *Anatomy*.)

the heart and carries blood to all the body. It is about 1½ feet long and one inch wide. Like other arteries it possesses three coats, of which the middle one is much the thickest. This consists partly of muscle fibre, but is mainly composed of a very elastic substance, called elastin. The aorta passes first to the right, and lies nearest the surface behind the end of the second right rib-cartilage; then it curves backwards and to the left, passes down behind the left lung close to the backbone, and through an opening in the diaphragm into the abdomen, where it divides, at the level of the navel, into

the two iliac arteries, which carry blood to the lower limbs. Its branches, in order, are: two coronary arteries to the heart wall; the innominate, left common carotid and left subclavian arteries to the head, neck, and upper limbs: several small branches to the œsophagus, bronchi, and other organs of the chest; nine intercostal arteries which run round the body between the ribs; five lumbar arteries to the muscles of the loins; cœliac axis to the stomach, liver, and pancreas; two mesenteric arteries to the bowels; and suprarenal, renal, and spermatic arteries to the suprarenal body, kidney, and testicle on each side. From the termination of the aorta rises a small branch, the middle sacral artery, which runs down into the pelvis, and may, in a sense, be regarded as the continuation of the aorta. In the female the ovarian arteries replace the spermatic.

The chief diseases of the aorta are atheroma and aneurysm. (*See* ARTERIES, DISEASES OF, *and* ANEURYSM.)

AORTITIS means a degenerative condition of the lining of the aorta. It is especially produced by syphilis.

APERIENTS (*aperio*, I open) are medicines which produce a natural movement of the bowels. (*See* CONSTIPATION *and* PURGATIVES.)

APEX is the pointed portion of any organ which has a conical shape. The apex of each lung reaches about one and a half or two inches above the collar-bone into the neck. (*See* CONSUMPTION.) The apex of the heart should be found beneath the fifth rib a fraction of an inch inside the nipple. It is displaced in some diseases. (*See* HEART DISEASE.)

APHAKIA, or APHACIA, is a term which means absence of the lens of the eye.

APHASIA (ἀ, neg.; φημί, I speak) means a loss of the power of speech, due to injury to the centres which govern this act in the brain. The higher of these centres, which have to do with forming the ideas of speech, putting words together in sentences, and governing the movements of mouth, tongue, and larynx, lie on the surface of the cerebral hemispheres, especially of the left; while the lower centres, which directly bring the muscles of the voice organs into action, under superintendence of the higher ones, are in the medulla or hind brain.

Causes.—The cause is destruction of a portion of the brain, including one of these higher centres, owing to rupture of a blood-vessel, and hæmorrhage into the brain tissue; or owing to blocking of a blood-vessel by an embolus (see EMBOLISM), or by clotting of the blood on the diseased wall of a vessel (*see* THROMBOSIS), any one of which cuts

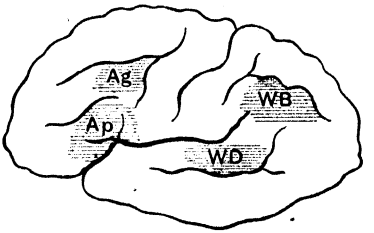


FIG. 18.—Diagram showing the areas of the brain affected in various forms of aphasia. *Ap*, with motor aphasia; *Ag*, with loss of power to write correctly; *WB*, with word blindness; *WD*, with word deafness.

off the supply of blood to the part concerned. The causes are thus the same as in apoplexy, and aphasia may be one of the symptoms of an apoplectic seizure, especially when the right side of the body is paralysed, or may occur by itself, according to the extent of brain involved. Other diseases, such as tumors, may also be the cause, the important factor being interference with the functions of certain definite areas of the brain.

Varieties.—It was first pointed out by Broca that the inferior frontal convolution on the left side of the brain in right-handed persons, and *vice versa*, is, after death, found to be diseased in those who have, in life, suffered from inability to speak, although the intelligence and powers of silent reading and of writing may have remained. Such a condition is known as *motor aphasia*. But the state is generally more complicated. In addition to Broca's convolution, which governs the movements of the tongue, mouth, and larynx that frame words to express ideas, there is a centre in the middle frontal convolution of the left side, which regulates the power of writing intelligibly, and disease of this region produces loss of

power to write rationally, even though the hand remain quite able to hold a pen, this condition being known as *agraphia*. These two forms involve loss of power of *production* of speech and writing, but there are corresponding losses of power of *perception* known as *word blindness* and *word deafness*, the two conditions being grouped together as *sensory aphasia*. In the former of these the afflicted person is unable to read correctly, though his vision is perfect, and he may be able to spell and even to write, though not to read what he writes. This condition is due to disease in the angular convolution. In word deafness the disability consists in failure to understand what is said, and, though the sufferer hears perfectly, the sounds are to him like those of a foreign tongue, which he does not understand; in this case the disease lies in the superior temporal convolution. There are still more complicated forms in which the disease affects, not the surface of the brain, but the strands of nerve fibres, which run from one centre to another, and reduce the working of the whole arrangement to a system.

Symptoms.—The disorder generally follows an attack of apoplexy and exists along with some paralysis on the right side of the body. When the right side of the brain, on the other hand, is injured, the result is paralysis on the left side of the body, accompanied usually by more or less *amnesia* or forgetfulness. *Aphasia* may come on suddenly and last only a few hours or days, being due then to a passing congestion of the brain, or to a block in the circulation, which is later swept away. Generally it is permanent, and, naturally, a person with aphasia has always some mental impairment. Sometimes he is absolutely without the power of speech, though often a few interjections, like 'Oh dear', 'Yes', or 'No', or meaningless sounds, or even oaths, can be pronounced. When the condition is one of *sensory aphasia* (see above) names of persons, of places, even of the commonest household articles, are forgotten, a cat is called 'a brush', a bell 'a pen', and so forth, or the person gives meaningless answers to questions, so that conversation becomes very slow or quite impossible.

Treatment. — This is just as in apoplexy, of which the condition often forms a part. (*See* APOPLEXY.) The condition is seldom much improved if it has lasted more than a week without betterment. But in some cases, after the hæmorrhage or other cause is long past, brilliant results are achieved by teaching the afflicted person to read and speak just as one would teach a child, a new part of the brain apparently being educated.

APHEMIA (ἀ, neg.; φημί, I speak) means loss of the power of speech due to disease in the brain.

APHONIA (ἀ, neg.; φωνή, the voice) means loss of voice. It is caused by some disorder in the throat or in the nerves proceeding to the throat muscles, or in hysteria. (*See* VOICE.)

APHTHÆ (*see* THRUSH).

APICOLYSIS is the term describing the operation for bringing about the collapse or compression of the apex of the lung—for example, in pulmonary tuberculosis—thus 'knocking out' the diseased area.

APIOL, called also parsley-camphor, is a clear greenish volatile oil derived from parsley and used in menstrual disorders in doses of 3 to 5 minims.

APNŒA (ἀ, neg.; πνέω, I breathe) means the stoppage of breathing which occurs when the blood is artificially supplied with too much oxygen; for example, by taking several deep breaths in quick succession. (*See* ASPHYXIA.)

APO- (ἀπό, from) is a prefix implying separation or derivation from.

APOMORPHINE is a crystalline alkaloid closely related to morphine and having a powerful emetic action. Apomorphine hydrochloride is given hypodermically in doses of $\frac{1}{17}$ to $\frac{1}{8}$ grain in cases of poisoning in which the patient is unable to swallow or a very rapid emetic action is desired.

APONEUROSIS is the term applied to a white fibrous membrane which serves as an investment for the muscles and which covers the skull beneath the scalp.

APOPLEXY (ἀποπληξία) is a term introduced by Hippocrates meaning a stroke of sudden insensibility or of bodily disablement connected with some diseased condition of the brain.

Causes.—Different forms of apoplexy have been described by medical writers, such as the *congestive*, where the cause appeared to lie in an engorgement of the blood-vessels of the brain and its membranes; the *serous*, where sudden effusion of fluid into the ventricles or substance of the brain causes symptoms of apoplexy in persons the subject of kidney disease; and the *spasmodic*, where spasm of the arteries brings on a temporary paralysis or loss of speech in elderly persons.

In persons who are the subject of heart disease, a clot may form in the cavities or on a valve of the heart, and being carried away by the blood-stream may lodge in a vessel of the brain so as to form a plug which prevents blood from reaching the part supplied by the vessel in question. The occurrence of this *embolism* is absolutely sudden and produces all the symptoms of apoplexy. This is not a common cause of apoplexy, though, when it occurs, the prospect of improvement is better than when the apoplectic symptoms are due to hæmorrhage. In elderly people, whose blood-vessels are extensively diseased and whose circulation is feeble, a type of apoplexy, of more gradual onset, may appear in consequence of the blood clotting in the interior of the vessels, this process being known as *thrombosis*.

By far the most frequent and important occasion of apoplexy is *hæmorrhage* into the brain by the rupture of blood-vessels. Indeed, by many modern writers the term apoplexy is applied only to cases of cerebral hæmorrhage. The blood-vessels of the brain, like those in other parts of the body, are liable to undergo degenerative changes after middle life. These changes affect the minute arteries as well as the larger vessels, rendering their texture fragile, and at the same time impairing their function in carrying on the healthy nutrition of the brain. Hence, in the immediate vicinity of the diseased blood-vessels the substance of the brain itself undergoes degeneration and becomes softened. The small vessels having thus lost the natural support of the surrounding tissues, and being here and there distended into aneurysms by disease, are liable to give way, and blood escapes into the brain. The hæmorrhage may be slight in amount and in parts of the brain where its presence gives rise to little disturbance; but where a large blood-vessel has ruptured, and more especially where the blood has been extravasated in or around the important structures at the base of the brain, the result is a stroke of apoplexy, as described below, and death not infrequently follows within a short period. In favourable cases, where a certain measure of recovery takes place, the effused blood undergoes

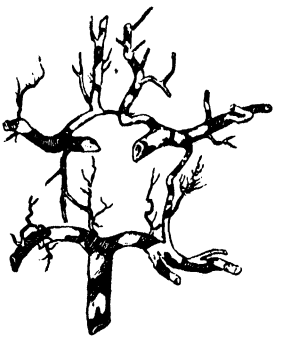


FIG. 19.—Arteries from the base of the brain, showing advanced atheromatous disease. The white areas are patches of atheroma.

gradual absorption, or becomes enveloped in a sort of capsule formed by the surrounding brain substance, and ceases to cause further disturbance. But even in such cases some degree of paralysis remains. Moreover, the nutrition of the brain is so impaired as to render probable a recurrence of the hæmorrhage, and thus the danger to life, as is well known, increases with each successive attack.

From what has been stated above, it will be observed that apoplexy is to be regarded as a disease of advanced life. Hippocrates states that it is of most frequent occurrence between the ages of forty and sixty, and all medical experience confirms the truth of this observation. Nevertheless it may occur at any period of life, and cases of true apoplexy in very young children have, for example, sometimes followed whooping-cough. It is more common in men

than in women. What has from early times been described as the apoplectic habit of body, consisting in a stout build, a short neck, and florid complexion, is now generally discredited, it being admitted that apoplexy occurs about as frequently in thin and spare persons who present no such peculiarity of conformation. A hereditary tendency is acknowledged as one of the predisposing causes of apoplexy, and the most important factor is progressive disease of the kidneys with changes in the heart and blood-vessels and raised blood-pressure. With respect to the exciting causes of a stroke of apoplexy, it may be stated generally that whatever tends directly or indirectly to increase the tension within the cerebral blood-vessels may bring on an attack. Hence, such causes as immoderate eating or drinking, severe exertion of body or mind, violent emotions, much stooping, overheated rooms, exposure of the head to the sun, sudden shocks to the body, and the sudden suppression of evacuations, such as the menstrual discharge, may precipitate the attack. Many cases in elderly people occur while some violent exertion is being made, such as hurrying to catch a train or during straining at stool.

Symptoms.—Apoplectic attacks vary both as regards their intensity, the particular symptoms shown, and the after effects, but well-marked cases present the following symptoms. The person attacked becomes, more or less suddenly, deprived of consciousness and all power of voluntary motion. He lies as if in a deep sleep, with a flushed face, a slow pulse, stertorous breathing, accompanied with puffing of the cheeks during expiration, and with the pupils of the eyes insensible to light and contracted or unequal. This state in many respects resembles the coma of narcotic poisoning, and is unfortunately too often mistaken by unskilled persons for alcoholic intoxication. The symptoms and history of the case, however, are usually sufficient to enable a medical man to form a correct diagnosis.

The presence of complete paralysis down one or other side is a point which in general differentiates apoplexy from narcotic poisoning and alcoholic intoxication, the paralysis being observable even during unconsciousness by lifting the limbs and noting the peculiar suddenness and helplessness with which they fall when not supported. The fact that in either of the last-named conditions the person can generally be partially roused, while in apoplexy unconsciousness is complete, is also valuable. Assistance is also gained by observing the state of the pupils, which, in narcotic poisoning, are usually much contracted, while in alcoholic intoxication they are widely dilated. (*See* OPIUM.)

In this condition of insensibility death may occur within a few hours, or there may be a gradual return to consciousness, in which case it is usually found that the result of the attack remains in the form of paralysis of one side of the body, while occasionally there may also be noticed some impairment of the mental powers, pointing to damage done to the brain. (*See* PARALYSIS *and* APHASIA.)

An attack of apoplexy may occur without unconsciousness, a sudden paralysis of one side of the body being the only manifestation. Occasionally, when the hæmorrhage takes place gently, the symptoms are gradually developed over a period of several hours (*ingravescent apoplexy*). Sometimes premonitory symptoms occur. Persistent headache of a dull throbbing character, a sense of fullness in the head, vomiting, giddiness, noises in the ears, slight confusion of mind, and numbness of a limb or of one side of the body are among the more important premonitory symptoms; and these may exist for a variable length of time before the attack comes on. Such symptoms, especially in a person known to be gouty or the subject of kidney disease, at or beyond middle life, indicate danger of an apoplectic seizure.

The effects of a stroke of apoplexy, as regards the paralysis which remains after the immediate attack is over, are described under *Hemiplegia* in the article on PARALYSIS. The dangerous period of an apoplectic attack is during the first two or three days and especially during the first twenty-four hours, when the hæmorrhage in the brain may be increased or even started again after it has ceased by injudicious disturbance of the patient, such as may be caused by his removal to a distance. A certain

amount of danger remains for a period of three weeks or thereabout while the process of absorption and organisation of the blood clot is taking place. During this period also such improvement in the patient's condition of paralysis, etc., as will take place reaches almost its full extent.

Treatment.—A knowledge of these facts is of the utmost importance in the treatment of apoplexy, as obviously much can be done in the way of warding off a stroke when it appears to threaten, and of preventing a recurrence in cases where there have been previous attacks. With respect, further, to the treatment of apoplexy, it must be admitted that little can be done during the state of unconsciousness, though the great importance of absolute quiet, with the body in the recumbent position and the head supported on a low pillow, cannot be too strongly impressed. Care must be taken that the patient receive nothing of a stimulant nature, which would tend to raise the general blood-pressure and increase the hæmorrhage in the brain.

The practice of blood-letting, once so common in this disease, is still sometimes used to reduce the pressure of the blood if high. A strong purgative like jalap powder, or if the patient be unable to swallow, a drop of croton oil in butter or milk laid on the tongue, is given for a similar purpose. Warmth to the surface of the body and cold cloths laid on the head are helpful. The case must be anxiously watched, and symptoms treated as they arise. When consciousness returns, care and quietness are necessary to prevent recurrence of the hæmorrhage or development of extensive softening of the brain. The diet must be low for some time after the attack, and the period of convalescence should be prolonged. In the after treatment of the resulting paralysis much may be done to prevent stiffness and to preserve the power of the muscles in the weakened limbs by judicious massage and electrical applications.

APOSTEMA (*ἀπόστημα*) is an old term for abscess.

APOSTOLI'S TREATMENT is a method of treating fibroid tumors and other diseases of the uterus by strong currents of electricity which was much used about the end of the nineteenth century.

APOTHECARIES' WEIGHT. (*See* WEIGHTS AND MEASURES.)

APPENDICECTOMY, or appendectomy, is the operation for the removal of the appendix vermiformis.

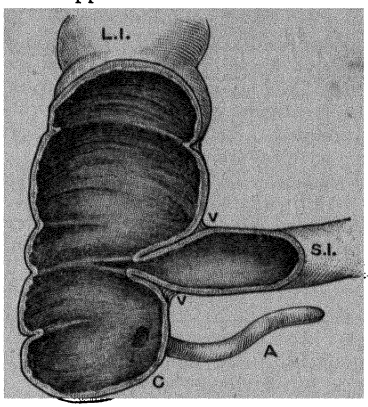


FIG. 20.—Part of the bowel situated in the right iliac region, showing the relations of the appendix. The front part of the bowel has been removed to show the interior. *A*, Appendix; *C*, cæcum; *LI*, continuation of large intestine; *SI*, small intestine; *VV*, the two flaps of the ileo-cæcal valve which prevents the return of digested material from the large into the small intestine. (After Gegenbaur.)

APPENDICITIS is the name of an inflammatory disease starting in the appendix vermiformis. (*See* INTESTINE.) Formerly, the condition was wrapped in much obscurity, and its effects attributed to 'gastric seizure', 'inflammation of the bowels', 'iliac phlegmon', 'perityphlitis' 'paratyphlitis', and conditions under various other names, In 1827, for the first time, a writer called Melier drew attention to the fact that inflammation may start in the appendix, but the earliest precise and full account of the disease was not given till 1886 by Fitz. For long the condition was called 'perityphlitis', and supposed to be an abscess formed by infection from the cæcum, the blind extremity of the large intestine; and in many cases the symptoms are due to inflammation and distension of this structure, the appendix being unaffected. Inflammation of the ap-

pendix itself does not produce marked symptoms, though it starts the disease. So long as only the appendix is affected, though there may be discomfort, there is no real pain, the occurrence of acute pain indicating that the peritoneum, the smooth membrane covering the bowels and lining the abdominal cavity, has become inflamed in that portion which forms the outer covering of the appendix. Not uncommonly a diseased appendix is found by chance in operation for some other trouble, and it may have given rise to no symptoms if its peritoneal covering be glossy and uninflamed. This point is of importance with regard to treatment.

Varieties.—The disease is classified in many ways with regard to its treatment and its anatomical characters. First of all, one must separate the *acute* from the *chronic* or *relapsing form*. In the latter the person affected is troubled by repeated slight attacks of pain in the right iliac region, perhaps never bad enough to keep him from moderate work, but sufficient to be a burden ; or there is a sense of constant indefinable weakness and discomfort in this situation. In some cases the slightly inflamed appendix undergoes at times spasmodic, painful contractions, the so-called *appendicular colic*. This may be associated with the presence of concretions in the interior of the appendix or with adhesions between it and neighbouring parts. In other cases the inflammatory process is so mild that no symptoms directly referable to the appendix ever occur, but the patient suffers from constipation, indigestion, or general abdominal discomfort produced in a nervous reflex manner by the disturbance of the appendix. This corresponds probably to a chronically inflamed appendix, of which the peritoneal covering has not yet become affected, or to an attack of peritonitis round the appendix from which recovery has taken place, but which has left adhesions behind, or to a small chronic abscess which has resulted from a past attack. The *acute form* is that which is usually known as an 'attack of appendicitis', and, though in ordinary cases it is a localised inflammation of the peritoneum, which tends to get better in a fortnight or thereabout, it may proceed to two very serious forms. *Gangrenous appendicitis* is one in which the inflammation is so intense that the appendix sloughs away, and the bowels communicate, through the opening, with the peritoneal cavity. The other form is *suppurative appendicitis*, in which the inflammation is not quite so severe but the appendix becomes the centre of an abscess. Both of these latter forms are extremely dangerous to life and are often very sudden in their development.

Causes.—The disease is said by many authorities to have increased much in the last thirty years, and, if this be so, it must be owing to some widespread change of social habits, or of diet. But the apparent increase is, if not entirely, at all events very largely, due to avoidance of such vague names as 'perityphlitis', 'inflammation of the bowels', 'gastric seizure', etc. *Constipation*, and the retention in the cæcum of undigested food, together with overeating, may have a close connection with the onset of an attack. The great modern increase in the habit of meat-eating has also been credited as the main factor responsible for the constipation and inflammation.

When congestion and inflammation of the appendix or neighbouring organs have been started the condition is continued and augmented by the presence of various *bacteria*, *e.g.* bacillus coli, streptococci, etc. The severity of an attack depends largely upon the nature of the bacteria present. A protest must be made against the widespread popular idea that grape-seeds, apple-pips, date-stones, and similar small objects have a special faculty for finding out the appendix, lodging there, and setting up appendicitis. The idea is fallacious, and, though such objects are found there occasionally, these cases are exceptional, and the small masses of hardened fæces or minute concretions of lime, which are very common, are a result of, rather than the cause of, the appendicitis. The disease is specially one of *youth*, and 80 per cent of all cases occur under the age of thirty. Further, the *male sex* is quite disproportionately attacked (also in about 80 per cent of all cases), and when a female is attacked the occasion is generally at a menstrual period.

Life in the tropics and *irregularity in meal times* seem both to predispose to it, so that travellers and business men who neglect or bolt their meals are very liable to attacks. In many cases an attack follows close upon *a strain*, such as lifting a heavy weight, a long cycle ride, or a blow on the abdomen, and in these cases the appendix has been probably for a long time in a state of chronic inflammation, ready to proceed to peritonitis. Like other organs possessing much lymphoid tissue in their structure, the appendix is liable to tuberculosis, and in its chronic form appendicitis is sometimes due to the tubercle bacillus.

Symptoms.—An attack of appendicitis comes on as a rule suddenly, without the early feelings of languor and malaise common to most acute diseases. The principal symptoms are four in number: (*a*) sudden pain in the abdomen, often vague in situation at first, but usually settling, in a day or two, in the right iliac region. It is generally very severe, and the patient has to lie constantly on his back with the right leg drawn up. (*b*) Disturbance of the digestive functions, consisting in loss of appetite, nausea, often vomiting, and constipation, which has usually been present for a day or two. (*c*) Tenderness to touch in the right iliac region, which in very many cases has its point of greatest intensity defined with curious exactitude at a point called Munro's or M'Burney's point, situated about half-way between the spine of the iliac bone and the navel. (*d*) Fever of a moderate amount, generally about 102°. The first three of these occur with varying intensity in other diseases of the abdomen, in which, however, fever is uncommon. Besides these, distinct resistance and hardness of the muscles in the right lower quarter of the abdomen can be made out on pressure, and swelling is usually visible in the right iliac region after two or three days. In an ordinary case these symptoms last for a week or so and then gradually decrease, leaving the person fairly well at the end of a fortnight. In *gangrenous appendicitis* the symptoms are extreme, the fever high, and death may come on with startling rapidity, if an operation be not performed. In *suppurative appendicitis* an abscess forms with marked swelling, though rarely before the end of the first week, and this also calls for operation.

In some cases an attack is very slight, the bowels around become matted together, an abscess collects in the cavity so formed, and only when it comes near the surface is the condition diagnosed.

Treatment.—In no circumstances should a purgative be given. A patient with acute appendicitis seen within thirty-six hours of the onset should be operated on forthwith, the mortality in the hands of good surgeons being very low. If the case is seen after forty-eight hours of the onset and improvement has set in, some surgeons recommend postponement of the operation until the inflammation has completely subsided; others hold that operation should be done at once. If operation is refused or impossible, the patient should be kept quiet in bed, be given only water by mouth, and perhaps have an injection of morphia. If the case is one of gangrenous appendicitis or of abscess formation, immediate operation is the only possible course; for the great danger of the disease consists in the production of a general peritonitis through the escape of bacteria and putrescent material in large amount from the interior of the appendix. (*See* PERITONITIS.)

With regard to treatment after an attack, great care regarding diet and regulation of the bowels is indispensable. Seeing that the mortality of operation to remove the appendix between two attacks is extremely low (only 1 in 500), and that its removal affords complete freedom from future attacks, it is the general opinion that most cases should be so treated. Certainly if a person has had two bad attacks, and especially if he is likely to reside at times in places where facilities for immediate operation are not very good, the operation should be performed at a time when conditions are most favourable.

APPENDICOSTOMY is the term describing the operation whereby an artificial opening is made into the appendix vermiformis, through which the bowel may be irrigated in certain diseases of the colon.

APPENDIX is a term applied to appendages of several hollow organs. The auricular or atrial appendix is a conical muscular pouch forming the upper part of each auricle of the heart. The epiploic appendices are a number of tags of fat hanging from the outer surface of the large intestine. The appendices of the larynx are two pouches, one on either side between the false and true vocal cords. The term appendix is most commonly applied to the appendix vermiformis of the large intestine. It is a tubular prolongation of the large intestine with an average length of 9 or 10 cm. and a width of 6 mm. It lies in the right lower corner of the abdomen and has peritoneal muscular and mucous coats similar to those of the rest of the intestine.

APPETITE is an instinctive craving for the food necessary to maintain the body and to supply it with sufficient energy to carry on its functions. The ultimate cause of appetite is a question of supply and demand in the muscles and various organs, but the proximate cause is doubtful. Some have attributed the cause of thirst to dryness of the nerve endings in the skin and mouth, as water evaporates from the surfaces, and the cause of hunger to slight irritation of the stomach caused by oozing into the organ of the gastric juice manufactured in its walls. But the question must be much more complex. Undoubtedly a good appetite is necessary to good digestion, and a perfectly healthy taste and appetite ought to be both a guide to the suitability of foods and a gauge of the amount required. Like every other bodily function, appetite may be out of order. It may be depraved, and may indicate quite unsuitable articles of diet, from toasted cheese in dyspeptics, who know by experience that such an article disorders their stomach functions, to cinders, hair, pebbles, etc., in the condition known as *pica*, which occurs sometimes during pregnancy, in hysteria, and frequently in mental disorders. The two chief disorders are, however, excessive increase of appetite and diminution or loss of appetite.

Excessive appetite may be simply a bad habit, due to habitual over-indulgence in good food, and resulting in acidity, gout, obesity, etc., according to the other habits and constitution of the person. It is often a sign of acid dyspepsia (*see* DYSPEPSIA) or of diabetes, and is then called 'boulimia'.

Diminished appetite is a sign common to almost all diseases causing general weakness, because the activity of the stomach and the secretion of gastric juice fail early when vital power is low. Thus it is one of the earliest signs of consumption, and, of course, its presence aggravates any such disease. It is the most common sign of dyspepsia due to gastritis (*see* DYSPEPSIA) and of cancer of the stomach. In some cases there is no apparent cause for its loss, and the appetite returns speedily after a course of tonics and bitters, like quassia, gentian, quinine, or nux vomica. There is one peculiar condition known as 'nervous anorexia', in which the sufferer, usually a young woman, sleeps little, eats almost nothing, but is constantly exerting energy upon some favourite pursuit; this condition is very liable to end in a total nervous breakdown. Diminished appetite in feverish states is a salutary thing as the digestive functions are reduced in power, and people in these circumstances should abstain from food and should rest quietly at the same time.

APRAXIA (ἀπραξία) means loss of power to carry out regulated movements.

APYREXIA (ἀ, neg.; πυρέσσω, I am fevered) means the stage of certain diseases, *e.g.* malaria, tuberculosis, in which temperature falls and there is no fever for a time.

ARACHNOID MEMBRANE (ἀράχνη, a spider; εἶδος, form) is one of the membranes covering the brain and spinal cord. (*See* BRAIN.) Arachnoiditis is the name applied to inflammation of this membrane.

ARCUS SENILIS is the white line which appears round the cornea of the eye with advancing years. (*See* AGE, NATURAL CHANGES IN.)

AREOLA literally means a small space, and is the term applied to the red or dusky ring round the nipple, or round an inflamed part. Increase in the duskiness of the areola on the breast is an important early sign of pregnancy.

ARGENTUM is the Latin word for silver.

ARGYLL ROBERTSON PUPIL is a condition (described originally by Dr. Argyll Robertson) in which the pupils contract when the eyes converge on a near object, but fail to contract when a bright light falls on the eye. It is found in several diseases, especially in locomotor ataxia and general paralysis.

ARGYRIA (*ἄργυρος*, silver) means the effect produced by taking silver salts over a long period, and consists of a deep duskiness of the skin, especially of the exposed parts.

ARGYROL (*see* SILVER).

ARM is the part of the upper limb between the shoulder and elbow, but is generally taken to include also the forearm and shoulder regions. The upper limb is attached to the body by the strong pectoral muscles in front and by several powerful muscles springing from the spine and ribs behind. The great mobility of the shoulder is largely due to the fact that the only contact with the bones of the trunk takes place between the collar-bone and the upper end of the sternum or breast-bone, the shoulder-blade sliding about freely between the muscles of the back as the arm is raised and lowered. The bones of the arm are the clavicle or collar-bone and the scapula or shoulder-blade lying at the upper part of the chest, the humerus, a single bone in the upper arm, and the radius and ulna lying side by side in the forearm. Eight small bones compose the wrist and connect the hand with the lower end of the radius. The shoulder-joint is of the ball-and-socket variety, the head of the humerus resting against the glenoid cavity of the shoulder-blade. The elbow is a hinged joint formed at the lower end of the humerus above, while the ulna forms the chief part of the joint below, the radius resting lightly against the humerus. When the hand is rotated so as to lie palm up and back up, the radius in the first case lies alongside the ulna and in the latter crosses over it. The chief muscle which bends the elbow is the biceps in front of the upper arm, while the triceps lying behind straightens the limb. A group of muscles attached at the inner side of the elbow act in a general way to bend the wrist and fingers, while another group of muscles attached to the outer side of the elbow have the general action of straightening and bending backwards the wrist and fingers. One large artery (brachial artery) runs down the inner side of the upper arm, corresponding to the seam of the coat sleeve in position. At the elbow this divides into two branches, the radial and ulnar arteries. The radial artery can be felt pulsating near the wrist and is generally known as 'the pulse'. The ulnar artery lies to the inner side of the forearm, deeply imbedded in muscles. A large group of nerves lies at the inner side of the armpit, and these nerves run downwards to supply the muscles and skin of the arm. The ulnar nerve can readily be felt behind the inner side of the elbow where it is exposed to bruising and is popularly known as the 'funny bone'. The large radial nerve runs down the back of the upper arm and the outer side of the forearm. At the back of the upper arm it is frequently damaged, leading then to the condition known as 'drop wrist', in which the hand hangs helpless and cannot be raised. The collar-bone, by reason of its exposed position, is very liable to fracture from falls on the shoulder, and the radius is frequently broken by falls on the palm of the hand. The shoulder-joint, on account of its great mobility, is prone to be dislocated in twists of the upper arm, but the elbow-joint is very seldom injured. A small bursa or cavity lies between the skin and the end of the ulna at the point of the elbow, and this is frequently inflamed as the result of injury, and in the same way as the bursa in front of the knee is affected in the condition known as 'housemaid's knee'.

ARMENIAN BOLE is a pale reddish earth used in tooth powders and sometimes administered internally for irritable conditions of the stomach.

ARMPIT, or AXILLA, is the pyramidal hollow between the upper arm and chest, bounded in front by the pectoral or breast muscles, behind by the shoulder-blade and its muscles, and running up to a point beneath the collar-bone. It contains the axillary vessels and nerves which run to the arm, also much fatty tissue and lymphatic glands. The latter are important, because in poisoned wounds of the arm they may become inflamed, resulting in abscess; and still more, because in cancer of the breast they become infected with cancer, and have to be removed with the breast. Wounds in the armpit are very dangerous on the outer, front, and back walls, because large vessels run there, but not so serious when towards the chest.

ARNICA is a medicine derived from *Arnica montana*, a plant of the Western United States and Europe. The tincture of arnica, made by steeping the root in rectified spirit, is the preparation most employed, and is very extensively used as a domestic remedy. Externally the tincture is used as a lotion for application to sprains and bruises, which it relieves by virtue of its weakly irritant action. It is seldom used internally, though sometimes it is given to stimulate digestion.

AROMATICS form a group of chemical substances containing carbon and a relatively small amount of hydrogen, some also containing oxygen. The group includes most of the essential oils of plants, *e.g.* anise, cloves, turpentine, camphor, thymol (hence the name, as these have all an aroma), and also benzene (derived from coal-tar), and its derivatives, such as phenol or carbolic acid, aniline, etc. These substances are almost all strongly antiseptic.

ARRHYTHMIA, or ARHYTHMIA (ἀρρυθμία, want of rhythm), means any variation from the normal regular rhythm of the heart-beat. The condition is produced by some affection interfering with the mechanism which controls the beating of the heart and includes the following disorders: sinus arrhythmia, auricular fibrillation, auricular flutter, heart block, extrasystole, pulsus alternans, and paroxysmal tachycardia. (*See* HEART DISEASES.)

ARROW POISON (*see* BITES, etc.).

ARROWROOT is a West Indian plant (*Maranta arundinacea*). As sold, it is a white powder, consisting of almost pure starch, derived from the root of the plant. It is much used as an invalid food, because the particular form of the starch renders it very easy of digestion, but it must of course be combined with other forms of nourishment. (*See* FARINACEOUS FOODS.)

ARSENIC is a metal, but is better known by its oxide, white arsenic, by two arsenites of copper, Scheele's green and emerald green, and by two sulphides of arsenic, orpiment or king's yellow, and realgar. It is very extensively used in dyeworks, in the manufacture of chemicals, in making enamel, in hardening shot and type, in fly-papers, sheep-dips, yellow and green paints, and is further given to horses to improve their coat, and much used in medicine. Applied pure, it is a strong germicide and caustic, and in large doses is a powerful irritant to stomach and intestines. In small doses continued for some time, it has the effect of modifying the changes which take place in the tissues and leading to the deposition of fat. When taken over long periods, larger and larger doses can be tolerated, till at last a quantity, many times the poisonous dose, has no ill effect. By some persons and in some districts, as among the mountaineers of Styria, its use has become a habit, and in these people it produces a sense of well-being and greater capacity for sustaining fatigue. Various organic combinations of arsenic have been introduced, such as cacodyle, salvarsan, and neosalvarsan.

Uses.—In small doses, for a short period, it stimulates the stomach functions and so improves digestion. Taken over longer periods, it is used as an alterative in chronic skin diseases, in various nervous diseases, in anæmia and leukæmia, in asthma, and in chronic

malaria. Ehrlich's great discovery in 1909 of the value of '606'—*i.e.* salvarsan or arsphenamine—in the treatment of syphilis is a landmark in the history of medicine. Arsphenamine is also used in the treatment of rat-bite fever, relapsing fever, and yaws.

ARSENIC POISONING may be acute or chronic.

Acute.—The symptoms are violent purging, vomiting, and great prostration. The treatment is to administer freshly prepared dialysed iron or peroxide of iron, or magnesia, and then give an emetic, followed by soothing drinks like milk, gruel, etc.

Chronic poisoning is not infrequent among dyers and paperhangers, or from contamination of food by, or other contact with, green or yellow paint, or wall-paper containing arsenic. The symptoms are irritability of the eyes and throat, with cough, tendency to sickness, diarrhœa, prostration, and skin eruptions, and often headache, tremors, paralyses, and other nervous signs. (*See* NEURITIS.) The treatment is first of all discovery and removal of the source of poisoning, after which one must wait till the arsenic has been gradually expelled from the system by help of fresh air, good food, and tonics. Persons who have been subjects of arsenic poisoning may be left in a very debilitated condition with weak digestion and symptoms of neuritis lasting several years.

ARSENO-BENZOL is the general name applied to a series of organic compounds of arsenic, better known by the proprietary name of one of these compounds, salvarsan.

ARSPHENAMINE is the name adopted by the Federal Trade Commission of the U.S. for salvarsan and is the officially recognised name in Great Britain, where, according to the Therapeutic Substances Act, it must be marked on the ampoule containing the stuff.

ARTERIES (ἀήρ, air; τηρέω, I keep) are vessels which convey blood away from the heart to the tissues of the body, limbs, and internal organs. In the case of most arteries, the blood has been purified by passing through the lungs, and is consequently bright red in colour, but in the pulmonary arteries which convey it to the lungs it is impure, dark, and like the blood in

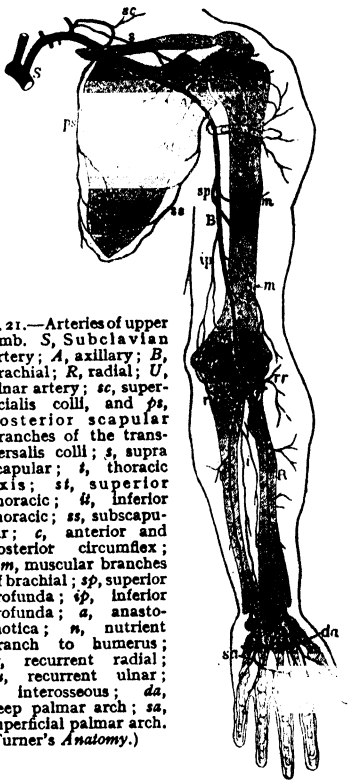


FIG. 21.—Arteries of upper limb. *S*, Subclavian artery; *A*, axillary; *B*, brachial; *R*, radial; *U*, ulnar artery; *sc*, superficialis colli, and *ps*, posterior scapular branches of the transversalis colli; *s*, supra scapular; *t*, thoracic axis; *st*, superior thoracic; *it*, inferior thoracic; *ss*, subscapular; *c*, anterior and posterior circumflex; *mm*, muscular branches of brachial; *sp*, superior profunda; *ip*, inferior profunda; *a*, anastomotica; *n*, nutrient branch to humerus; *rr*, recurrent radial; *ru*, recurrent ulnar; *i*, interosseous; *da*, deep palmar arch; *sa*, superficial palmar arch. (Turner's *Anatomy*.)

veins, therefore called venous blood. The arterial system begins at the left ventricle of the heart with the aorta (*see* AORTA), which gives off branches that subdivide into smaller and smaller vessels, the final divisions, called arterioles, being microscopic, and ending in a network of 'capillaries', which perforate the tissues like the pores of a sponge, and bathe them in blood that is collected and brought back to the heart by veins. (*See* CIRCULATION.)

The chief arteries after the *aorta* and its branches (*see* AORTA) are: (1) the *common carotid*, running up each side of the neck and dividing into *internal carotid* to the brain, and *external carotid* to the neck and face; (2) the *subclavian*

to each arm, continued by the *axillary* in the armpit, and the *brachial* along the inner side of the arm, dividing at the elbow into *radial* and *ulnar*, which unite across the palm of the hand in arches that give branches to the fingers; (3) the two *common iliacs*, in which the aorta ends, each of which divides into the *internal iliac* to the organs in the

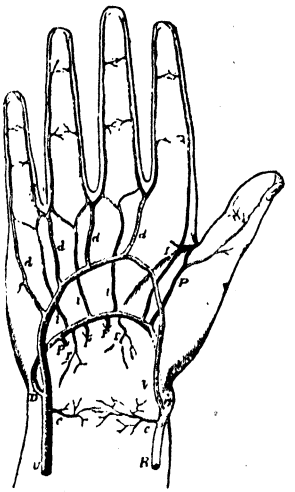


FIG. 22.—Arteries of hand. *R*, Radial artery; *U*, ulnar artery; *V*, superficial volar; *P*, a large artery of the thumb; *I*, radial artery of forefinger; *D*, deep branch of ulnar artery; *cc*, anterior carpal branches; *dddd*, digital branches from superficial palmar arch; *iii*, interosseous branches from the deep arch; *ppp*, perforating branches; *rr*, recurrent branches. (Turner's *Anatomy*.)

pelvis, and the *external iliac* to the lower limb, continued by the *femoral* in the thigh, and the *popliteal* behind the knee, dividing into *anterior* and *posterior tibial* arteries to the front and back of the leg. The latter passes behind the inner ankle to the sole of the foot, where it forms arches similar to those in the hand, and supplies the foot and toes by *plantar branches*.

Structure.—The arteries are highly elastic, dilating at each heart-beat as blood is driven into them, and forcing it on by their resiliency. (*See* PULSE.) Every artery has *three coats*: (*a*) the outer or 'adventitia', consisting of ordinary strong fibrous tissue; (*b*) the middle or 'media', consisting of muscular fibre supported by elastic fibres, which in some of the larger arteries form

distinct membranes; and (*c*) the inner or 'intima', consisting of a layer of yellow elastic tissue on whose inner surface rests a layer of smooth plate-like

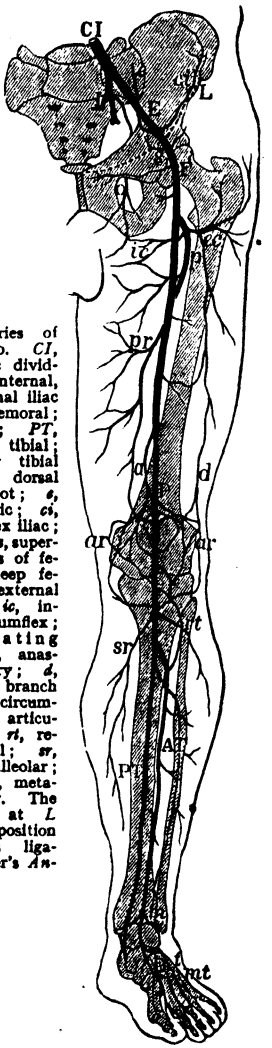


FIG. 23.—Arteries of lower limb. *CI*, Common iliac dividing into *I*, internal, and *E*, external iliac artery; *F*, femoral; *P*, popliteal; *PT*, posterior tibial; *AT*, anterior tibial artery; *D*, dorsal artery of foot; *e*, deep epigastric; *ci*, deep circumflex iliac; *o*, obturator; *s*, superficial branches of femoral; *p*, deep femoral; *ec*, external circumflex; *ic*, internal circumflex; *pr*, perforating branches; *a*, anastomatic artery; *d*, descending branch of external circumflex; *ar*, *ar*, articular arteries; *ri*, recurrent tibial; *sr*, sural; *m*, malleolar; *t*, tarsal; *mt*, metatarsal artery. The dotted line at *L* marks the position of Poupart's ligament. (Turner's *Anatomy*.)

endothelial cells, over which flows the blood. Besides these the large arteries have the muscle of the middle coat largely replaced by elastic fibres, which render the artery still more expansile and elastic. When an artery is cut across, the muscular coat instantly

shrinks, drawing the cut end within a fibrous sheath that surrounds the

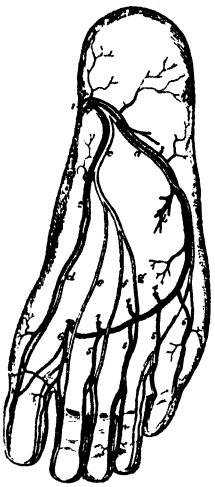


FIG. 24.—Arteries of the sole of the foot. 1, Posterior tibial artery, dividing into 2, internal, and 3, external plantar arteries; 444, posterior perforating branches; 5555, digital branches; 6, dorsal artery of the foot appearing in the sole between the first and second toes. The letters refer to the corresponding plantar nerves and their branches. (Turner's *Anatomy*.)

artery, and bunching it up, so that a very small hole is left to be closed by blood-clot. (*See* HÆMORRHAGE.)

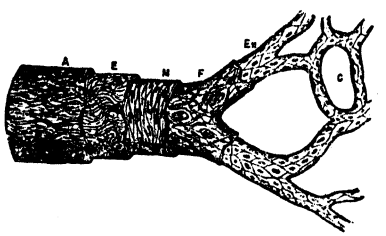


FIG. 25.—Diagram to show the structure of an artery. *A*, Tunica adventitia; *E*, elastic layers, and *M*, muscular fibres of the tunica media; *F*, elastic layer, and *En*, endothelial cells of the tunica intima. The last are continuous with the cells forming *C*, the capillaries. (Turner's *Anatomy*.)

ARTERIES, DISEASES OF.—Although these tubes are subject, like the muscles, to a great amount of strain and wear, they are, like the muscles, singularly free from diseases. One of these diseases is aneurysm. (*See* ANEURYSM.)

Arterio-sclerosis, which is a condition of thickening and rigidity affecting particularly the middle coat of arteries, comes on as a natural change in old age, but in some persons the change tends to come on early in life, possibly as a hereditary defect, while certain diseases, of which the chief are gout, syphilis, alcoholism, and lead-poisoning, bring it on in middle life. The results are general debility with wasting of the muscles, failure of appetite, tendency to faints and fits, headaches, coldness of the hands and feet with a great liability to gangrene, and, most important of all, an early failure of mental power due to thickening and blocking of the arteries in the brain, the young or middle-aged man becoming torpid, incapable of clear and connected thought and conversation, and liable to fits of absent-mindedness and aberration. There is a great liability to apoplexy, and Bright's disease comes on from changes in the kidney blood-vessels. All acute diseases like pneumonia, influenza, etc., are more serious in such a person.

A similar change, beginning usually in the inner coat but involving the middle coat in time, may occur in small nodes or swellings here and there on arteries, this condition being called *atheroma*. It leads in smaller arteries to partial blockage of the vessel with diminution of the supply of blood to the part or organ concerned. If it occurs in a large artery, this is very likely in course of time to produce aneurysm; if in a small one, clotting of the blood, so that serious states, like apoplexy and aphasia, may result if the small artery be in the brain. Following on atheroma, plates of lime may form in the arteries, or these vessels may, in extreme states, be changed into brittle calcareous tubes, very liable to tearing from slight injuries.

Syphilis and other inflammatory diseases may bring about an *obliterative inflammation*, in which the internal coat becomes greatly thickened (*endarteritis*) and in which the artery is more or less completely choked up. This leads to very serious effects, particularly in the case of arteries supplying the heart and brain.

ARTERITIS means inflammation of an artery.

ARTHRITIS (ἄρθρον, a joint) means inflammation of a joint or joints. The chief forms are rheumatic, gouty, rheumatoid, gonorrhœal, tuberculous, and traumatic. (*See* JOINTS, DISEASES OF.)

ARTHROPATHY is a term applied to any form of joint disease.

ARTICULAR means anything connected with a joint, *e.g.* articular rheumatism.

ARTICULATION is a term employed in two senses in medicine, either meaning the enunciation of words and sentences or meaning a joint.

ARTIFICIAL LIMBS AND OTHER PARTS.—It is often necessary, for the sake of either usefulness or appearance, to supply the place of portions of the body, lost by injury or disease, with more or less efficient copies of the natural part. From the most ancient times this has been the case: Herodotus speaks of a man who had a wooden foot; the Romans carried the manufacture of limbs to a high degree of efficiency, as witnessed by a leg, neatly formed of thin bronze plates, found in a tomb at Capua; the Etruscans fashioned gold teeth five centuries before our era; Goetz von Berlichingen, to supply his lost right hand, had one made of iron; and Ambroise Paré, who wrote on surgery in the sixteenth century, has a chapter upon artificial limbs.

Arms.—Owing to the very delicate movements which the upper limb has to carry out, the most battered and stiffened natural arm or hand is superior to the most complex product of art. Therefore, in amputating, the rule is, in the upper limb, to spare every fragment that can be left, regardless of appearance. But, when an amputation has been necessary, a wooden stump laced to the upper arm or to a corset, and having at its end a screw-plate to which can be fitted a fork, knife, or hook, is one of the cheapest and best substitutes. For light work, such as knitting, fingers, which can be manipulated by the other hand to grasp and hold articles, are sometimes useful. The French Government supplied to soldiers after 1871 an arm in which the thumb could be made to grasp by shrugging the shoulders, the connection being a spring controlled by whipcord running up the arm and looped round the opposite shoulder. Complicated and expensive arms are also made, in which movements are given to the fingers by hydraulic apparatus in the armpit.

Legs.—An artificial substitute can come much nearer to the usefulness of the original in the lower than in the upper limb. For a working man, the most useful is a wooden peg attached by a leather bucket, which is pressed upon by the end of the stump, grips the sides of the stump, and rests upon the ischial or sitting bone above. This is modified so far, in the Beaufort leg, that a short wooden foot with rounded sole but no joints is added, so as to give surer support and a slightly more natural gait. Bly's leg is an expensive and complex but very light, useful, and durable one, in which the ankle-joint is a glass ball fitting into a vulcanite cup, while the joints are controlled by bands placed in the position of the natural sinews, so as to render the movements in walking very like the natural ones. Following the war of 1914-18 artificial legs of a light and simple character have been fashioned, provided with elastic supports at the knee and ankle-joints resembling the natural sinews, so that movements in walking are attainable which are almost indistinguishable from the natural gait.

Eyes.—Artificial eyes are worn both for appearance and to protect the socket from dust, though, of course, vision is impossible. They are made of glass or celluloid, and are thin shells of a boat-shape, representing the front half of the eye which has been removed. The stump which is left has still the eye-muscles in it, and so the artificial eye still has the power of moving with the other, though to a less extent, and it is often very difficult for this reason to tell at a short distance that a person has a false eye. The constant movements and the tears wear away such an eye, and it must be renewed once or twice a year.

Teeth.—Where a single tooth is false it is often fitted by a gold peg to the fang of the lost natural one. Where a number are fitted, a plate either adhering accurately to the gum

by suction, or attached to neighbouring teeth by 'crown and bridge work' is employed to carry them. It has been found that in the case of elaborate artificial attachments to roots of teeth suppurative processes of a harmful nature are apt to take place, leading to rheumatism and similar conditions. Less dental work is, therefore, done at the present day in the form of 'crowning' teeth and attaching artificial teeth by pegs than was formerly carried out.

Nose.—Often through disease the nose has been eaten away, leaving the nostrils projecting forward in an unsightly manner. Sometimes this is remedied by a gutta-percha substitute, attached to a pair of goggles, which having themselves a bizarre appearance distract attention from the nose. More often a triangular flap of skin is raised from the forehead, turned downwards over the gap, allowed to grow there, and then the small bridge which has maintained its nutrition is cut through, and the edges of the wound in the forehead are simply drawn together. Recently a plan has been introduced for improving the shape of noses with sunken bridge by injecting under the skin melted, hard paraffin, that solidifies as it cools, or a new bridge is fashioned from a piece of cartilage of a rib inserted under the skin.

ARTIFICIAL RESPIRATION (*see* DROWNING, RECOVERY FROM).

ARYTENOID (*ἀρυταινοειδής*, shaped like a ladle) is the name applied to two cartilages in the larynx.

ASAFŒTIDA is a gum resin of unpleasant odour, obtained from the root of *Ferula foetida*, and used as an expectorant to increase the secretion of mucus in the air-passages, as an antispasmodic in colic with flatulence, and in hysterical pains and cramps, which it subdues. The dose of tincture of asafœtida is ½ to 1 teaspoonful.

ASBESTOSIS is a disease of the lungs caused by the inhalation of asbestos particles.

ASCARIS is the name of a round worm, sometimes nearly a foot in length, which is parasitic in the human intestine and that of the horse, and very much resembles a large earthworm. (*See* PARASITES.)

ASCITES (*ἀσκός*, a wine-skin) means dropsical swelling of the abdomen. (*See* DROPSY.)

ASCORBIC ACID is a crystalline substance extracted from various vegetables, or synthetically prepared, and has the same action as vitamin C (*see* VITAMIN).

ASEPSIS (*ἀ*, neg.; *σήπω*, I make putrid) is a term, used in distinction from 'antisepsis', to mean that principle in surgery by which, instead of strong germicides like corrosive sublimate or carbolic acid being applied to wounds, the latter are washed with water which has been rendered sterile by boiling, and all the dressings, sponges, and instruments used are simply purified by steaming, boiling, or dry heat. Thin sterilised india-rubber gloves are now generally worn by surgeons and prevent risk of infection from the hands. Aseptic surgery is the ideal, but, except in very carefully regulated hospitals, only antiseptic surgery is, as a rule, practically attainable. Aseptic surgery has the advantage that the germ-destroying activity of the tissues and their healing power after wounds are not lessened by the strong lotions of carbolic acid, corrosive sublimate, lysol, etc., which are used in operations performed under antiseptic principles, and which decrease the vitality of the tissues; and therefore healing is surer and more rapid after an aseptic operation. But antiseptic surgery has this advantage, that in few cases except those of patients long in hospital can freedom from sources of infection be assured; the bedding, the surgeon's hands, the patient's own skin swarm with germs, and the liberal use of strong germicides has the effect of rendering these innocuous. Further, discharges which soak through an aseptic dressing are channels of infection, but by passage through dressings containing antiseptics the latter are taken up by the discharges, and the growth of organisms thus prevented. The principle adopted in doing an operation must

therefore depend upon the previous cleansing of the patient, upon the regime of the hospital, and upon the surgeon's predilection. In most cases there is a certain amount of compromise between antiseptic and aseptic procedure. (*See also* ANTISEPTICS.)

ASEPTOL is the name applied to a reddish oily disinfectant, phenolsulphonic acid, which is used in the strength of 1 to 10 per cent in water.

ASIATIC CHOLERA (*see* CHOLERA).

ASPERGILLUS is the name applied to a group of fungi including the common moulds. Several of these are capable of infecting the lungs and producing a disease resembling pulmonary tuberculosis.

ASPHYXIA (*ἀ*, neg.; *σφύξις*, pulse) means literally absence of pulse, but is the name given to the whole series of symptoms which follow stoppage of breathing and of the heart's action.

Causes.—For practical consideration by far the most important cause is *drowning*. Human beings are not adapted to extract the oxygen dissolved in water—firstly, because the amount is only one-third of that required to supply the needs of the processes of diffusion which take place in the lungs; and, secondly, because the air or fluid taken in through the mouth must return the same way, there being no second opening and rapid constant stream like that by which in fishes a very great quantity of water passes over the gills in a short time. *Blockage of the air passages* occurs in some diseases, such as croup, diphtheria, swelling of the throat due to wounds or inflammation, asthma (to a partial extent), tumours in the chest (causing slow asphyxia), and the external conditions of suffocation and strangling. *Poisonous gases* also cause asphyxia. Carbonic acid gas in excessive amount in the air, due to the breathing of a number of individuals in a small space, as in the Black Hole of Calcutta, or to the fumes given off in fermentation vats has often caused death. Carbon monoxide gas is still more deadly, and in the form of 'water gas', or when it is given off, for example, by a stove or charcoal brazier in a badly ventilated room, has killed many persons during sleep. (*See* COAL-GAS POISONING.) Several gases, such as sulphurous acid (from burning sulphur), ammonia, and chlorine (from bleaching-powder), cause involuntary closure of the entrance to the larynx, and thus prevent breathing. Other gases, such as nitrous oxide (or laughing-gas), chloroform, and ether, in poisonous quantity, cause stoppage of breathing by paralysing the respiration-centre in the brain.

Symptoms.—In the vast majority of cases death from asphyxia is due to insufficiency of oxygen supplied to the blood. The first signs—apart from instinctive efforts to escape from the cause, such as the struggles of a drowning man—are rapid pulse and gasping for breath. Next comes great increase in the pressure of the blood, causing throbbing in the head, with lividity or blueness of the skin, due to failure of aëration of the blood, followed by still greater struggles for breath and by general convulsions. In this stage, the veins and right side of the heart become overfilled with blood, owing to stoppage of the circulation, which follows contraction of the minute arteries all over the body from the irritation of the impure blood in them. Accordingly, the heart becomes overdistended and gradually weaker, a paralytic stage sets in, and all struggling and breathing slowly cease. When, on the other hand, asphyxia is due to charcoal fumes, coal-gas, and other narcotic influences, there is no convulsive stage, and death ensues gently and may occur in the course of sleep. After death, the right side of the heart, the large veins, and the pulmonary artery are found distended by blood, and this blood is fluid instead of in clots, as it is after a gradual death. These are the chief signs of death by asphyxia, but each cause produces distinguishing signs of its own.

Treatment.—So long as the heart continues to beat, recovery may be looked for under prompt treatment. The one essential of treatment is to get the impure blood aërated by artificial respiration. Besides this, the feeble circulation can be helped by various methods. (*See under* DROWNING, RECOVERY FROM.) When the heart is

very feeble or even stopped, the face extremely blue, and the veins of the neck and arms swollen, the person's life may possibly be saved by opening a vein in the arm or neck, and so allowing the blood to escape and the heart to contract again.

ASPIDIUM is the name of the genus of ferns called shield-ferns. The root of *Aspidium filix-mas* (male fern) is much used as a remedy for tapeworms. It is administered in the form of a fluid extract in doses of 45 to 90 minims.

ASPIRATION (*aspiro*, I breathe) means the withdrawal of fluid or gases from the natural cavities of the body or from cavities produced by disease. It may be performed either for curative purposes, or, very often, a small amount is drawn off with a hypodermic syringe for diagnosis of the nature or origin of the fluid.

Uses.—*Dropsy* is one of the commonest conditions requiring its application. When in the chest or abdomen, dropsy is usually relieved by means of a metal tube or canula about the size of a small quill, which is provided with a sharp point or trocar capable of being drawn out. After the canula, with the trocar inserted in it, has been pushed through the skin the trocar is withdrawn, leaving the tube in place. To this tube is attached an india-rubber tube leading to a bottle, which is air-tight, and in which a vacuum can be produced by a hand air-pump. The fluid is drawn out into the bottle, and 30, 60 or more ounces may be withdrawn at one time. When the dropsy is in the legs, Southey's tubes are sometimes used. This canula is very fine, and has about a yard of fine india-rubber tubing attached, which draws the water slowly off (in the course of several hours) by siphon action. *Pleurisy with effusion* is another condition requiring aspiration, and a pint or two of fluid may be drawn off by the aspirator. *Chronic abscesses* and *tuberculous joints* often call for its use, the operation being done with a small syringe and hollow needle. *Spina bifida* and *pericarditis* are two other conditions in which aspiration is sometimes performed. The spinal canal is aspirated by the operation of lumbar puncture. (*See* LUMBAR PUNCTURE.) In children the ventricles of the brain are sometimes similarly relieved from excess of fluid by piercing the fontanelle (soft spot) on the infant's head.

Before the operation, the skin is very carefully cleansed. The needle or trocar is plunged boldly into the lower part of the abdomen when this cavity contains fluid, or between the ribs in the back, near the lower angle of the shoulder-blade when the chest is being tapped. There is practically no pain, and only a local anæsthetic is necessary.

ASPIRIN, or ACETYL-SALICYLIC ACID, is a white crystalline powder which is used like sodium salicylate as a remedy for rheumatism, pleurisy, chorea, etc., also to reduce fever in infectious diseases. It has some action in relieving pain and producing sleep and is therefore frequently used for headache and slighter degrees of insomnia. The dose is 5 to 15 grains.

ASSIMILATION (*see* DIGESTION).

ASSOCIATION means the grouping of functions of similar parts. The term is especially applied to nerve fibres which pass from one part of the brain to another and correlate the action of different centres.

ASTASIA-ABASIA is the term applied to the condition in which a person is unable, because of loss of will-power through hysteria, to stand or to walk.

ASTEREOGNOSIS means the loss of the capacity to recognize the nature of an object by feeling it, and indicates a lesion (*e.g.* tumor) of the brain.

ASTHENIA (ἀ, neg.; σθένος, strength) means want of strength in the system. (*See* DEBILITY.)

ASTHENOPIA (ἀ, neg.; σθένος, strength; ὤψ, the eye) means a sense of weakness in the eyes, coming on when they are used. As a rule it is due to long-sightedness, slight inflammation, or weakness of the muscles that mo the eyes. (*See* VISION.)

ASTHMA (ἄσθμα, a gasping; ἀσθμαίνω,

I gasp for breath) is a disorder of respiration characterised by severe paroxysms of difficult breathing, usually followed by a period of complete relief, with recurrence of the attacks at more or less frequent intervals. The term is often incorrectly employed in reference to states of embarrassed respiration, which are plainly due to permanent organic disease within the chest, and which have none of the distinctive characters of true asthma.

Causes.—The essential nature of the disease lies in a *spasmodic* contraction of the smaller bronchial tubes. This is due to some deranged condition of the nervous system, affecting, either directly or by reflex action, the nerves supplying the muscular fibres lining the bronchi and regulating their calibre. Some *congestion* of the mucous membrane of these small tubes is probably present, and also helps to hinder the free passage of air through them. The bronchial tubes being thus narrowed, and losing, for the time, their expansile power, air can only, with the utmost difficulty, be got into or out of the chest. In these circumstances, the muscles of respiration act with great violence to expand the chest, which can only with still greater difficulty be emptied, and hence the distress. But while asthma is thus to be regarded as essentially a nervous ailment, its occurrence, apart from some organic disease in the chest, *e.g.* former tuberculosis, or elsewhere, is comparatively rare.

Some cases, however, appear to be of purely nervous origin. To these the term *nervous* or *spasmodic asthma* is applied, and it is more particularly to this form that the symptoms narrated below refer. In such cases no actual disease can be discovered with which the asthma could be directly connected. Attacks of this nature appear capable of being excited in those subject to them by various means. Thus violent emotions are not infrequently the cause of asthmatic paroxysms. Circumstances, apparently the most trifling, have been known to give rise to severe paroxysms of asthma, as the extinguishing of a light in a sleeping apartment or the shutting of a door.

Asthma is very frequently associated with some form of chest complaint, more particularly bronchitis, and hence the term *bronchitic asthma*. The relation between the two ailments in such cases is rendered sufficiently obvious by the fact that the one does not occur without the other; and it is evident that the irritation of the bronchial mucous membrane gives rise, by reflex nervous action, to narrowing of the tubes. When the bronchitis is cured, the asthma disappears.

Closely allied to the last type of asthma is the group of cases associated with hay fever, in which the mucous membrane of the nose and respiratory passages swells up and the bronchial muscles are spasmodically contracted under the influence of various protein substances, to which the persons affected are particularly sensitive. Such substances include in different persons the pollens of various grasses and flowers, the emanations from horses, cats, and various birds when these substances are inhaled. Other persons show similar sensitiveness to certain foods, which may include peas, lentils, oats, fruits, nuts, and particularly some animal substances, such as the meat of certain animals, milk, eggs, oysters, and different shellfish. In still other persons sensitiveness is shown to the products of indigestion at times, although, when the digestive organs are working well, the persons affected may be able to take the same foods which at times are responsible for asthmatic attacks. In still another group of persons sensitiveness of the bronchial mucous membrane is particularly manifested towards bacteria which from time to time are inhaled and develop in the respiratory passages. (*See* HAY FEVER.) This peculiar sensitiveness probably explains how severe attacks of asthma are occasionally brought on by changes of air otherwise inappreciable, and how, on the other hand, the tendency to asthma may be completely cured by a slight change of locality, as, for example, by transference from the country to a town or from one town to another.

Asthmatic-like paroxysms are also of occasional occurrence in some forms of heart disease, and the term *cardiac asthma* is used to describe such cases. They can, however, scarcely be regarded as cases of asthma, but rather as attacks of difficult breathing referable to some

impediment to the pulmonary circulation, the result of the heart disease.

In persons who are the subject of chronic Bright's disease, attacks of asthmatic nature may also occur, the condition being then known as *renal asthma*.

Asthma is much more common in men than in women. It may be developed at any age, but is most frequently observed in early and middle life. A large number of cases originate in diseases affecting the respiratory system during infancy, such as whooping-cough, measles, and bronchitis. Asthma is often hereditary, and in all cases one attack appears to predispose to others.

Symptoms.—The onset of an attack of asthma is usually sudden, although there may exist certain premonitory symptoms which warn the sufferer of its approach, such as a feeling of discomfort, drowsiness, irritability, and depression of spirits. The period when the asthmatic paroxysm comes on is generally during the night, or rather in the early hours of morning. The patient then awakes in a state of great anxiety and alarm, with a sense of weight and tightness across the chest, which he feels himself unable to expand with freedom. Respiration is performed with great difficulty, and is accompanied by wheezing noises. His distress rapidly increases, and he can no longer retain the recumbent position, but gets up, and sits or stands with his shoulders raised, his head thrown back, and his whole body heaving with his desperate efforts to breathe. His countenance is pale or livid, and wet with perspiration, while his extremities are cold ; his pulse is rapid and weak, and frequently irregular or intermitting. All his clothing must be loose about him ; he cannot bear to be touched, and the very presence of others around him seems to aggravate his distress. His one desire is to breathe fresh air ; and he will place himself by an open window and sit for hours in the middle of the night, unmindful of the exposure. The paroxysm, after continuing for a variable length of time, often extending over many hours, begins to abate, the breathing becomes easier, and the subsidence of the attack is frequently marked by the occurrence of coughing with expectoration. After the cessation of the attack the patient appears to be, and feels, comparatively well. In cases, however, of long standing, the subject of asthma comes to bear permanent evidence of its effects. He is easily put out of breath on exertion and he requires to lie with his head elevated, circumstances to be ascribed to organic changes in the chest, which oft-recurring attacks of asthma are liable to induce. (*See* EMPHYSEMA.) The asthmatic paroxysms, although occasionally periodic, do not generally observe any regularity in their return. They may recur each successive night for several days, or there may be no return for many weeks or months, this being to a large extent dependent on a renewal of the exciting cause.

Treatment. — The treatment of asthma consists in the employment of remedies to allay the paroxysms, and in the adoption of measures likely to prevent their recurrence. During the attack the patient should be placed in as favourable circumstances for breathing as practicable. He usually selects the position easiest for himself. Abundance of air should be admitted to the apartment, and he should be interfered with as little as possible. The remedial agents employed with the view of relieving the paroxysms are very numerous, and only a few of the more important of them can be mentioned. Opiates administered internally or hypodermically are sometimes employed but are dangerous, as is also the inhalation of anæsthetic vapours. Much value is attached by many to the smoking of stramonium, and even tobacco smoking appears in some instances to give relief. The fumes of nitre-paper (blotting-paper prepared by being dipped in a saturated solution of nitre and dried) burnt in the apartment often succeed in mitigating the paroxysm. (*See* NITRE.) Glass capsules containing nitrite of amyl, which are crushed and held beneath the nostrils, sometimes give considerable relief in bad cases ; so too does paraldehyde in teaspoonful doses, or the tincture of *lobelia inflata*. Adrenaline either inhaled from a spray or injected beneath the skin sometimes gives immediate relief in a paroxysm. Ephedrine acts in a similar manner None of these remedies, however, ought to be tried without medical advice. An

emetic is often useful when the attack is due to some error in diet. Coffee is a popular and useful remedy, but, to do good, the infusion must be very strong, and taken upon an empty stomach. Dry cupping of the back, and placing of the hands in very hot water contained in basins placed at the side of the bed, are other household remedies.

To prevent the recurrence of the paroxysms special care must be taken by the sufferer to avoid those influences, whether connected with locality or mode of life, which his experience may have proved to have been the occasion of former attacks. Particularly must care be taken to avoid exposure to the weather and other influences apt to bring on bronchitis. Where the paroxysms are of periodic occurrence, the use of quinine or arsenic has been tried with good results. In the group of cases found to be due to a particular animal emanation or article of diet care should be taken to avoid this cause. The sensitiveness of the individual can frequently be diminished by a course of treatment by vaccine prepared from the bacteria present in his expectoration, or, more simply, by a course of injections of peptone 5 per cent solution administered either intravenously or into the muscles.

ASTIGMATISM (ἀ, neg.; στίγμα, a point) is an error of refraction in the eye due to the cornea (the clear membrane in front of the eye) being unequally curved in different directions, so that rays of light in different meridians cannot be brought to a focus together on the retina. The curvature, instead of being globular, is egg-shaped, longer in one axis than the other. The condition causes objects to seem distorted and out of place, a ball for instance looking like an egg, a circle like an ellipse. The condition is remedied by suitable spectacles of which one surface forms part of a cylinder. (*See* SPECTACLES.)

ASTRAGALUS is the name applied to the somewhat square-shaped bone which forms the lower part of the ankle-joint and unites the leg bones to the foot.

ASTRINGENTS (*astringo*, I bind) are substances which cause contraction of mucous surfaces, blood-vessels, or tissues, or which stop secretions and check discharges.

Varieties.—Dilute acids; soluble salts of the heavy metals, such as perchloride of mercury, acetate of lead (sugar of lead), nitrate of silver (lunar caustic), sulphate of copper (bluestone), perchloride of iron, sulphate of zinc; also alum, lime-water, some vegetable products, like tannic and gallic acids, and witch hazel, and adrenaline.

Uses.—Locally, perchloride of mercury, nitrate of silver, and sulphate of copper are applied in very weak solutions to ulcers to harden the healing tissues. Perchloride of iron, tannic and gallic acids, witch hazel, and suprarenal gland extract are much used to control bleeding from the throat, from wounds, etc., or to diminish congestion. Alum and sulphate of zinc are used as astringent eye-washes. In diarrhœa, sulphate of copper, tannic acid, and lime-water are among the chief remedies. For piles, acetate of lead is a useful astringent. For details as to the methods of use see under the headings of the substances mentioned.

ASYNERGIA means the absence of harmonious and co-ordinated movements between muscles having opposite actions—*e.g.* the flexors and extensors of a joint—and is a sign of disease of the nervous system.

ASYSTOLE (ἀ, neg.; συστολή, a contraction) means serious failure of the heart, the walls having become so weak or over-dilated as to be unable to contract.

ATAVISM (*atavus*, a grandfather) means the principle of inheritance of disease or bodily characters from grandparents or remoter ancestors, the parents not having been affected by these.

ATAXIA (ἀ, neg.; τάξις, order) means loss of power of governing movements, though the power necessary to make the movements is still present. Thus an ataxic person may have a good grip in each hand but be unable to do any fine movements with the fingers, or, if the ataxia be in the legs, he throws these about a great deal in walking, though he can lift the legs and take steps quite

well. This is due to a sensory defect. (*See* LOCOMOTOR ATAXIA.)

ATEBRIN is a synthetic acridine product much used in place of quinine for the treatment of malaria. The *British Pharmacopœia* name for it is MEPACRINE HYDROCHLORIDE.

ATELECTASIS (ἀτελής, imperfect; ἔκτασις, expansion) means collapse of a part of the lung, or failure of the lung to expand at birth.

ATHEROMA (ἀθήρη, porridge) is a degenerative change in the inner and middle coats of arteries. (*See* ARTERIES, DISEASES OF.)

ATHETOSIS (ἄθετος, without fixed position) is the name for slow, involuntary, writhing, and repeated movements of the hands and feet, caused by disease of the brain.

ATLAS is the name applied to the first cervical vertebra.

ATONY (ἀ, neg.; τόνος, strength) means want of tone or vigour in muscles and other organs. (*See* TONICS.)

ATOPHAN is a yellowish powder which is used in the treatment of gout and rheumatic conditions.

ATOXYL, or SODIUM ARSANILATE, is a white powder constituting an organic preparation of arsenic. It is used by intramuscular and intravenous injection for treatment of sleeping sickness and other forms of disease due to the presence of trypanosomes in the blood.

ATRESIA (ἀ, neg.; τίτρημι, I pierce) means the absence of a natural opening, or closure of it by a membrane. Thus atresia may be found in new-born infants preventing the bowels from moving, and, in young girls after puberty, absence of the menstrual flow may be due to such a malformation.

ATRIUM is another name for an auricle of the heart. The term is also applied to the drum of the ear.

ATROPHY (ἀ, neg.; τρέφω, I nourish) is a term in medicine used to describe a state of wasting due to some interference with the function of healthy nutrition. It is essential for the maintenance of health that a due relation exist between the processes of waste and repair, so that the one may not be in excess of the other. When the appropriation of nutriment exceeds the waste, hypertrophy or increase in bulk of the tissues takes place. (*See* HYPERTROPHY.) When, on the other hand, the supply of nutritive matter is suspended or diminished, or when the power of assimilation is impaired, atrophy or wasting is the result. Thus the whole body becomes atrophied in many diseases; and in old age every part of the frame, with the exception of the heart, undergoes atrophic change. Atrophy may, however, affect single organs or parts of the body, irrespective of the general state of nutrition, and this may be brought about in a variety of ways. One of the most frequently observed of such instances is atrophy from disuse, or cessation of function. Thus, when a limb is deprived of the natural power of motion, either by paralysis or by painful joint disease, atrophy of all its tissues sooner or later takes place. This form of atrophy is likewise well exemplified in the case of those organs and structures of the body which subserve important ends during fœtal life, but which, ceasing to be necessary after birth, undergo a sort of natural atrophy, such as the thymus gland, and certain vessels specially concerned in the fœtal circulation. The uterus after parturition undergoes atrophy, and the ovaries, after the child-bearing period, become shrunken. Atrophy of a part may also be caused by interruption to its normal blood supply, as in the case of the ligature or obstruction of an artery. Again, long-standing disease, by affecting the nutrition of an organ and by inducing the deposit of morbid products, may result in atrophy, as frequently happens in affections of the liver and kidneys. Parts that are subjected to continuous pressure are liable to become atrophied, as is sometimes seen in internal organs which have been compressed by tumors or other morbid growths, and as is well illustrated in the case of the feet of Chinese ladies, which are prevented from growing by persistent compression exercised from birth. Atrophy may

manifest itself simply by loss of substance; but, on the other hand, it is often found to co-exist with degenerative changes and the formation of fibrous or fatty growth, so that the part may be not reduced in bulk, although atrophied as regards its proper structure. Thus, in the case of the heart, when affected with fatty degeneration, there is atrophy of the proper muscular texture, but this, being largely replaced by fatty material, the organ may undergo no diminution in volume, but may, on the contrary, be increased in size. Atrophy is usually a gradual and slow process, but sometimes it proceeds rapidly. In the disease known by the name of *acute yellow atrophy of the liver*, that organ undergoes such rapidly destructive change as results in its shrinking to half, or one-third, of its normal size in the course of a few days.

The term *progressive muscular atrophy* (*wasting* or *creeping palsy*) is applied to an affection of the muscular system, which is characterised by the atrophy and subsequent paralysis of certain muscles, or groups of muscles, and is associated with morbid changes in the anterior part of the grey matter in the spinal cord. This disease begins insidiously, and is often first observed to affect the muscles of one hand, generally the right. Gradually other muscles in the arms and legs become affected in a similar manner, their atrophy being attended with a corresponding diminution in power. (*See* PROGRESSIVE MUSCULAR ATROPHY *under* PARALYSIS.)

The term *idiopathic muscular atrophy* (also known as *muscular dystrophy*) is applied to a somewhat similar condition affecting young people in whom a progressive degeneration of the muscles occurs. In this condition no change is found in the nervous system after death, the cause apparently acting directly upon the muscles. (*See* MUSCLES, DISEASES OF.)

ATROPINE (Ἄτροπος, fate) is the active principle of belladonna, the juice of the deadly nightshade. It is very extensively used in the treatment of eye diseases. It is said to be used as a cosmetic to give the eyes a full, lustrous appearance, but, in addition to this effect, it temporarily impairs vision by paralysing accommodative power. (*See* ACCOMMODATION.) It has the effect of checking the activity of almost all the glands of the body, including the sweat glands of the skin, the milk glands in the breasts, and the salivary glands in the mouth. It relieves pain, because it paralyses sensory nerves, and relieves spasm by paralysing nerves in the muscle of the intestine, bile-ducts, bladder, stomach, etc. It has the power, in moderate doses, of markedly increasing the rate of the heart-beats, though by very large doses the heart, along with all other muscles, is paralysed and stopped.

Uses.—Externally, an ointment of atropine or extract or liniment of belladonna is much used in neuralgia, and other painful conditions. Plaster of belladonna is very useful in muscular rheumatism. To the breasts, a plaster or extract of belladonna is applied to stop the milk formation in threatened abscess. In eye troubles, atropine drops are used to dilate the pupil for more thorough examination of the interior of the eye, or to draw the iris away from wounds and ulcers on the centre of the eye; they also soothe the pain due to light falling on an inflamed eye: and are further used to paralyse the ciliary muscle and so prevent accommodative changes in the lens of the eye while the person is being tested for spectacles. As belladonna checks sweating, it has a most important use in the excessive night sweats of consumption, being given usually in pills. It is much employed in cough-mixtures for bronchitis and whooping-cough to dry up the mucus and check spasmodic coughing. In renal colic, gall-stone colic, and other agonising spasmodic conditions, atropine is given along with morphia by hypodermic injection. It has been used as an antidote in opium poisoning and to muscarine, the poisonous principle of some toad-stools.

ATROPINE or BELLADONNA POISONING.—This may occur from children eating the berries or leaves of the deadly nightshade. The warning symptoms are: (1) great dryness of the mouth and throat, (2) wide dilatation

of the pupils, (3) increased rate of the heart's action. There is sickness later, and the poisoned person has an excited delirium with, at the same time, bodily languor and weakness. If the dose has been very large, paralysis, unconsciousness, and gradual stoppage of heart and breathing ensue.

Treatment.—An emetic should be given as soon as possible; such as a tablespoonful of mustard in cold water. After vomiting has ceased, large draughts of water and stimulant, such as alcohol and sal volatile, are administered, and if breathing become feeble, artificial respiration must be performed. Small doses of morphine and pilocarpine may be given as antidotes. The patient should be made to pass water frequently, as the poison is excreted by the kidneys, and may otherwise be reabsorbed.

AUDITORY NERVE, or NERVE OF HEARING, is the eighth of the cranial nerves. It begins on the floor of the fourth ventricle in the medulla or hind brain, though it has numerous connections with other parts of the brain. It runs outwards, enters the temporal bone of the skull, and is distributed to various parts of the internal ear. It really consists of two branches; one of these is concerned with hearing, while the other is distributed to the vestibule and semicircular canals of the internal ear, and is concerned with the sense of balancing. Disturbance of the former causes deafness and of the latter giddiness.

AURA (*aura*, a breeze) is a peculiar feeling which persons, subject to epileptic or hysterical seizures, have just before the onset of an attack. It may be a sensation of a cold breeze, a peculiar smell, a vision of some animal or person, an undefinable sense of disgust, or the like, but it is very important for persons who experience it, because it gives warning that a fit is coming, and enables a place of safety or seclusion to be reached.

AURAL DISEASES (*see* EAR, DISEASES OF).

AURICLE is a term applied both to the pinna or flap of the ear and also to the chamber at either side of the base of the heart.

AURUM is the Latin name for gold.

AUSCULTATION (*auscultо*, I listen) is a term in medicine applied to the method employed by physicians for determining, by the sense of hearing, the condition of certain internal organs. The ancient physicians appear to have practised a kind of auscultation, by which they were able to detect the presence of air or fluids in the cavities of the chest and abdomen. In 1761 Auenbrugger of Vienna introduced the art of *percussion* in reference more especially to diseases of the chest. This consisted in tapping with the fingers the surface of the body, so as to elicit sounds by which the comparative resonance of the subjacent parts or organs might be estimated.

In 1819 the distinguished French physician, Laennec, introduced the method of auscultation by means of the stethoscope (στῆθος, the chest, and σκοπέω, I examine), with which his name stands permanently associated. For some time previously, physicians, more especially in the hospitals of Paris, had been in the habit of applying the ear over the region of the heart for the purpose of listening to the sounds of that organ, and it was in the employment of this method that Laennec conceived the idea that these sounds might be better conveyed through the medium of some solid body interposed between his ear and the patient's chest. He accordingly, by way of experiment, rolled up a quire of paper into the form of a cylinder and applied it in the manner just mentioned, when he found, as he states, that he was able to perceive the action of the heart more distinctly than he had ever been able to do by the immediate application of his ear. He thence inferred that not merely the heart's sounds, but also those of other organs of the chest might be brought within reach of the ear by some such instrument, and he, therefore, had constructed the wooden cylinder, or stethoscope, which bears his name. This instrument was subsequently modified by Piorry to the form now generally used of a thin narrow cylinder of about 7 inches long, with an

expansion at one end for applying to the chest, and a more or less flattened surface at the other for the ear of the listener.

For some time now the binaural stethoscope, consisting of a small ex-

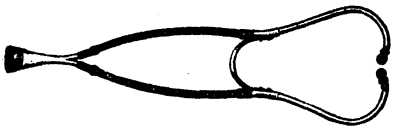


FIG. 26.—Binaural stethoscope.

panded chest-piece and two flexible tubes with ivory or vulcanite ends that fit tightly into the ears of the observer, has come into general use. This form is, in some ways, more convenient to use, though the sounds are no more clearly heard than with Piorry's instrument, and, in some cases, are less distinct, as the conduction of sound by the flexible tubes is entirely aërial. Various modifications of the binaural stethoscope have been introduced, such as the phonendoscope, in which the place of the chest-piece is taken by a small drum. An electrical stethoscope has recently been devised, through which, by the help of microphone, telephone, and electric valves, the beating of the heart, murmurs, etc., may be heard at a distance from the patient with any desired intensity.

The numerous conditions affecting the lungs can be recognised and discriminated from each other with a precision which, but for auscultation and the stethoscope, would have been altogether unattainable, a point which bears most intimately upon the treatment of this great and common class of ailments. The same holds good in the case of the heart, whose varied and often complex forms of disease can, by auscultation, be identified with striking accuracy. But in addition to these, its main uses, auscultation is found to render great assistance in the investigation of many obscure internal affections, such as aneurysms and certain diseases of the œsophagus and stomach. To the accoucheur the stethoscope yields valuable aid in the detection of some forms of uterine tumors, and especially in the diagnosis of pregnancy,—the auscultatory evidence afforded at a particular stage by the sounds of the fœtal heart being by far the most reliable of the many signs of that condition.

AUTACOID (*αὐτός*, self; *ἄκος*, remedy) is a term applied to an organic substance formed by the cells of one organ and passed into the circulation to produce effects like those of drugs upon other organs at a distance. Some autacoids have a stimulating property and are then known as hormones; others have a controlling or inhibitory influence and are then known as chalones or colyones. An example of the former group is insulin and of the latter group the substance in the placenta which prevents secretion of milk.

AUTO- (*αὐτός*, self) is a prefix meaning self.

AUTOGENOUS (*αὐτογενής*, self-produced) means self-generated and is the term applied to products which arise within the body. It is applied especially to bacterial vaccines manufactured from the organisms found in discharges from the body and used for the treatment of the person from whom the bacteria were derived.

AUTO-INTOXICATION (*αὐτός*, self; *τοξικόν*, poison) means literally self-poisoning, and is any condition of poisoning brought about by substances formed in or by the body. With regard to micro-organisms, many of these produce by their growth substances which, after accumulating to a certain amount, check the growth if they do not destroy the life of the organism: for example, the alcohol formed by the yeast plant. A similar condition occurs also in animals and man. In certain persons substances are formed during digestion of various foods which produce great irritation; and in those subject to habitual constipation a state of ill-health is caused by substances formed, either by digestion or by bacterial growth in the bowels, and absorbed into the general system. Acute diseases, like pneumonia, tetanus, and diphtheria are, broadly speaking, examples; for their most serious symptoms are due to poisons circulating in the blood, though produced, not by the body itself, but by micro-organisms implanted in it. Other examples are furnished by dis-

eases of the liver, like jaundice and acute yellow atrophy, when the liver fails to excrete poisonous substances which it ought to get rid of in the bile; by diabetes, in which the patient may become unconscious and die owing to the formation in the blood of acetone or some similar substance; and by gout, in which changes in the joints follow on faulty chemical processes in the tissues.

The term is most frequently applied to those chronic, insidious, and less severe types of poisoning which result from the presence of bacteria about the teeth, in the intestine, and in small, unrecognised, suppurating centres in the deeper parts of the body. Some of these produce a gradual destructive action on the blood (*e.g.* poisoning due to *Streptococcus hæmolyticus* found in the tooth sockets). Others produce slow inflammatory changes in the synovial membranes of the joints, leading to arthritis, or, in the delicate serous membranes, leading to chronic inflammation of these structures.

AUTOLYSIS means the disintegration and softening of dead cells brought about by enzymes in the cells themselves.

AUTOMATISM means the performance of acts without conscious will, as, for example, after an attack of epilepsy or concussion of the brain. In such conditions the person may perform acts of which he is neither conscious at the time nor has any memory afterwards. The condition is of considerable importance from a legal point of view because acts done in this state, and for which the person committing them is not responsible, may be of a criminal nature.

AUTONOMIC (*αὐτόνομος*, independent) is the term applied to a part of the nervous system regulating the functions of some of the internal organs independently of the will power. This part of the nervous system is connected with the brain and spinal cord through certain nerve centres in the mid-brain, the medulla, and the lower end of the cord, by nerve fibres in the 3rd, 7th, 9th, and 10th cranial nerves and 2nd, 3rd, and 4th sacral nerves. The term autonomic nervous system is by some writers used to include both the autonomic system proper and the remainder of the 'vegetative' nervous system which is known as the 'sympathetic' system. (*See* SYMPATHETIC SYSTEM.)

AUTOPSY (*αὐτοψία*, a seeing with one's own eyes) means the examination of the internal organs of a dead body. It is carried out in such a way as to produce almost no disfigurement. The brain is examined by an opening across the scalp, afterwards hidden by the hair, and the contents of chest and abdomen are inspected through an opening down the middle line in front. If necessary minute pieces of organs are removed for microscopic examination. It is a social duty of the deceased person's relatives to permit or request a *post-mortem* examination in cases where the disease was a matter of uncertainty. Nothing causes so much doubt in diagnosis, and therefore in treatment, as the inability of a medical man to confirm his opinions, owing to sentiment on the part of a deceased person's relatives.

AUTO-SUGGESTION is the term applied to a peculiar mental state, which sometimes occurs after accidents, in which the will and judgement are partially perverted, so that slight or temporary injuries are greatly exaggerated in the imagination, and the person believes himself to be affected by some serious disability. Examples of this are found in paralysed and insensitive limbs following some minor bruise, for example in a railway accident, and the blindness, deafness, or inability to speak, which sometimes followed concussion in soldiers, especially when the injury was received in the dark. This state is also called 'traumatic suggestion'. The condition frequently approaches very near to or is mingled with the condition of malingering, in which the person consciously suggests to himself or produces some disability from an ulterior motive, as, for example, in some of the prolonged cases of disability following a trifling injury for which a person is in receipt of compensation. The term is also applied to the reverse process, by which, either as a result of suggestion by another person, or suggestion applied by the will power of the

person affected, a cure of such a condition is accomplished.

AVERTIN (*see* BROMETHOL).

AVITAMINOSIS is the term applied to the condition of a human being or an animal deprived of one or more vitamins.

AXILLA is the anatomical name for the armpit. (*See* ARMPIT.)

AZOCHLORAMIDE is a new chlorine antiseptic, recommended, for example, in the treatment of the infected area in diabetic gangrene.

AZOTÆMIA means the presence of urea and other nitrogenous bodies in greater concentration than normal in the blood. The condition is generally associated with advanced types of kidney disease.

AZOTE (ἀ, neg.; ζωτικός, capable of maintaining life) is another name for nitrogen.

AZOTIZED bodies are bodies containing nitrogen or azote. The principal are the proteins, substances which form most of the bodily tissues, of which albumin is the chief. (*See* PROTEINS, ALBUMINS, NITROGENOUS FOODS.)

B

BABINSKI REFLEX is the name applied to an abnormal response of the plantar reflex. When a sharp body is drawn along the sole of the foot, instead of the toes bending down towards the sole as usual, the great toe is turned upwards and the other toes tend to spread apart. It is normally found in very young children, but in adults indicates some severe disturbance in the upper part of the central nervous system.

BACILLÆMIA is the term given to the condition in which bacilli are present in the blood but do not multiply therein. (More usually called BACTERIÆMIA.)

BACILLI (*bacillus*, a little rod) are micro-organisms which are rod-like in form. (*See under* BACTERIOLOGY.)

BACILLURIA means the presence of bacilli in the urine, the result, usually, of infection of the kidney or the bladder.

BACK.—The back consists mainly of the spinal column and hinder parts of the ribs and the wide-spreading iliac or haunch bones with the sacrum below. The bones are covered by thick and powerful muscles, which above support and move the head and which below pass round the flanks and downwards into the lower limbs. The skin covering the back is very insensitive and is not greatly subject to painful conditions. The powerful muscles, of which the chief is the erector spinæ, are much subject to minor injuries, the result of twists and strains, and also to rheumatic affections. (*See* LUMBAGO.) Diseases and injuries of the spinal column and spinal cord are of a very serious nature. (*See* SPINAL COLUMN *and* SPINAL CORD.) A theory has been advanced that many painful disorders and diseases are due to pressure upon nerves issuing between the vertebræ of the spine resulting from displacements of these bones. This idea is, however, without foundation.

BACKACHE is a symptom of many diseases. In addition to being the result of local causes, pain referred to the back is often due to disease or disorder in deep-seated organs.

Causes.—(*a*) LOCAL.—*Lumbago*, or a rheumatic condition in the muscles or nerves of the loins, which may be of a chronic aching nature, or may come on suddenly, feeling like a blow, is the commonest cause. A similar condition is often set up by unwonted exercise of these muscles in golfing, rowing, and the like. *Weakness* in growing boys or girls may cause a feeling of extreme weariness every day, and may be associated with lateral curvature of the spine, if not attended to. *Spinal disease* sometimes causes backache, and is associated with rigidity of the back, and often with great tenderness to the touch, with or without any deformity. Stiffness with pain sometimes follows some long-continued fever which has led to weakness in the back, especially found after typhoid fever; a state of permanent stiffness is sometimes found in old people in whom the spine has become the seat of chronic rheumatic changes leading to the formation of bony outgrowths between the different vertebræ.

(*b*) INDIRECT.—*Kidney disease* is sometimes a cause of pain in the loins. All sorts of *pelvic trouble* in women, such as menstrual disorders, prolapse of the womb, and ovarian inflammations and tumors, are constantly accompanied by a dull, dragging-down pain in the back. *Gall-stones* cause an acute pain high up near the right shoulder. *Stomach ulcers* and *catarrh* often cause a pain above the level of the last rib and close to the left side of the spine. Backache is also one of the first symptoms of *smallpox*, and of several other febrile diseases.

Treatment.—This is of course the treatment of the disease causing the pain. When the pain is due to a local cause, such as lumbago, the loins must be kept warm by extra clothing or a flannel belt. Belladonna plaster (*see* ADHESIVE PLASTERS) relieves it, also massage, ironing with a flat-iron through a piece of cloth, and, in acute cases, application of mustard leaf, hot fomentations, or a hot-water bottle or thermophore. Weakness in young persons is got over by Swedish drill, calisthenics, and other forms of exercise, with regular daily periods of rest, and

the careful avoidance of stooping or a twisted position at lessons. Perhaps the best exercise of all for strengthening the muscles of the back is got by the use of a skipping-rope.

BACTERIA (*βακτήριον*, a rod) is a term which at first meant micro-organisms in the form of short rods, but the word is now vaguely used to cover a great variety of low microscopic forms of plant life. It is equivalent to terms such as 'germs', 'microbes', 'micro-organisms'.

BACTERICIDE strictly means anything which kills bacteria, but is usually applied to drugs and antiseptics which do this. Hence BACTERICIDAL.

BACTERIOLOGY is the branch of biological science concerned with the study of the lowest forms of plant life, particularly of those which cause disease in men and animals, and putrefaction. (For details on INFECTION, IMMUNITY, ANTISEPTICS, VACCINATION, SERUM THERAPY, and OPSONINS, see these headings.) Although bacteria had been noticed about 1687 by Leeuwenhoek and others after the introduction of the microscope, they were not definitely associated with disease until the nineteenth century. Goodsir in 1842 described *sarcinæ* in the stomach, and Davaine in 1865 noticed the large organisms of anthrax, but Pasteur was the first, about 1865, to make a complete study of the manner in which micro-organisms multiply and produce disease. He was followed by Koch, who in 1876 worked out the complete life-history and spore formation of the bacillus of anthrax. In 1877 Koch published his methods of staining films of bacteria; in 1878 his great memoir on the cause of infectious diseases, describing those kinds of bacteria which produce suppuration in wounds; and in 1881 his method of obtaining pure cultures of different organisms. Koch's methods founded the science of bacteriology, and with little change they are still in use.

Classification of micro-organisms.—If we include the filter-passing viruses under the heading of 'bacteria', the micro-organisms of the vegetable kingdom which cause disease may be grouped as follows: (1) *Moulds*, of which penicillium, the green cheese-mould, and mucor, a white mould, are examples. These grow on leather, bread, and in fact anything of a nutritious nature which happens to be damp, their spores floating everywhere in the air. One mould is sometimes a cause of pneumonia, another causes disease in salmon, and others produce

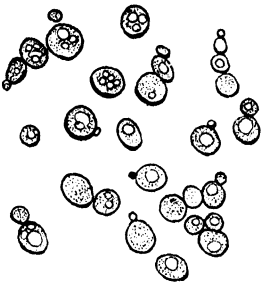


FIG. 27.—Yeast in process of budding. Magnified by 350. (Thoma's *Pathology*.)

the various forms of ringworm. (2) *Yeasts*, of which one is of great importance as being the producer of alcohol. (3) *Bacteria* proper. The latter are again divided, mainly owing to their shape, into *cocci*, which are round; *bacilli*, which are long, slender rods; *spirilla*, which are curved or wavy. They have secondary names according to some physical property, such as the power of producing colour, as *staphylococcus pyogenes albus*, which appears under the microscope in grape-like clusters, produces pus in the body, and grows in white masses when artificially cultivated. *Streptococci* are cocci arranged in chains, *diplococci* occur in pairs. (4) *Rickettsiæ*, named after the bacteriologist Ricketts, are disease-causing micro-organisms, coccal or rod-shaped, and intermediate in size between bacteria and viruses. Rickettsiæ are the infecting agents in typhus and typhus-like fevers, and also of trench fever. *Rickettsia prowazeki*, the infecting agent of typhus, is conveyed to man by infected lice. Other Rickettsial infections—such as Rocky Mountain fever—are conveyed by ticks or fleas. (5) *Filter-passers* or *viruses* are living agents which cause disease and are so minute that they pass through porcelain filters impassable by ordinary bacteria and cannot be seen with ordinary microscopic methods (ultramicro-

scopic). They appear to be living crystals of protein, and cause such diseases as infantile paralysis, measles, mumps, chicken-pox, distemper, influenza.

Properties of bacteria.—MOTION.—It is doubtful if cocci have this power, but most of the bacilli and spirilla move rapidly and freely, either by quick contortions similar to those of a fish-tail, or by beating the fluid in which they lie by flagella, long whip-like lashes, with which many, such as the bacillus of typhoid fever, and the spirillum of cholera, are provided. This power of movement is of immense importance in the spread of disease. The movements become more active if the temperature is raised and bacteria are attracted to certain substances and repelled by others, this property being known as *positive* and *negative chemiotaxis*.

SIZE.—It is difficult at first to grasp the extreme smallness of these bodies. Many thousands of them may lie upon the smallest visible speck of dust. The round forms or cocci are not more than $\frac{1}{25000}$ inch in breadth. The bacillus of anthrax, much the largest disease-producing bacillus, is less than $\frac{1}{3000}$ inch in length, and most of the bacilli are only $\frac{1}{50000}$ inch, or a little more, in breadth.

REPRODUCTION.—The moulds have special filaments which produce hundreds of spores, and the yeasts give off little buds from their surface which produce new chains of yeast, but most of the simpler bacteria multiply by growing in size and then splitting into two. As a result of this, long chains are formed in which the individuals lie end to end, or masses, in which they lie side by side. A bacterium may grow and split in about half an hour, with the result that, given favourable circumstances of warmth, food, etc., a single bacillus could, in the course of twenty-four hours, produce nearly *300,000,000,000,000* individuals. Fortunately such favourable circumstances are seldom completely attained in nature. Another important method of reproduction possessed by some bacilli, such as that of anthrax, is by spores. Each bacillus produces only one spore, which, however, is much more tenacious of life than the bacillus and often capable of surviving after being boiled, or after drying for months or years. Each spore again produces a bacillus when it lights in a suitable germinating ground. This explains many obscure cases of infection.

Effects of growth.—Diseases are due, in many cases, to the growth of the bacteria and their irritation or destruction of the tissues in which they lie, as, for example, in tuberculosis, leprosy, abscess; in other cases to the production by them of poisonous substances called 'toxins', which circulate in the blood, and cause fever, delirium, paralysis, and other general effects. In this manner the serious results of pneumonia, diphtheria, tetanus, and most other acute infectious diseases are produced. Many bacilli produce acids by their growth, such as that which turns milk sour, and may be of great commercial value, as the bacillus which produces vinegar. Alcohol, as is well known, is the product of the activity of yeast. Many bacteria also produce brilliant pigments of red, yellow, blue, green, or purple colour, such as the *Bacillus prodigiosus*, which turns milk red, and the bacillus which produces blue pus in abscesses. Many bacteria produce gases from the substances in which they develop such as sulphuretted hydrogen, carbon dioxide, marsh gas, etc. Others liquefy solid substances, such as gelatin, and in this manner the common bacillus of the intestine, which inhabits the alimentary canal from a few days after birth till the end of life, probably plays a useful and necessary part in digestion, although it also, from time to time, when other factors aid it, produces untoward results in appendicitis, peritonitis, and other diseases in the neighbourhood of the bowels. Many of the actions of bacteria depend upon ferments which are produced by them and exercise a complicated action. These ferments are sometimes set free in the fluid surrounding the bacteria, and sometimes retained for a time within the bacteria themselves. Most bacteria produce substances which finally stop their growth and activity; thus vinegar, alcohol, and the evil-smelling substances resulting from the activity of the intestinal bacillus check the excessive growth of and finally kill their respective bacteria, and a similar result explains the crisis in, and recovery

from many diseases like pneumonia and relapsing fever.

Conditions of growth.—Food.—Some bacteria live by taking carbonic acid and nitrogen from the air and producing complex organic substances in their growth, so that these bacteria are of great importance in some of the operations of farming. Most, however, break down the complex plant and animal bodies into simpler substances. All require some moisture for their growth. Some bacteria are readily killed by drying, thus the spirillum of cholera is killed by two or three hours of drying, but the ordinary bacteria of suppuration may be dried for at least several days, and anthrax spores still survive after drying for several years. A few bacteria live best, or only, in living bodies, being then called 'parasitic', or, if they produce disease, 'pathogenic'. Others live only in dead matter, and are called 'saprophytic'. The substances on which they grow best are gelatinous or starchy matters containing a little soluble animal substance, like peptone, and a trace of salts, or in fluids like broth, containing much animal or vegetable matter.

Warmth.—The bacteria of putrefaction flourish best at the ordinary temperature found inside a house—*i.e.* about 20° C.; the disease-producing bacteria at the temperature of the body—*i.e.* 37° C. Freezing, though it stops growth for the time, does not kill most bacteria, which afterwards take on new activity; but a process of thawing and freezing repeated several times in succession kills all organisms. Boiling, on the other hand, is more deadly to them, and, if continued for a few minutes, kills most bacteria, though not their spores. The latter are killed by superheated steam at 120° C. Dry heat can be survived at much higher temperatures. The surest method of destruction is Koch's plan of sterilising dishes, instruments, etc. These are exposed for twenty minutes to steam rising from boiling water, in a special apparatus, or, equally efficiently, in an ordinary pot with a lid. This kills all bacteria. Next day they are similarly treated, when any spores which have been present have developed into bacteria, and these are likewise killed. A third application of steam, on the day again following, renders the freedom from spores and bacteria sure.

Light.—Bacteria develop best in the dark, though some produce their special effects only when exposed to light. Direct sunlight stops their growth, and exposure for several hours to the full light of the sun kills most bacteria, notably those of plague and tuberculosis. The effect of sunlight is increased by dryness, and it has been found, for example, that even anthrax spores, which possess greater vitality than almost any other bacteria, are killed when dried and exposed to sunlight for one and a half hours, although,

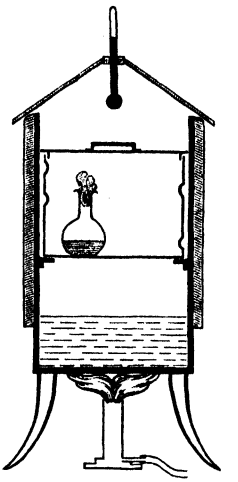


Fig. 28.—Diagrammatic section of Koch's steriliser, showing the manner in which the metal box containing the articles to be sterilised is exposed to steam.

if moisture is present, a much longer exposure to sunlight is necessary. The effect is still further increased by heat, so that bacteria live for a very short time only in hot, dry, and sunshiny localities. Electric light has a similar, although weaker action, the violet rays being most powerful in killing bacteria, but the X-rays have very little effect in checking bacterial growth.

Air.—Most bacteria grow with or without fresh air. A certain amount of fresh air is necessary to rapid putrefaction, but a very free supply, and certainly the presence of pure oxygen, tends to destroy bacteria. Bacteria, such as those of tetanus (lock-jaw) and of gas gangrene, can develop only

BACTERIOLOGY

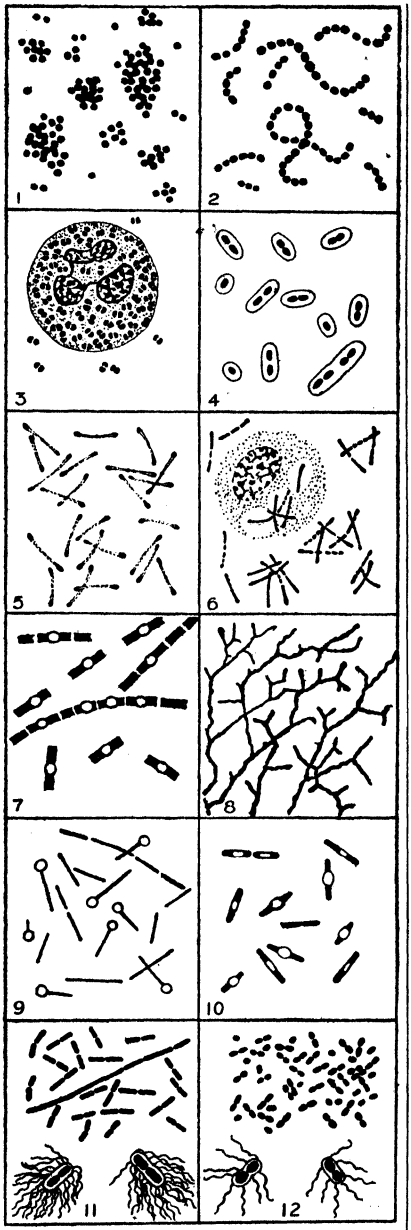


FIG. 29.—Various bacteria of disease. (1) Staphylococcus. (2) Streptococcus. (3) Gonococcus in pus cell. (4) Pneumococcus, with capsule. (5) Diphtheria bacillus. (6) Tubercle bacillus, with phagocyte. (7) Anthrax bacillus. (8) Organism of actinomycosis. (9) Tetanus bacillus. (10) Bacillus of gas gangrene. (11) Typhoid bacillus (the lower two show flagella). (12) Bacillus coli (the lower two show flagella). (Drawn by R. Muir.)

deep in the earth or in deep wounds where oxygen is absent, and these are known as 'anaerobic bacteria'.

Relation to disease.—The first bacterium stated to be connected with disease was the anthrax bacillus. Since the introduction of modern bacteriological methods about 1880, a great number of bacteria responsible for disease have been demonstrated. The proof that a bacterium is the direct cause of any disease depends upon the fulfilment of three conditions laid down by Koch: (1) that the bacterium be always found in the body or its discharges when a certain disease is present; (2) that the bacterium can be isolated and cultivated under laboratory conditions and thus freed from other possible causes of the disease; and (3) that on the inoculation of a healthy man or animal with a culture of the bacterium, which is now free from any possible contamination, symptoms of the original disease appear in the animal inoculated. Thus complete proof has been obtained in the case of a large number of diseases, while in the case of other diseases for some technical reason, such as that the organism cannot be grown in the laboratory or because no animal can be found to suffer typically from the disease, an absolute proof of the connection between the disease and the organism is so far wanting.

Among the diseases which have been definitely shown to be due to particular organisms are the following:

ACUTE INFLAMMATION AND SUPPURATION.—Localised inflammation may be due to a great variety of organisms, of which the various *staphylococci* and *streptococci* are the chief. Staphylococci are the most common agents in producing pustules on the skin, boils, and catarrhs of mucous surfaces. Streptococci commonly produce more deep-seated, serious, and spreading diseases, such as erysipelas. They also occur in broncho-pneumonia and ulcerative endocarditis. The streptococcus is a common cause of tonsillitis, is responsible for puerperal fever, often starts infection of wounds (especially those

sustained in war), and indeed may attack any part of the body, resulting in such conditions as peritonitis, meningitis, empyema. Suppuration may also be produced by several bacteria mentioned below as associated with particular diseases.

PNEUMONIA of the acute lobar type is usually due to the pneumococcus or *Diplococcus lanceolatus*. This organism is of several different types, types I. and II. being much the most common, while type III. is found in about 12 per cent of cases of pneumonia, and of these about half end in death. A few cases of pneumonia are due to the *streptococcus*, the *bacillus of influenza*, and the *pneumobacillus*. The catarrhal type of pneumonia is due to a great variety of organisms.

CEREBRO-SPINAL FEVER.—This disease is due to the *Meningococcus* or *Diplococcus intracellularis meningitidis*, which occurs in four types. It appears to gain entrance to the body through the nasal passages, where it is frequently found even in people who do not suffer from the disease.

RHEUMATIC FEVER, especially that variety associated with severe disorders of the heart valves, is thought to be due to an organism of the streptococcus group.

SCARLATINA and some allied infections are due to an organism of the streptococcus group.

GONORRHŒA is due to a diplococcus—the gonococcus—which is found to a large extent inside the cells of the discharge.

SYPHILIS is caused by an organism known as the *Spirochæta pallida* or *Treponema pallidum*, a minute spiral-shaped organism of which the precise place in the vegetable or animal kingdom is not definitely settled. Other diseases due to different varieties of spirochætes are RELAPSING FEVER, YAWS, INFECTIVE JAUNDICE, and RAT-BITE FEVER.

TUBERCULOSIS is due to one or other of a group of bacilli known as the 'human tubercle bacillus', 'bovine bacillus', etc. Phthisis in the lung is almost always caused by a bacillus of the human type, while abdominal tuberculosis, as well as tuberculosis of bones and joints, found in children, is due in a good many cases to the bovine type derived from milk, and tuberculosis of the glands in young children is due to the latter type. Other types of tubercle bacilli cause

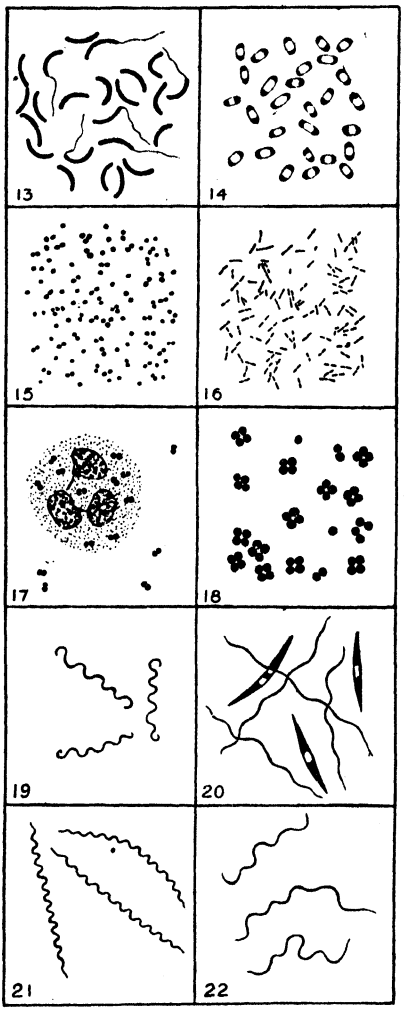


FIG. 30.—Various bacteria of disease. (13) Cholera vibrio showing flagella. (14) Plague bacillus. (15) Micrococcus of Malta fever. (16) Influenza bacillus. (17) Diplococcus of cerebro-spinal meningitis. (18) Micrococcus tetragenus. (19) Spirochæte of epidemic jaundice. (20) Spirochæte and fusiform bacillus of Vincent's angina (septic sore throat). (21) Spirochæte of syphilis. (22) Spirochæte refringens. (Drawn by R. Muir.)

similar diseases in birds and fish, while closely allied bacilli are found subsisting in grass. LEPROSY is caused

by a bacillus presenting certain close resemblances to the bacillus of tuberculosis.

GLANDERS, or FARCY, is caused by *Bacillus mallei*.

ACTINOMYCOSIS, or WOODY TONGUE, is caused by a bacillus or streptothrix growing in long chains and forming globe-shaped bodies, the *Streptothrix actinomyces*. The MADURA FOOT of India is caused by a similar streptothrix.

ANTHRAX, or WOOLSORTERS' DISEASE, is due to a relatively large organism, the *Bacillus anthracis*, which produces spores that may retain their vitality when dried for several years.

TYPHOID FEVER and the group of diseases related to it, such as paratyphoid fever A and B, bacillary dysentery, and forms of food poisoning, are due to the *Bacillus typhosus*, *Bacillus paratyphosus*, *Bacillus dysenteriae*, and a number of other organisms which resemble one another considerably in their mode of growth, cultural characters, and, broadly speaking, in the effects which they produce on the intestine and the body generally.

DIPHTHERIA is due to the *Bacillus diphtheriae* (Klebs-Loeffler bacillus), which is often found in the throat of healthy persons, but which in susceptible persons produces a very severe type of surface inflammation with general toxic effects throughout the body.

TETANUS, or LOCK-JAW, is produced by the *Bacillus tetani* or drum-stick bacillus, which is an anaerobic bacillus growing especially deep in the soil or in dung-heaps. It produces spores which, like those of anthrax, are extremely tenacious of life.

GAS GANGRENE is a disease produced by various anaerobic bacilli, especially the *Bacillus Welchii* (or *Bacillus aerogenes encapsulatus*), which grow deep in highly cultivated soil, and like the tetanus bacillus cause infection when such soil is disturbed.

CHOLERA is due to the cholera spirillum, an organism of S-shaped appearance which is very readily destroyed by drying or by weak antiseptics.

PLAGUE is caused by a rod-shaped bacillus, *Bacillus pestis*, which is transmitted to man through rodents and fleas.

BACTERIOLOGY

INFLUENZA is believed in some cases at least to be due to a small bacillus, the *Bacillus influenzae* (Pfeiffer's bacillus). Some large epidemics of recent years have certainly been caused by a filter-passing virus, which is looked upon as the primary cause of true influenza.

WHOOPING-COUGH is believed to be due to a minute oval bacterium, the bacillus of Bordet-Gengou.

MALTA FEVER is due to a minute coccus, the *Micrococcus melitensis*.

MALARIAL FEVERS are due to a number of organisms which are plasmodia or minute parasites of animal nature. Three different but closely related types cause the three varieties of malaria. Other diseases, which are due to similar minute animal parasites, are AMŒBIC DYSENTERY, due to the *Entamœba histolytica*, SLEEPING SICKNESS, due to the *Trypanosoma gambiense*, KALA-AZAR, due to the *Leishmania donovani*, and other closely allied diseases.

Other diseases have been found to present characters which render probable their organismal origin, but either materials have not yet been found suitable for the growth of these organisms in the laboratory, or in other cases it has been found that the organisms are not visible by the power of the modern microscope, and that they are so small that they can pass through the pores of a porcelain filter which will retain ordinary germs. Some of these germs, known as viruses or filter-passers, can be cultivated and cause disease when inoculated into animals. Into this group of diseases fall smallpox measles, yellow fever, infantile paralysis and hydrophobia.

Study of bacteria.—It is impossible to go more than very briefly into the highly technical methods employed in a bacteriological laboratory. The material to be examined must be collected in such a way as to prevent contamination by organisms from outside sources, *e.g.* the skin or the air, For example, in collecting matter from the throat to find if the diphtheria bacillus is present, a glass tube plugged with cotton-wool and containing a cotton-wool swab at the end of a piece of wire is used. The throat is rubbed with the swab, which is then carefully returned, reinserted in the tube, and

sent to the laboratory. When the urine is to be examined for the presence of bacteria, it is carefully drawn off under aseptic precautions by means of a catheter into a sterile bottle closed with a sterilised stopper and similarly sent to the laboratory. Similar precautions are taken in the case of material from other sources. The bacteriological methods used fall into four groups.

(1) EXAMINATION BY THE MICROSCOPE.—If bacteria are placed in a little fluid upon a glass slide and examined with the aid of a microscope, they appear when magnified some hundreds of times as clear, transparent, often quickly moving particles or lines. For careful observation they must be killed by heat or by some powerful chemical substance, and thereafter stained with appropriate reagents. These are usually aniline dyes of different colours; and the bacteria of different diseases, apart from their size, shape, and general appearance, can often be recognised from the way in which they become stained or fail to stain with certain dyes. Methylene blue is a simple dye generally used for all bacteria. The tubercle bacillus is distinguished by the peculiar tenacity with which it retains the red fuchsin stain when treated by sulphuric acid and spirit, while from other bacteria this dye can be readily extracted by these reagents. The majority of bacteria are stained a deep purple colour by Gram's stain (successive application of gentian-violet, iodine, and alcohol), but some are readily recognised by being negative to this stain, *e.g.* the gonococcus, meningococcus, and the typhoid bacillus. Neisser's stain is much used for the recognition of the diphtheria bacillus; it consists of two tains (methylene blue and Bismarck brown) which stain this bacillus in a characteristic variegated manner. Many other bacteria have similar special staining properties by which they can be recognised without further trouble.

(2) CULTIVATION.—In general, however, it is not possible to identify an organism with certainty, simply by its appearance, even if suitably stained, and the changes which its growth in large masses produces upon various nutrient substances contained in glass culture tubes ' must also be observed. In doing this the first necessity is to prepare a nutrient ' medium ' and place it in flat covered plates or in glass tubes of which the open end is plugged with a piece of cotton-wool so as to exclude organisms that might enter from the air while freely admitting the air itself. These tubes and their contents must be carefully ' sterilised ' in the manner already indicated; they are then ' inoculated ', by means of a purified platinum needle or a glass rod, with material containing the organism which it is desired to study; and are finally placed inside an incubator maintained day and night at the temperature of the body. After being ' incubated " for several days the bacteria have multiplied so as to form ' colonies '

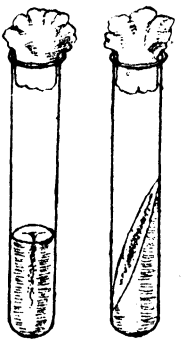


FIG. 31.—Culture tubes for bacteria. The tube on the left shows a ' stab-culture ' in gelatine, that on the right a ' stroke-culture ' on agar.

easily visible to the naked eye, and from these small fragments are removed by the platinum needle, stained, and microscopically examined.

Among the nutrient substances on which bacteria are grown in the laboratory, the chief are broth, gelatin, agar, potato, and milk. The turbidity produced in broth after some days' growth, the power to liquefy gelatin, the colours produced on the surface of agar or of cut potato, and the curdling of milk form distinctive characters of different bacteria. Again various sugars may be added to these substances and the bacteria are thus divided into classes according to their power of fermenting the sugar as they grow. The formation of acid by other bacteria is tested by adding to the tubes litmus or some other reagent which changes its colour when acidified, and the development of

gas-bubbles is also an important distinguishing mark.

Some bacteria (known as anaerobic bacteria) fail to grow unless the oxygen be extracted from the tubes in which they are placed or an atmosphere of hydrogen gas be provided by means of a special apparatus.

Since many different types of bacteria are as a rule mingled together in the discharge from a diseased part of the body, it becomes necessary to separate these and to obtain for study cultures of each, free from contamination by the others. For this separation, the organisms are either grown upon a medium to which have been added substances that destroy some kinds of bacteria while sparing others; or they are diluted by mixture with a large quantity of sterile fluid, and, drops of this being stroked over the surface of some nutrient material lying on a broad covered glass plate (Petri dish), the individual bacteria produce within a few days widely separated 'colonies' that can be seen by the naked eye and removed for further examination.

(3) AGGLUTINATION or PRECIPITATION is a method much used for the identification of certain bacteria. The manner in which it is carried out is described in the article AGGLUTINATION. It is usually performed by making a uniform emulsion with water of the bacteria to be identified, and then adding on a microscopic slide a drop of this emulsion to a drop of 'immune' serum. Various stock sera are kept in the laboratory, and one of these is chosen corresponding to the disease to which the bacterium is supposed to belong. If the bacteria on microscopic examination are seen to clump together under the action of the serum, this identifies the bacteria as belonging to the disease from which the serum has been prepared. If the bacteria do not clump, the same process is carried out with another serum until the appropriate serum is found. The same process may be carried out without microscopic examination by placing the bacterial emulsion in small test tubes and adding drops of the sera to these. Precipitation of the bacteria to the bottom of the tube can be seen to take place in a tube containing the corresponding bacteria and serum. This method is much used in identifying the meningococcus, typhoid bacillus, diphtheria bacillus, dysentery bacilli, and others.

(4) INOCULATION OF ANIMALS.—For the purpose of making certain which of the many kinds of bacteria derived from a case of disease is its actual cause, or in some instances when the bacteria are so few in number or so difficult to cultivate that they cannot be found, it becomes necessary to inoculate animals like mice, guinea-pigs, or rabbits with material containing the bacteria, in order, if possible, to reproduce the disease. This inoculation is effected through pricking the skin or puncturing the abdomen by means of a needle and syringe charged with the material in question. Subsequently the animal is killed and its organs examined for signs of the disease.

BACTERIOPHAGE was a name given by d'Herelle to an agent which affects growing bacteria so as to break up and destroy them. It is either a ferment produced by the bacteria themselves, or an extremely minute form of bacteria.

BACTERIOSTATIC. Bringing bacteria to a standstill by preventing their nourishment and growth.

BÆL-FRUIT, the fruit of *Aegle marmelos*, is a remedy much used in India for dysentery and diarrhœa. It is doubtful if the dried fruit has much action, as it contains no astringent principle like tannin, and in healthy persons is a laxative.

BAGASSOSIS is an industrial lung disease occurring in those who work with 'Bagasse'. 'Bagasse' is the name given to the broken sugar cane after sugar has been extracted from it. Bagasse used to be a waste product of the sugar industry, but it is now in demand for war purposes. It is broken up by machines, and this gives rise to a lot of dust. The inhalation of this dust causes an acute lung affection, and subsequently in some cases a chronic lung disease.

BALANITIS means inflammation of the parts covered by the prepuce.

BALBUTIES is the medical term for stammering or stuttering.

BALDNESS is a condition largely associated with the habits of civilisation, and said not to occur in those primitive peoples who live constantly an open-air

life. It is generally partial and slowly progressive, and is so universal that it may be looked on as a natural change in age. It may also occur rapidly in patches, or even every hair on the body may be lost, in the disease called alopecia areata.

Causes.—Certain *serious diseases* are associated with partial loss of hair as one of their symptoms; but these diseases are of so much greater importance that the thinness of hair is not taken account of, and as a rule remedies itself as these diseases wear off. Such diseases are acute fevers, myxœdema, syphilis, consumption, anæmia, and great anxiety or nervous shock. Gradual premature baldness is, to a considerable extent, hereditary, and it is generally preceded for some years by seborrhœic eczema, a condition of dandriff on the scalp set up by bacterial decomposition of the natural oil of the hair. Every day, in the healthy scalp, a certain number of hairs reach the end of their existence, and are combed out, being replaced in time by others growing up from below. Each hair-follicle in this way produces many hairs in the course of a person's life, but, if the change is too rapid, the hairs become gradually finer, then downy, and lastly the hair-producing power of the follicle wears out. This rapid change is due to the eczematous condition of the scalp. The wearing of hats may have an influence, through diminishing the blood-supply to the crown and temples by pressure on the blood-vessels of the scalp. A habit of excessive perspiration about the head disintegrates the hair and quickens its loss, and, for this reason, baldness is very common in those who have lived much in the tropics. Many skin diseases, like lupus, erysipelas, ringworm, which leave a hardened condition of the scalp behind them, cause baldness, and such cases are made worse by the various stimulating hair washes sold for baldness.

Treatment.—The earlier the condition is attacked, the more promising the outlook, for there is little hope of obtaining more than a downy growth, by any treatment, from a shiny, bald scalp. A hard hat should be worn as little as possible, and in summer, in the country, or by the seaside, no cap should be worn. No hard brush or sharp comb should be used, as their irritation induces dandruff. The head should be frequently washed, say once a week, with extract of quillayia and hot water, or super-fatted soap, or a whipped-up egg. The hair should be always thoroughly dried after washing, and, if it remains hard and brittle, a little hair-oil composed of lanolin (1 part) and sesame oil (16 parts) may be applied. If baldness is definitely appearing, the hair, in boys, may be cut short and bay rum or spirit used daily to wash the scalp. This treatment makes the hair hard and bristly, and removes all dandruff. In people who prefer to wear the hair longer, the head may be daily washed, till the hair ceases coming out, with Hebra's soap, consisting of green soap (2 parts), rectified spirit (1 part), filtered and perfumed. After washing, the soap must be thoroughly rinsed out and the hair dried, and oiled as above. A pomade consisting of tannin 1 drachm, lanolin 6 drachms, sesame oil 2 drachms, is also good for checking the loss of hair. Perchloride of mercury is one of the best substances for removing dandruff, either in a wash containing 5 ounces of water, 1 ounce of eau-de-Cologne, and 1 grain of perchloride of mercury, or in a pomade like that given above, to which 2 or 3 grains of the perchloride of mercury may be added. The many vaunted hair restorers contain either a little Goulard's water or, more generally, tincture of cantharides or Spanish fly. The latter is very stimulating in advanced cases, 1 drachm of vinegar of cantharides being used in 1 ounce of spirit to dab on the scalp, coupled with the washing mentioned above. It is of great importance to attend to the general health, for quite apart from definite disease, baldness advances more rapidly in those of poor health than in the robust. The hair should further be frequently cut (every three weeks), and singeing in many cases does good.

ALOPECIA AREATA, or patchy baldness, is very common on the scalp, but may affect the hair all over the body. Many authorities regard it as an infectious condition. In some cases it appears to be associated with general debility or with disease of the teeth, throat, or eye. These should be ex-

amined and, if necessary, treated. Locally, alopecia is treated with strong stimulating applications, and the hair generally returns, after a time, lighter in colour, or even white.

BALNEOLOGY (βαλανεῖον, bath; λόγος, discourse) is the department of medical science which deals with the giving of baths. (*See* BATHS.)

BALSAMS (βάλσαμον) are substances which contain resins and benzoic acid. Balsam of Peru, balsam of Tolu, and Friar's balsam or compound tincture of benzoin, are the chief. They are given internally for colds, and aid expectoration, while locally they are used to cover abrasions and stimulate ulcers. Friar's balsam, one teaspoonful, inhaled from a jug of boiling water, is said to cut short at their commencement colds and influenza. Balsam of Peru is given internally in doses of 5 to 15 drops with beaten-up egg; balsam of Tolu is similarly administered in doses of 5 to 15 grains, or is given as the more familiar syrup of Tolu in doses of one teaspoonful.

BANDAGES are pieces of flannel, calico, muslin, etc., used to support injured parts or retain dressings on wounds. The two usual forms are the triangular and the roller bandage.

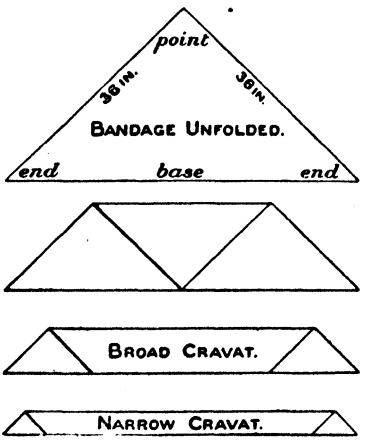


FIG. 32.—Triangular bandage unfolded and folded.

Triangular bandages are used in ambulance work, on the battlefield, and whenever an easily applied temporary bandage is wanted. They are made by taking a piece of calico one yard square, and cutting it across cornerwise so as to form two triangles. The cut

FIG. 33.—Bandage for shoulder. Two triangles: one folded into sling for wrist; the second open with point on neck and ends tied round arm.

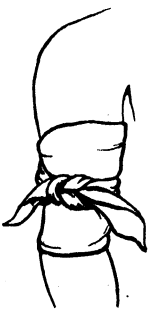


FIG. 34.—Bandage for arm. Triangle folded broad is carried three times round and tied.

FIG. 35.—Bandage for open hand. Triangle is folded narrow; centre placed on palm of hand, ends carried round to back, crossed, carried round wrist twice, and tied.

side of each is called the 'base', and the right-angled corner opposite, the 'point'. The bandage either singly, or two together, can be used for almost

any part of the body, but is merely a covering intended to retain a dressing,

FIG. 36.—Bandage for elbow. Triangle folded broad is laid with centre on elbow; ends are crossed in front, carried round forearm, crossed again in front, carried round upper arm, and tied.

and does not exert much pressure. A triangular bandage may be applied in one of three forms: (*a*) *open* as a triangle, sometimes with a hem turned over at the base, according to the size

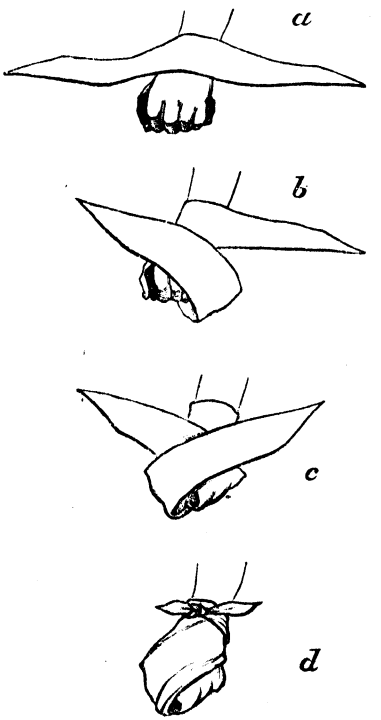


FIG. 37.—Bandage for closed fist, in which a roll of cotton-wool, lint, etc., is grasped. Four stages.

of the part to be covered; (*b*) *folded broad*, with the point turned in twice towards the centre of the base; and (*c*

folded narrow, like a cravat, the point being turned in three times. These bandages are of great use for first aid and for military work, as they take up little room, can be readily applied, and can be taken off easily without disturbing the injured part. Their mode of application is readily seen from the diagrams.

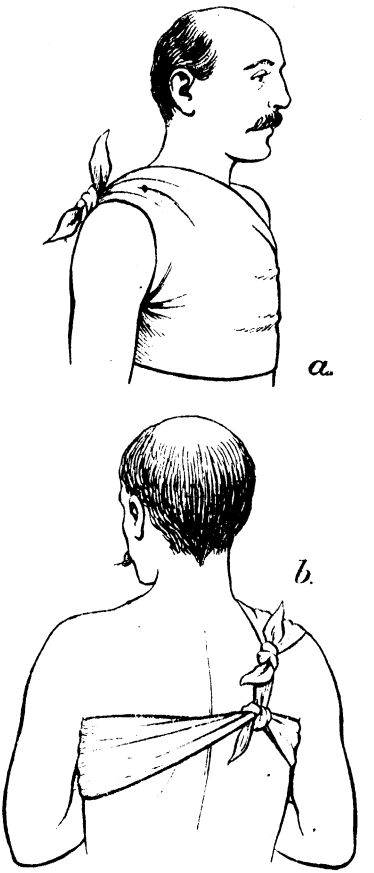


FIG. 38.—Bandage to cover the chest. One triangle: the point is laid over one shoulder, the ends carried round the sides and tied over the same shoulder-blade; the longer of the two ends is carried up and tied to the point; *a*, front; *b*, back. To cover the back the same bandage is used with knots in front.

The flat hand may be covered in by a bandage similar to that for the foot, the wrist being placed on the centre of the base and the fingers towards the

point, which is turned back over them; the ends are folded in and tied off round the wrist.

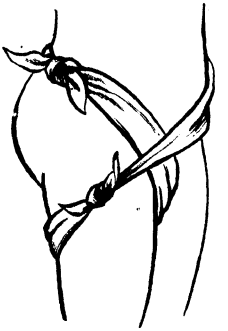


FIG. 39.—Bandage for groin. Two triangles, folded narrow and tied end to end.

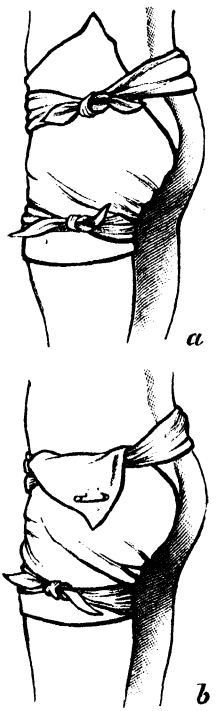


FIG. 40.—Bandage for hip. Two triangles: one folded narrow and tied round waist; the other with point on the side and ends tied round thigh; *a*, first stage; *b*, finished.

Bandages similar to those shown for the arm and elbow may be applied to the leg and knee of a person who is not

going about, but in walking, triangular bandages applied to these parts are apt to slip down.

It is well that the knots of all triangular bandages should be reef-knots, which are much more easily undone than the other form; and it is

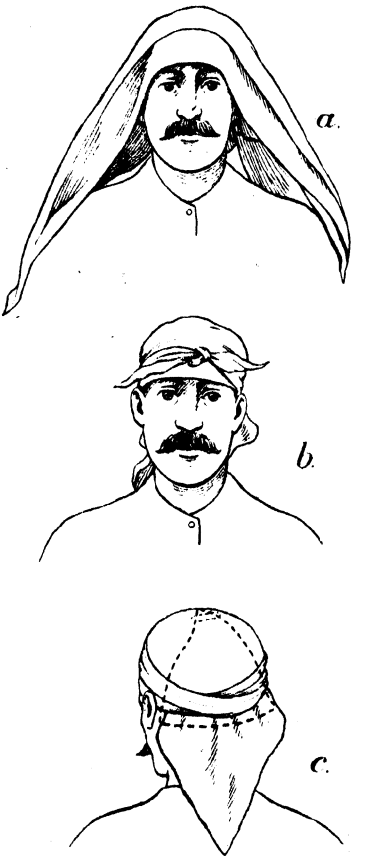


FIG. 41.—Bandage for head. Triangle with a hem turned up on base is placed with centre of base on forehead and point on back of neck; ends are carried behind head, crossed on neck, carried forward, and tied on forehead. Point is finally pinned up. Three stages.

essential that they should always be tied on the outer side of a limb, or in such a position that they can be easily removed without disturbing the injured part.

The applications of the triangular bandage in the treatment of fractures

are described under FRACTURES, and for their adjustment as slings, see SLINGS.

FIG. 42.—Bandage for eye. Triangle folded narrow; centre is placed over the eye, ends carried round head, crossed, carried forwards, and tied.

FIG. 43.—Bandage for lower jaw. Two triangles folded narrow; placed one with centre below, the other with centre in front of the chin. The former is tied above, the latter behind head. The ends of both are finally tied together.

FIG. 44.—Bandage for side of head. Triangle folded narrow; centre is placed over one ear, one end carried over top of head, the other beneath chin; the two turn round one another above ear, and are then carried round forehead and back of head and tied over centre of bandage.

Roller bandages are strips 10, 15, or 20 feet long, and varying in width

from 2 to 4 inches, according as a limb or the body is to be covered. They are generally sterilised before use, or impregnated with some antiseptic (*see* ANTISEPTICS), and may be of flannel, which can be washed and used repeatedly, of calico, or of cheesecloth. The chief *methods* of applying roller

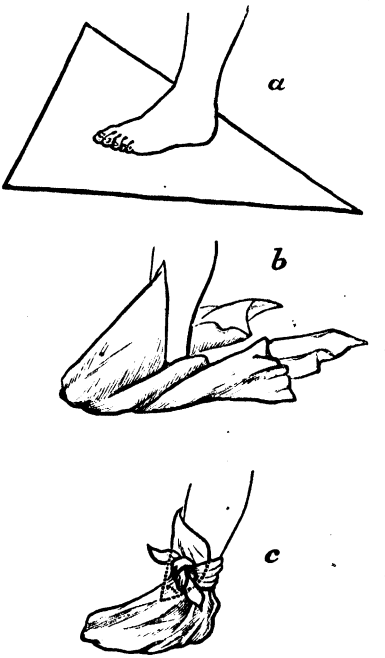


FIG. 45.—Bandage for foot. Foot is placed on triangle with heel near the centre of base; ends are folded over three times to lie along side of heel; point is turned up over front of ankle, ends tied round ankle, and point is finally pinned down over the knot. *a*, First stage; *b*, second stage; *c*, finished.

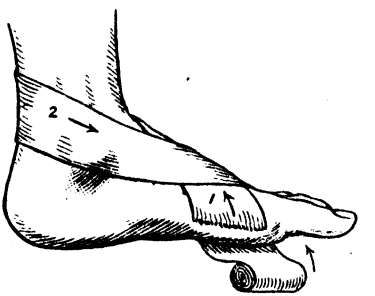


FIG. 46.—Method of 'fixing' bandage firmly for application to foot.

bandages are: *Simple spiral*, in which the bandage circles up the limb, each turn overlapping half of that pre-

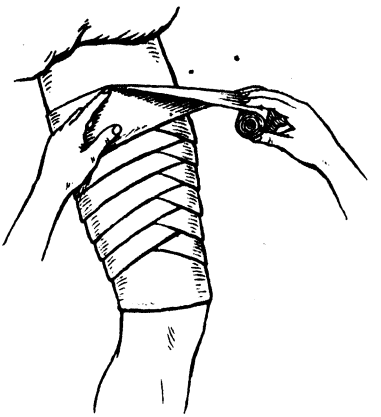
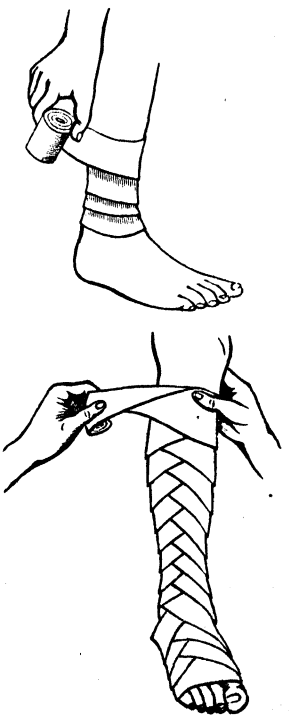


FIG. 47.—Spiral with reverses for thigh.

ceding. This is used for a cylindrical part of the body like the upper arm. *Spiral with reverses*, in which the



BANDAGES

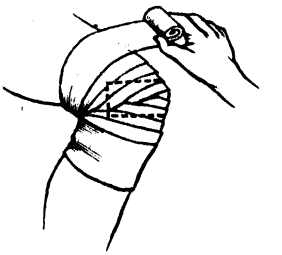


FIG. 48. — Roller bandages for the lower limb. The first is a bandage for the lower part of the leg (simple spiral); the second for the whole leg (spiral with reverses); and the third for the knee (spica). The dotted outline in above figure shows the beginning of bandage.

bandage is turned sharply over on itself at each circle so as to lie smooth when the circles tend to separate widely. It is used for conical parts like the forearm or calf. *Figure of 8*, in which the bandage loops alternately round two parts of the body. It is used to cover a projection or hollow such as the shoulder or armpit, by looping round trunk and arm alternately. *Spica*, which is used for a joint, the turns covering one another completely in the bend of the joint, and separating partly over the prominence like the arrangement in a coat-of-mail. It is simply

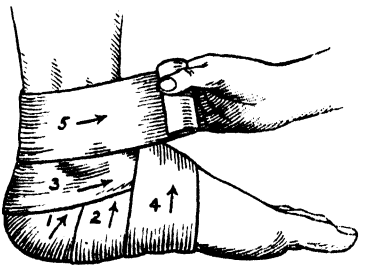


FIG. 49. — Bandage covering heel. First turn covers heel, second and third bind down its loose edges; fourth and fifth bind down the loose edges of second and third.

a modified figure of 8. *Trefoil* is a bandage applied to the head, and is the same in principle as the figure of 8, though it has three loops instead of two.

In applying a roller bandage the first circle must be firmly fixed by covering it completely with the next to prevent slipping; or a still better method of fixing consists in taking a figure of 8 turn round the limb, as shown in Figs.

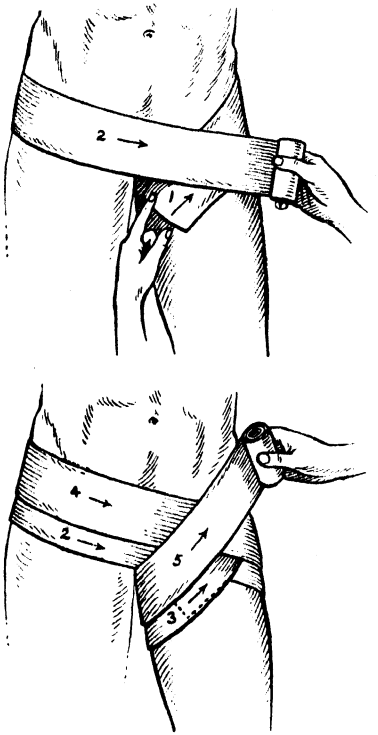


FIG. 50.—Ascending spica for groin.

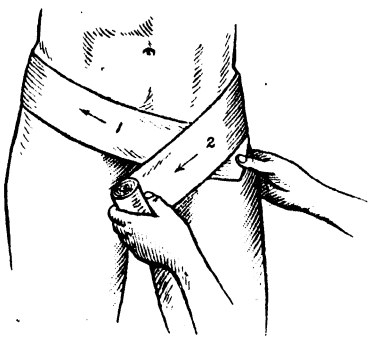


FIG. 51.—Commencement of descending spica for groin. In the ascending spica the bandage runs up across the front of the thigh and each turn is higher than the one before. In the descending spica the turns across the thigh run down and each turn is at a lower level than its predecessor. The body turns pass round the pelvis, not round the waist. When both groins are to be bandaged, a turn of ascending spica on one alternates with a turn of descending spica on the other; after each pair of turns a complete circular turn is made round the pelvis.

46 and 50, and covering this with the subsequent turns of the bandage. The bandage must pass upwards or the

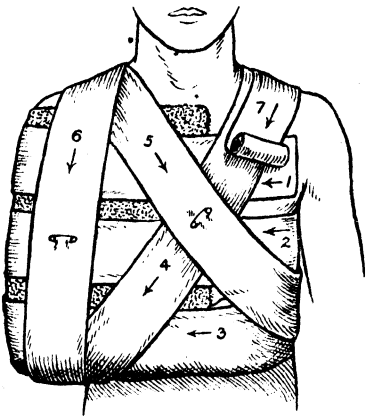


FIG. 52.—Bandage to fix a dressing on the chest, and cover in the arm. In actual practice a wider bandage would be used, and the turns would overlap. For clearness they are here shown separated.

limb will become blue owing to the blood in the superficial veins being pressed backwards towards the extremity of the limb. It should cross the front of the limb from within outwards in order to give more room for

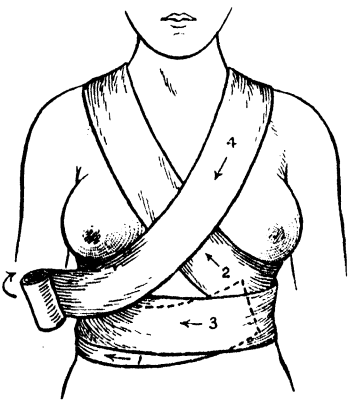


FIG. 53.—Bandage to support the breasts. A wide bandage is used. After each pair of turns beneath the breasts a circle to fix is taken round the waist.

making reverses towards the outer side. Where skin surfaces come into contact, one should be separated from the other

by cotton wool, as otherwise moisture accumulates and the surfaces readily become abraded. This should be done, for example, between the fingers, behind the ear, in the armpit, etc. In order to make the bandage lie smoothly it is important in applying it that the head of the bandage should always, except in reversing, remain in contact with the part that is being bandaged, round which it is simply rolled.

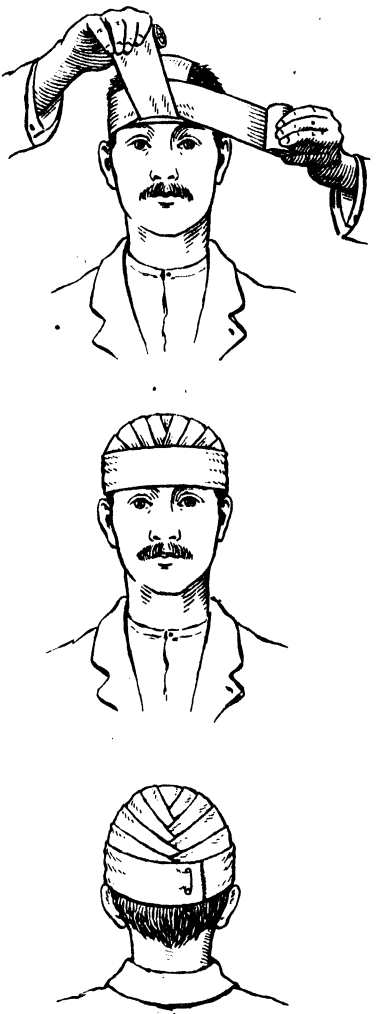


FIG. 54. — Capelline Bandage for head. Two bandages are stitched end to end. The bandage is rolled off one to the other till one roller is half as large again as the other. The larger part circles round the head close above the eyebrows and ears, and low down on the back of the head, binding down at each turn a strip of the other, which passes alternately backward and forward on either side.

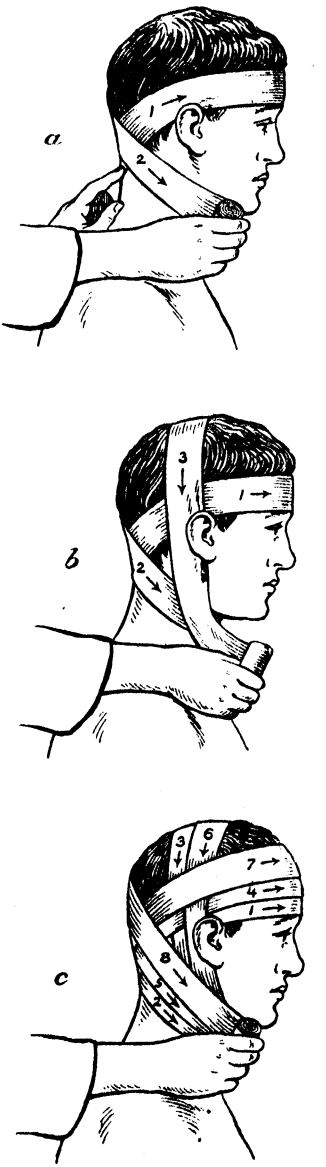


FIG. 55. — Bandage for head (trefoil). This consists essentially of three turns repeated in order. *a* shows commencement on the nape of the neck and first turn; *b* shows second and third turns, the bandage next passing below chin and round to nape of neck; *c* shows the gradual covering in of head; and *d* a further stage. To fix all, a final turn in the position of the first should be made low down on the nape of the neck behind and close above the eyebrows in front.

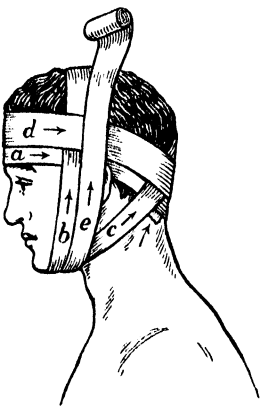


FIG. 56. — Same bandage (trefoil) from the other side. Shows that the vertical turns pass behind the ear on one side, in front of it on the other. When bandage is used to cover in one ear, the first turn should pass round the other side of the head, as shown. This bandage cannot be used to cover in the part of the head shown bare in *d*, for which the capelline bandage or a four-tailed bandage may be used.

The *width* of roller bandages varies: for the finger 1 inch is the usual width; for the head 2 inches; for the arm 2½ inches; for the leg 3 inches; for the abdomen or chest 4 or 5 inches.

Bandages of special shape are used for certain parts of the body. The

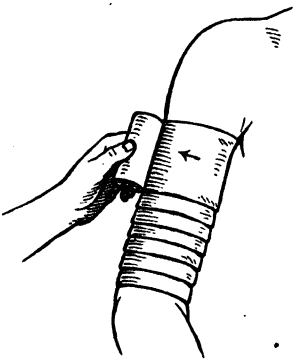


FIG. 57.—Simple spiral for arm.

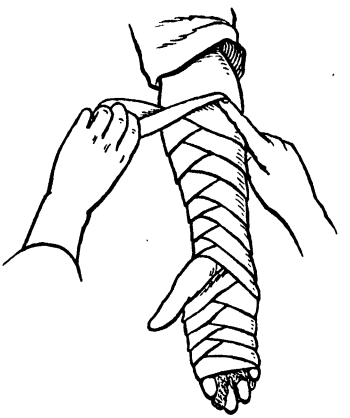


FIG. 58.—Spiral with reverses for hand and forearm.

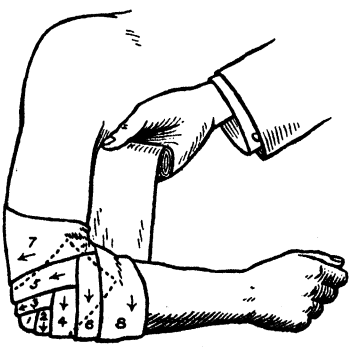


FIG. 59.—Spica for elbow.

four-tailed bandage is made for the jaw or the crown of the head by tearing a

four-foot strip of roller bandage up the middle from both ends, leaving about

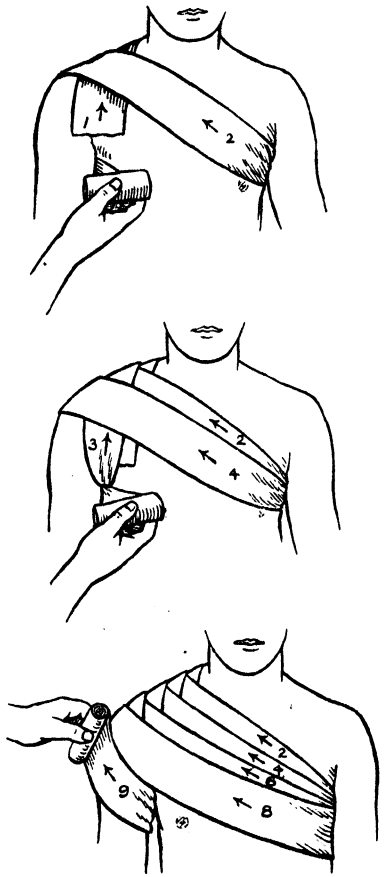
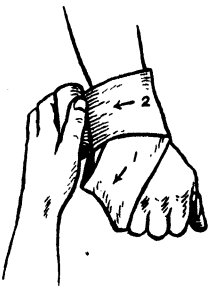


FIG. 60.—Spica for shoulder or armpit.

four inches untorn in the centre; it is applied in the same manner as the two triangular bandages shown in Fig. 43.



The *T-shaped bandage* for the fork is made by stitching the middle of a four-

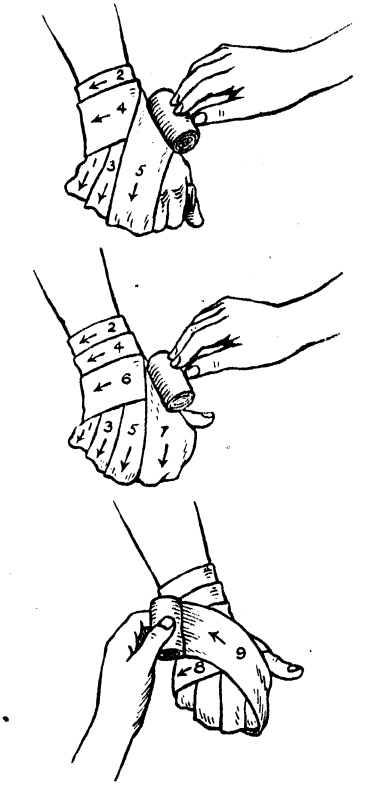


FIG. 61.—Bandage for closed fist, in which a pad of wool should be placed. There are alternate loops round wrist and round knuckles. Four stages.

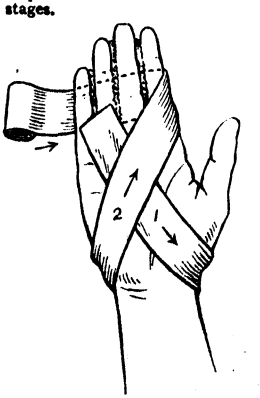


FIG. 62.—Method of 'fixing' bandage before commencing spiral with reverses for hand.

foot strip of roller bandage to the end of a similar strip which is torn up the

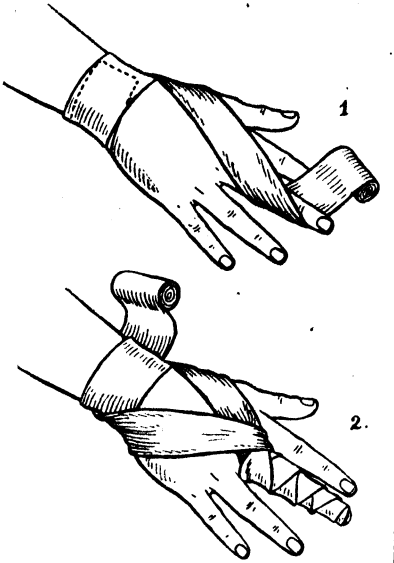


FIG. 63. — Bandage for finger. It starts round wrist for the purpose of fixing, passes in an open spiral down to the point of the finger (1), then upwards again as a spiral with reverse at each turn (2), and ends round wrist.

middle for the greater part of its length; the untorn strip forms a waist belt, the divided part passes down through the fork and its ends are pinned to the part that forms the waist belt. The *many-tailed* bandage for the abdomen

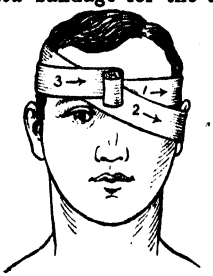


FIG. 64.—Bandage for eye; turns pass alternately round forehead and down over eye.

is made by stitching a strip of roller bandage down the middle of several four-foot strips, each of which overlaps one half of that below; shorter strips are used for fractured or painful limbs.

Bandages of special substance.— When a very rigid support is required, calico roller bandages are rubbed with plaster of Paris in powder, dipped in water till bubbles cease to rise from them, and then, being applied wet, set quite hard and can be worn for months; or they are painted with water-glass, which also sets hard. A piece of lint

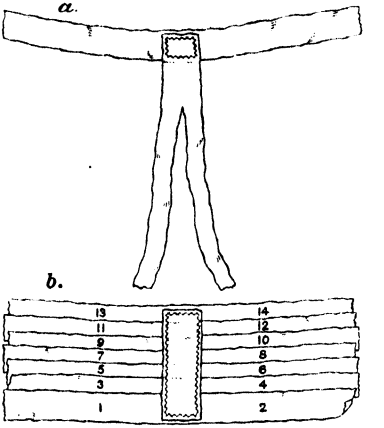


FIG. 65.—Two special bandages. *a*, T-bandage; *b*, many-tailed bandage; the central strip is placed behind the part to be bandaged, and the numbers indicate the order in which the 'tails' of the bandage are applied.

or layer of cotton wool must always be placed next the skin before a plaster bandage is applied. Great care is necessary that plaster bandages are put on smoothly, so as not to press upon any one place, and so possibly produce an ulcer, and also that they are applied without stretching, so that they may not be too tight. The part to be bandaged must be supported so that the bandage can pass freely round without moving it; and it must remain motionless for twenty to thirty minutes after the bandage is applied, so that the latter may harden.

The various forms of elastic bandages, are treated under VEINS, DISEASES OF.

BARAGNOSIS means the inability on the part of a patient to recognize that an object placed in the hand has weight, a condition due to disease of the brain.

BARANY'S TEST is a test for gauging the efficiency of the balancing mechanism (the vestibular apparatus) by applying hot or cold air or water to the external ear.

BARBER'S ITCH (*see* SYCOSIS).

BARBITONE (*see* VERONAL).

BARIUM SULPHATE is a heavy, white powder used in X-ray diagnosis in doses of 2 or more ounces.

BARLEY-WATER is a beverage made by allowing 2 ounces of pearl barley to simmer for two hours with a quart of water, then adding sugar and lemon to flavour, and straining.

BARLOW'S DISEASE is another term for infantile scurvy. Sir Thomas Barlow, an English physician, was born in 1845.

BASAL METABOLISM (*see* METABOLISM).

BASEDOW'S DISEASE is another name for exophthalmic goitre or Graves's disease.

BASILIC VEIN (βασιλικός, royal) is the prominent vein which runs from near the bend of the elbow upwards along the inner side of the upper arm. It was generally the vein opened in venesection for blood-letting.

BASILICON OINTMENT (βασιλικός, royal) is an old name for an ointment of resin, lard, wax, and almond oil.

BASOPHILIA is a term applied to the bluish appearance under the microscope of immature red blood corpuscles when stained by certain dyes. This appearance, with the blue areas collected in points, is seen in lead poisoning, and the condition is called punctate basophilia. The term basophilia may also mean an increase in the numbers of basophil cells in the blood.

BATHER'S ITCH, also called SWIMMER'S ITCH, WATER ITCH, and SCHISTOSOME DERMATITIS, is the term given to a blotchy rash on the skin occurring in those bathing in fresh-water which is infested with a trematode worm, *Schistosoma cercariæ*. The worm is parasitic in snails. The skin rash is caused by penetration of the skin by the free-swimming larval cercaria. Bather's itch is common in the U.S.A., and has occurred in one place only in Great Britain, namely, Roath Lake, Cardiff.

BATHS.—The main action of water on the skin is as a vehicle for heat, and baths act largely either by extracting heat from or adding it to the body. The sweat glands of the skin excrete some 30 ounces of water daily, containing about one-twentieth part of the nitrogenous waste of the body, and its excretory activity may be greatly increased by baths of high temperature. Baths also exert a pronounced effect upon the nervous system owing to the sensitiveness of the skin to heat, and to electrical, chemical, and mechanical influences. We give a description of the various baths; their uses are mentioned under various diseases.

A. WATER BATHS.—(1) COLD.—This is a bath about 60° Fahr. or 16° C. (cold tap temperature). It should be taken while the body is warm, and its daily use is a healthy habit and helps to prevent colds. The average person should go straight from bed to a plunge bath of the above temperature, or, if preferred, a warm bath of about 100° Fahr. or 38° C. may be first taken, and then a cold douche or sponge from the cold-water tap. The cold bath should last from a few seconds to two minutes, and the warm bath preceding it up to ten minutes. The bather should rub himself vigorously in both baths, and must at once rub himself dry with a coarse towel and quickly dress. During drying the skin becomes rosy, and a delightful warm glow comes on and lasts several hours. Persons whose blood-vessels do not react properly to changes of temperature are apt to suffer one or other of two things after a bath. The 'reaction' is due to a quick contraction, followed by a moderate dilatation of the blood-vessels in the skin, and in persons with a bad 'tone' of the arteries, either an excessive dilatation follows a hot bath, which the cold bath cannot overcome, and the blood being unduly cooled in the full vessels of the skin a 'chill' results; or the vessels contract too firmly after the cold bath, so that cold hands and feet result. The latter can be got over by taking the cold bath in two stages, first a tepid bath on getting out of bed, and then a sponge or douche from the cold tap. As to those liable to chills and colds, even the weakest person may get part of the benefits of a cold bath without any ill effect, by taking a tepid bath at 90° Fahr. or 32° C., and cooling it down by running in tap water in the course of five minutes to 75° Fahr. or 24° C., rubbing the body and legs vigorously all the while, or having them rubbed by an at-

tendant, and afterwards drying rapidly. Very cold baths must be avoided by those with a tendency to apoplexy.

(2) TEPID.—A tepid bath is one slightly below the body temperature, viz. about 90° Fahr. or 32° C. It is the convenient temperature for large baths. Prolonged tepid baths raise blood-pressure and have a soothing effect. They are thus very valuable in treating mania and delirium. The patient is placed in a bath at 95° Fahr. cooled down slowly to about 92° Fahr.; he remains in it at first half an hour and on subsequent days gradually longer up to eight hours daily.

(3) WARM.—A warm bath is one ranging from about the body temperature, 99° Fahr. or 37° C., to about 110° Fahr. or 43° C. Water at 115° Fahr. can just be borne by the hand, but not by the whole body. A warm bath quickens the pulse, and after some time weakens the heart. It also causes free perspiration. A warm bath of about 104° Fahr. for ten or fifteen minutes, followed by a cold douche, in the robust, is one of the best means of preventing the stiffness which follows prolonged muscular effort, or of warding off a cold. But very warm baths are dangerous to those suffering from disease of the heart. The warm bath of 100° to 110° given for ten to fifteen minutes is useful for reducing blood-pressure in cases of kidney disease and relieves mental depression in cases of melancholy.

B. VAPOUR BATHS.—(1) AROMATIC.—The patient sits in a special box, his head protruding through a hole in the lid, while steam from water containing fir-balsam, lavender, etc., circulates round him. Beyond acting as a hot bath this form is not of much use.

(2) RUSSIAN BATHS have much the same effect as warm-water baths. The bath is generally taken in a room which is filled with vapour, but as good an effect may also be got from a cabinet, or a tent of blankets, in which the patient sits on a chair some inches over boiling water. In a vapour bath 120° Fahr. can be borne readily, and the person should remain in the vapour simply until he breaks into a copious perspiration, usually about fifteen or twenty minutes. If the case be one of Bright's disease the person should then go to bed and lie between blankets, but if not he should take a cold douche or bath, according to the state of his 'reaction'. In Russia it is a common practice immediately after the vapour bath to pour a stream of ice-cold water all over the surface of the body.

C. DRY BATHS.—(1) HOT-AIR BATHS may be taken as the TURKISH or ROMAN bath, in a specially constructed building heated by pipes in the walls, with tepid room, hot room, washing room, and cooling room, through which the bather goes in succession. A hot bath may also be taken in an electric-light cabinet, where the person

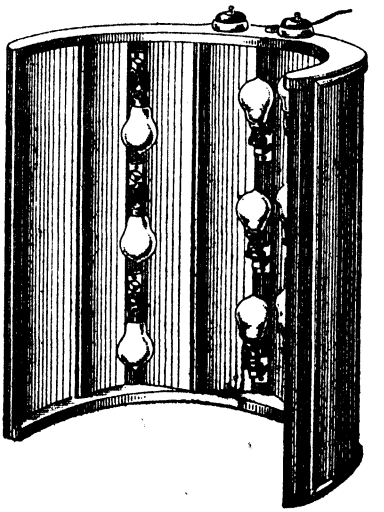


FIG. 66.—Radiant heat bath with electric-light bulbs under-curved asbestos shield to cover patient.

sits exposed to brilliant light and heat till he sweats copiously, when he takes a cold-water bath.

Such a bath may also be given in bed, the patient lying under a curved wire shield. In hospitals the under-surface of the shield is provided with numerous electric-light bulbs which speedily raise the temperature of the enclosed air to a high degree. A simpler form of shield, in which the air is heated from a spirit lamp, is also often used where the electric current is not available. Under the patient are blankets, and over the shield are heaped other blankets; hot-water bottles are placed alongside the limbs of the patient as he lies beneath the shield, and through the end of the

latter passes a funnel which brings the hot air from a large spirit lamp placed near the bed. The patient lies on the bed covered to the chin by a blanket or by asbestos cloths; the wire shield reaching up to his neck.

The duration of a Roman bath is about two hours, and it leaves a feeling of great freshness. In either of these baths one may lose 6 lbs., by sweating, at one time. They are useful for reducing fat, for rheumatism, and against colds, while the hot-air bath, given in bed for fifteen minutes at a time, promotes the action of the skin in Bright's disease. The electric-light bath can be given in bed, the lights being underneath a curved shield, 5 feet long, which

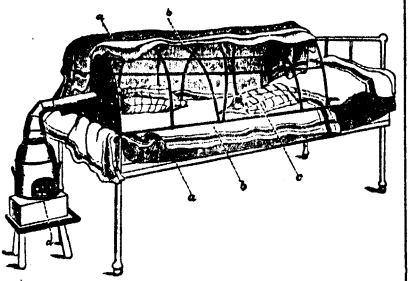


FIG. 67.—Simple arrangement for hot-air bath, consisting of a strong wire cage, under which the patient lies. *aa*, Waterproof sheets on bed and over cage; *bb*, blankets between patient and waterproof sheets; *c*, hot-water bottles in flannel; *d*, spirit lamp and funnel for supplying hot air under the cage. Another blanket is used to wrap round the patient.

covers the patient, and there are also smaller shields for single limbs. A dry temperature of 200° Fahr. can be borne without discomfort for a quarter of an hour, and has excellent results in Bright's disease, chronic rheumatism, rheumatoid arthritis, and sciatica. When a sick person is being treated by such a high-temperature bath, it is necessary that his pulse should be frequently examined, in case the heart's action should become enfeebled.

(2) SAND BATHS are used for rheumatic conditions, the sand being made very hot to purify it, and heaped on the patient when moderately cool.

D. MEDICINAL BATHS.—(1) ALKALINE BATHS are used to soften the skin in certain skin diseases like general eczema. Six ounces of washing soda are added to 30 gallons of tepid water.

(2) BRAN BATHS are used to soothe general irritation of the skin. Four pounds of bran are boiled and the liquor added to a tepid bath, in which the patient soaks for half an hour.

(3) CALOMEL BATH is a modified vapour bath given in a cabinet or inside a tent of blankets, the patient's head being outside the vapour. Twenty grains of calomel are vaporised from a hot metal plate.

(4) PEAT and MUD BATHS are used generally for rheumatism at various spas. The patient is covered with a layer of warmed mud, such as fango, lies in it for perhaps twenty minutes, and is then washed clean by a cold douche. Such baths can be taken at a much higher temperature than water baths (102° to 112° F.).

(5) MUSTARD BATHS are used for the feet to check colds, and for the whole body as a good general stimulant, and in infectious diseases when the rash does not develop. For this, a handful of mustard is made into a paste with cold water and stirred into the warm bath.

(6) PINE-NEEDLE BATHS are pleasant and stimulating. They are prepared by adding to a tepid bath the water in which several pounds of fresh pine needles have been boiled.

(7) SEA-WATER BATHS are best taken in the sea. Brine baths are also found at various spas. Failing that, about 9 lbs. of common salt are added to 30 gallons of water. The effect is very stimulating. Such baths are much used in treating debilitated persons, cases of chronic rheumatism, and cases of glandular enlargement. A smaller amount of the same strength may be used to bathe the feet and legs of weakly children.

(8) CARBONIC ACID BATHS are used for their stimulating effect upon the skin and upon the body generally. They may be administered by the aid of water which is naturally effervescent, as at Royat, St. Moritz, Spa, Marienbad, where they are specially in vogue for the treatment of heart disorders; or the carbonic acid may be allowed to escape from cylinders in the bath-water; or weak formic acid is mixed with the water in which small cotton bags of washing soda are placed. Such effervescent baths, especially when taken warm, have a marked action in

increasing the circulation in the skin and diminishing general arterial blood-pressure.

(9) FOAM BATHS contain some soapy substance such as an extract of quillaia bark which on stirring produces a copious froth. They usually contain also some substance which adds to the frothy effect by development of carbonic acid gas, and they then have the effects mentioned above under carbonic acid baths.

(10) SULPHUR BATHS are used for the presence in the water of sulphuretted hydrogen, which not only stimulates the skin but is to some extent absorbed. The bath may be prepared artificially by adding from ¼ to ½ lb. of sulphuret of potassium or of yellow sulphur to 30 gallons of hot water. Sulphur baths are specially used in the treatment of skin diseases and in rheumatism.

E. ELECTRIC BATHS may be given in earthenware, stone, or wooden baths. The bath is filled with tepid water, in which the patient lies. An electrode hangs in the water at either end, not touching the patient, and a moderate current is passed through the water. This bath is very useful in cases of debility and neurasthenia. (*See* ELECTRICITY IN MEDICINE.)

BAYER 205 (*see* GERMANIN).

BCG VACCINE. BCG stands for *Bacille Calmette-Guérin*, Calmette and Guérin being the names of two French bacteriologists. BCG is a vaccine against tuberculosis made of bovine tubercle bacilli cultured for years on a medium containing bile. As animal inoculation showed this vaccine to be harmless, Calmette vaccinated infants with it. This method of protecting against tuberculosis was popular in France but criticised in England. But prolonged experience with it in other countries—*e.g.* Norway and U.S.A.—seems to show that it has some value.

BEARBERRY, or *Arctostaphylos uva-ursi*, is a remedy used in chronic inflammation of the bladder, in doses of ½ ounce or more of the infusion.

BEAT ELBOW, BEAT HAND, and BEAT KNEE are terms applied by miners to an inflamed condition with swelling of the elbow, hand, or knee. The condition is particularly common in miners, but occurs in other trades also from constant pressure and the ingraining of particles of dirt, caused by the constant use of a tool or pressure in resting on the joints at work. The condition sometimes proceeds to suppuration, but usually subsides under soothing and antiseptic applications.

BED.—The bed used in cases of sickness should consist of an iron *frame* of at least 6 feet in length and 3 feet 3 inches to 3 feet 6 inches in width, and should be provided with a stiff *wire mattress*. A piece of canvas or felt, fixed to the mattress, should form a *mattress cover* to prevent rusting of the wire. Upon this is a mattress of wool, or, preferably, of hair. The mattress should have a loose cover of cotton, which can be washed from time to time as required. Over the mattress is placed a sheet which is tucked in firmly beneath the mattress all round to form the *under sheet*. The bed is completed by the *upper sheet* and *blankets*, varying in number according to the season of the year, and by a light *bedcover*. Two thin *pillows*, each covered by a linen or cotton pillow-slip, should be supplied, but it is important both in health and in disease that the support for the head should not be too high, and the pillows should simply be sufficient to fill up the distance between the head and shoulder when the patient lies on the side.

The bed should stand with its head towards the wall and the foot towards the centre of the room or ward, and there should be a free passage up either side for access by the attendants. In some diseases and injuries the bed requires special modification. In all cases confined to bed for longer than a few days a *draw sheet* is required. The draw sheet is formed as follows: An ordinary sheet is folded lengthwise so that the folded sheet is sufficiently wide to extend from the patient's shoulders to behind the knees. Between the folds of this is placed a mackintosh sheet one yard square, or it is often more convenient to place the mackintosh sheet beneath the draw sheet, directly upon the under sheet. This folded sheet is pushed at one end under the mattress, carried across the bed, and the superfluous length is folded up and pushed

out of the way under the mattress at the other side. From time to time the sheet is pulled through beneath the patient towards the shorter end, thus bringing a fresh piece of sheet beneath the back. In *rheumatic fever*, *Bright's disease*, and other conditions in which the patient perspires profusely, the patient lies directly upon and is covered by a blanket, as the woollen material absorbs the perspiration better than sheets. In cases of *fracture* of a lower limb it is necessary to make the bed more rigid, and for this purpose boards are placed across the wire mattress. In cases of *bronchitis* it is frequently necessary to erect a tent over the bed, to cut off draughts or to retain a moist atmosphere produced by a steam kettle. This purpose can be effected by a light screen placed round the bed and covered with a blanket. In cases of paralysis, prolonged fever, and other *devitalising conditions*, the patient may require to be placed upon a mattress, which supports his body evenly instead of allowing pressure to come upon its most projecting parts. For this purpose a *water bed* may be employed, or, better, an *air bed*. The water bed is filled with warm water after it is placed upon the mattress, and care is taken to expel all bubbles of air by stroking it with the hand towards the inlet through which the water is poured. The pneumatic or air bed is much more easily managed, and is pumped up by an ordinary bicycle pump from time to time without the necessity of removing the patient. The under sheet is laid directly on top of the water bed, or air bed, as the case may be. A *bed rest* must sometimes be provided for patients unable to breathe comfortably in a recumbent position, or in order to change the position from time to time of a patient permanently confined to bed. For this purpose, four or five pillows may be placed behind the patient's back, or, preferably, a rest, consisting of a horizontal part hinged to a cane-backed rest resembling the back of a chair and supported on a strut, is used and furnished with a couple of pillows. In order to give a still further change of position, a *bed table* may be used. This is supported on four legs some 3 feet 6 inches high and is of sufficient width (about 4 feet) to enable each pair of legs to stand on either side of the bed. Upon this the patient can lean forward.

BED BUG, or *Cimex lectularius*, is a wingless, blood-sucking insect, parasitic on man. The bed bug remains hidden during the day in cracks in walls and floors, and in beds. Eggs hatch out into larvæ in 6 to 10 days, which become adult within about 6 weeks. Various agents have been used to disinfect premises, such as sulphur dioxide, ethylene oxide mixed with carbon dioxide, hydrogen cyanide, and, lastly, heavy naphtha.

BED CHANGING. — Two methods are adopted for changing the bedclothes without removing the sick person from the bed. One of these, called medical changing, is generally applicable when the upper part of the body or head is affected. The other, known as surgical changing, is generally used when the lower part of the body is

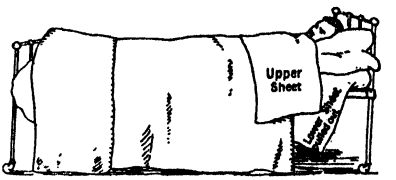


FIG. 68.—Sheet changing, first stage.

affected or when the lower limbs are the seat of fracture or similar disability.

MEDICAL CHANGING.—The pillows are first removed; the patient is then turned upon one side (left) near the left edge of the bed. The soiled sheet with the draw sheet is then rolled up lengthwise from the right edge of the bed until the roll lies against the

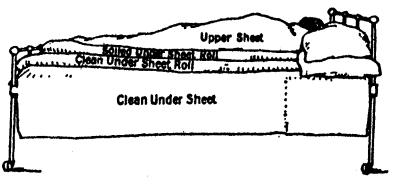


FIG. 69.—Patient turned on right side and sheets rolled against his back.

patient's back. The fresh sheet is made into a roll lengthwise; one edge is tucked in under the right edge of the mattress and the sheet is unrolled across the bed towards the left until

the roll lies alongside the roll of soiled sheet. The patient is next turned on the back and then on the right side near the right-hand side of the bed. He now lies upon the unrolled portion of the fresh sheet. The soiled sheet,

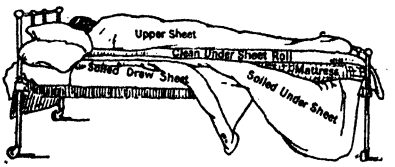


FIG. 70.—Patient turned on left side, and sheet rolls pulled through beneath him to be spread out.

which now lies behind his back, is pulled off the bed and the roll of fresh sheet is unrolled and its edge tucked beneath the left-hand edge of the mattress. During this procedure the patient remains covered by the upper sheet and blankets. A fresh draw sheet is introduced by similar procedure. The pillows, having been placed in fresh pillow-slips, are again set under the patient's head.

SURGICAL CHANGING.—In some cases the under sheet is more conveniently changed from the top or bottom of the bed. To do this the edges of the soiled sheet are pulled out all round from under the edges of the mattress. The sheet is then pulled down under the patient's hips, and, finally, from under the legs. The fresh sheet is now rolled up from top and bottom to the middle, and the double roll is pushed through from the side of the bed beneath the patient's hips while an attendant raises these slightly from the bed. By gently easing up the patient's shoulders the upper half of the sheet is unrolled and tucked in at the top of the mattress, and by similarly elevating his legs slightly the lower half is unrolled and tucked in at the foot of the bed.

CHANGING DRAW SHEET.—When it is necessary to insert a fresh draw sheet, the draw sheet is folded up as in the method for changing the under sheet and is introduced either by rolling the patient over or slightly elevating his hips. When the draw sheet requires to be replaced frequently, it is more convenient to place the square of mackintosh on the under sheet and to insert the draw sheet above it separately.

CHANGING NIGHTDRESS.—When it is necessary to change the nightdress of a person confined to bed, the fresh nightdress should be warmed; one arm is then slipped out of the soiled nightdress and inserted into the corresponding sleeve of the fresh nightdress. The soiled nightdress is then slipped over the patient's head and removed, and the fresh one is slipped on and arranged. This should be carried out without removing the upper sheet and blankets. In the case of patients too ill to be much disturbed, the nightdress may conveniently be slit down the back.

BED SORES are areas of inflamed skin, tending to ulcerate, which appear upon the body or limbs of those long confined to bed, and especially of those much weakened by disease.

Causes. — Sores seldom occur in vigorous persons confined to bed by a fractured limb or other minor cause. They appear in those who have not much fat between bones and skin, in the aged, in those suffering from prostrating weakness, like that of typhoid fever, and especially in those whose nervous system is at fault and the nutrition of whose skin is consequently impaired, for example in persons with fractured spine, or with degeneration of the spinal cord, or in general paralytics. The direct cause may be wrinkles left in the bed-clothes, discharges allowed to soil the invalid's back, and want of daily observation of the places where sores are likely to form.

Symptoms.—Very often the invalid feels no pain, sometimes he complains only of a hard place or wrinkle in the bed-clothes. The sites where sores commonly form are where the bones show plainly through the skin in the lower part of the back, on the heels, on the haunch, on one ankle, on the elbows, or on the shoulder blades. At first, for one or two days, there is redness of the skin over a prominence, which quickly turns blue and dusky. Then a black slough forms, and comes away, leaving a raw surface, which widens if not carefully treated.

Treatment.—The great treatment is preventive, by keeping the patient's back scrupulously clean and dry, by washing it daily with soap and water, sponging it with spirit in order to dry

and harden the skin, and, finally, dusting it with a powder of zinc oxide or boric acid (or instead of using spirit and dusting powder, the skin may be preserved by rubbing in daily a little zinc oxide ointment); by examining night and morning for any sign of redness; and especially by changing the invalid's position, so as to relieve the various prominences from constant pressure. If redness appear over a prominent part, this must be wrapped in dry cotton wool, or the patient at once put on a water bed, which should be half or three-quarters filled with warm water, or better, upon an air bed. When a black, hard slough is forming, and the surface is breaking, the slough must be removed by wet dressings of boric lint or cold-water poultices of charcoal and linseed meal till the surface is clean, and then a return made to dry dressings, the invalid lying on a water bed or air bed, and not being permitted to rest on the sore. Another method is to dress the slough once or more daily with lint soaked in a solution of picric acid or of tannic acid as used for burns (*see* BURNS).

BEEF ESSENCE is a preparation of beef so made as to retain the proteins of the beef and, therefore, it has stronger nutritive qualities than beef-tea. To prepare beef essence one takes 1 lb. of lean beef, cuts it into small squares, and puts in an earthenware jar with two tablespoonfuls of cold water. The jar is covered with a lid and placed in a hot oven for three or four hours, or allowed to simmer in a saucepan for a similar period. The resulting fluid is then strained through muslin and the beef thoroughly squeezed, three or four tablespoonfuls of dark brown fluid being obtained. This may be administered to an invalid in doses of from 1 teaspoonful to 1 tablespoonful at a time.

BEEF-TEA (*see* NITROGENOUS FOODS) forms a valuable stimulant for invalids, although, when it has been boiled for a prolonged period, the protein matters are coagulated and left in the meat.

To prepare beef-tea one should take 1 lb. of lean beef, cut into small squares, and place it in an earthenware jar with a pint of cold water. The jar is covered with a lid and placed in a saucepan of hot water which stands by the side of the fire and simmers for three or four hours. The beef-tea is then strained through muslin and the residue of beef thoroughly squeezed; a pinch of salt is added, and the beef-tea set aside to cool. Beef-tea is usually administered in quantities of one teacupful at a time, *i.e.* 5 or 6 ounces.

BELLADONNA (*see* ATROPINE).

BELL'S PARALYSIS is paralysis of the muscles of the face on one or both sides, causing inability to close the eye, to smile, to show the teeth, and the like, on the affected side. The paralysis is due to damage of the seventh or facial nerve. When due to cold, it is often temporary, and complete recovery may ensue, but when due to a wound in front of the ear, to fracture of the base of the skull, or to a stroke of apoplexy, it is apt to be permanent, although apoplectic paralysis of the face is more favourable for recovery than that due to injury. (*See* PARALYSIS.)

BELTS AND BINDERS are very commonly worn, not only as articles of dress, but as supports and curative agents.

Uses.—Flannel or linen binders are worn by infants for warmth, as a support to the body, and because, for some time after birth, the region of the navel remains thin and weak; such a binder should extend from the middle of the chest well on to the hips. Women, after labour, wear a binder because it gives a feeling of support; it should be of similar extent to the infant's, and it is very important that it should be as tight as possible below, and very loose in its upper half. Narrower flannel binders give great comfort in cases of lumbago when worn next the skin, and are advantageous in the subjects of Bright's disease. Persons of all ages, with weak and easily tired back, get great support from wearing a broad belt, like that of a footballer, round the waist. When, however, the upper part of the body is subject to great muscular efforts, as in athletes and navvies, it is a great mistake to encircle the waist tightly with a narrow belt, which ought to run round in the hollow on either side between the

summit of the haunch-bone and the hip-joint, and so give full play to the abdominal muscles and those of the loins. Elderly persons who have a large, flabby abdomen often suffer from a form of dyspepsia due to want of support of the abdominal organs, which is relieved speedily by wearing a broad,

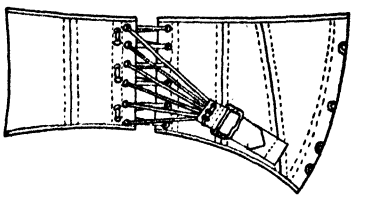


FIG. 71.—One form of belt for support of abdominal organs.

shaped belt round the lower part of the abdomen, or corsets with such a belt attached. This abdominal belt should be tight in its lower part, and loose above the navel, to allow free movement of the stomach in digestion. Such belts are often fitted with special pads intended to support the stomach when this organ is displaced downwards within the abdomen. A similar but differently shaped pad is added inside

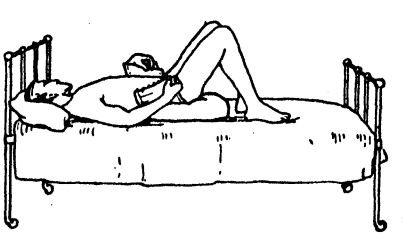


FIG. 72.—Method of applying belt.

the belt for the support of a displaced kidney. These pads may be formed of wool or may be of hollow india-rubber for inflation.

BENDS (*see* CAISSON DISEASE).

BENZEDRINE, or AMPHETAMINE SULPHATE, is a drug which produces effects that in many ways resemble those produced by stimulation of the sympathetic nervous system. In addition, benzedrine has a peculiar effect on the brain. It quickens mental processes, gives a feeling of well-being and confidence, and increases capacity for work. But all this is temporary. The drug is a powerful one, and should in no circumstances be taken except on medical advice.

BENZENE, or BENZOL, is a colourless volatile liquid used as a remedy for tapeworm, and in leukæmia.

BENZOCAINE is a white powder with soothing properties used as a sedative for inflamed and painful surfaces. The dose is 5 to 10 grains.

BENZOIC ACID is an antiseptic. It, or benzoate of sodium, is given internally in doses of 5 to 15 grains in cases of suppuration along the urinary tract, especially in inflammation of the bladder with decomposition of the urine. Other acids are neutralised in the blood, but it is excreted as hippuric acid and acidifies the urine. (For benzoin see BALSAM.)

BENZYL BENZOATE, is a substance that used to be given in the treatment of colic and dysmenorrhœa and is now widely used as a lotion in the treatment of scabies, being mixed for this purpose with equal parts of methylated spirit and soft soap. The formula is $C_6H_5COOCH_2C_6H_5$.

BERGER RHYTHM is the term applied to normal rhythmical changes of electric potential in the brain. The electrical 'waves' can be recorded graphically. One important point is that a person with epilepsy has abnormal waves.

BERI-BERI, called by the Japanese KAKKÉ, is a disease of hot climates, having been found in Japan, Malay, China, Manila, Fiji Islands, India, West Africa, Western Australia, and round the Gulf of Mexico, and consisting in inflammation of the nerves all over the body. (*See* NEURITIS.)

Causes.—It is found among those living in certain parts of the tropics, whose diet consists mainly of highly milled rice. It also occurs in Newfoundland and Labrador, where the inhabitants' main item of diet is white wheaten flour. In both groups of population the removal of the husk of rice and of the wheat berry leaves the diet very deficient in vitamin B1. It is the lack of this vitamin that causes the trouble.

Symptoms. — The affected person becomes, first of all, for some days

feverish and weak; then, though feeling better in general health, he gradually develops symptoms of paralysis, especially of hands and feet, dropsy, palpitation of the heart, and loss of sensation in large areas of skin, especially about the legs. These pass off, in general, in the course of some weeks, and the sufferer gradually recovers health, or occasionally they get worse, and he dies from cardiac failure.

Treatment.—The special treatment required is the provision of plenty of nourishing food containing vitamin B1, and complete rest. (*See also* NEURITIS.)

BERKEFELD FILTER is a candle-shaped filter made of diatomaceous earth. It restrains ordinary bacteria but lets through ultramicroscopic viruses, called on that account filterable viruses or filter-passers.

BEZOAR is a concretion found in the stomach and intestines of animals, especially goats, which was formerly used as a remedy against poisoning.

BICARBONATE OF SODA, or BAKING SODA. (*See* ALKALI.)

BIDET is a fixed sitz-bath raised on legs which is used for administering douches and enemata.

BILE is a thick, bitter, golden-brown or greenish-yellow fluid, secreted by the liver, and stored in the gall-bladder. It consists of water, mucus, brown and green pigments, salts of two complex acids (glycocholic and taurocholic acids), and some mineral salts, and it is discharged through the bile-ducts into the intestine, a few inches below the opening from the stomach. This discharge is constant, but is much increased shortly after food is taken, and again, some hours later, when the food is digested. Bile is partly an excretion of waste material thrown out by the liver, partly a secretion endowed with some functions in digestion, especially that of fats, and it further aids the absorption of nourishment from the food passing down the bowels, and prevents excessive decomposition and smell by destroying various organisms, especially micrococci. About a pint to a quart is daily secreted in man, but the greater part of this is reabsorbed with the food, passes into the blood, and ultimately circulates back to the liver, to be again excreted, and so on.

Jaundice is a condition in which the flow of bile becomes obstructed, so that the bile is not poured into the intestine, but circulates in the blood. As a consequence, the bile pigments are deposited in the tissues, and the skin becomes olive-green or brown, while, at the same time, the stools become grey or white and the urine dark. (*See* JAUNDICE.)

Bilious headache, or biliousness, is rather a vague term, applied either to megrim (*see* HEADACHE) or to the headache and vomiting which occur in acute catarrh of the stomach set up by errors in diet. (*See* DYSPEPSIA.)

Vomiting of bile occurs in the two last-named conditions, and also is a sign of obstruction of the bowels, but bile may be brought up in any case of persistent vomiting or retching.

BILHARZIA (*see* PARASITES).

BILISELECTAN (*see* PHENIODOL).

BINET-SIMON TEST is a method of testing the intelligence of persons who are mentally defective by asking them a series of questions and getting them to perform several simple exercises such as drawing, which can normally be performed by children of various ages. By this means the mentally defective can be classified as possessing the intelligence of a child of six, eight, ten years, etc. (*See* MENTAL DEFECTIVENESS.)

BINOVULAR TWINS is the term applied to twins which result from the fertilization of two separate ova.

BIOCHEMISTRY means the chemistry of living organisms and of vital processes.

BIOPSY means the removal and examination of tissue from the living body for diagnostic purposes. For example, a piece of a tumor may be cut out and examined to determine whether it is cancerous.

BIOTIN, VITAMIN H, or CO-ENZYME R, is a newly-discovered organic substance necessary for the growth of yeast. Rats given raw egg-white develop a skin disease which can be prevented if they are also given biotin. Biotin appears to be essential to human nutrition. In deficiency of this vitamin exfoliative dermatitis develops.

Biotin is made inactive by a protein in egg-white known as avidin. It is inactivated when the egg-white is eaten raw, not when it is cooked.

BIPP is a colloquial term used to designate an antiseptic and soothing paste applied to wounds and consisting of bismuth subnitrate, iodoform, and paraffin. It was much used in the war of 1914–18.

BIRTH (*see* LABOUR).—The average length of a child at birth is 18-20 inches, and its weight 6-7 lb. A child is said to be *still-born* when it is alive, but makes no movement, after birth. The usual cause is the birth of the feet and body before the head (which in most cases comes first), and the child speedily dies unless active means be taken to make it breathe. Such infants may be blue in the face, when recovery, by means of artificial respiration, and alternate dipping into hot and cold water, is promising; or they may be white and collapsed, when recovery is very unpromising. A *dead-born* child may have perished some weeks before birth, or in the process of expulsion. *Premature birth* is one which takes place before the natural time (*see* PREGNANCY), but in which the child is capable of surviving. A birth which takes place so prematurely that the child must necessarily die is known as an abortion or *miscarriage*. (*See* MISCARRIAGE.)

BIRTH-MARKS are of various kinds. The most common are port-wine marks. (*See* NÆVUS.) Pigment spots are found, very often raised above the surface and more or less hairy, being then called moles. (*See* MOLES.)

BISMUTH is a metal, of which the carbonate, oxide, subnitrate, salicylate, and oxychloride are much used in medicine.

Uses.—In irritative and painful conditions of the stomach or of the bowels, *e.g.* when diarrhœa or vomiting is present, they have a marked sedative action. The salicylate of bismuth especially is used to check diarrhœa, the usual medicinal dose of it or of the subnitrate being about 20 grains. The carbonate and oxychloride are of great use as an aid to X-ray diagnosis. Suspended in some sterile fluid they may be injected into sinuses, or they may be given by the stomach in doses of 2 or more ounces with milk, porridge, or gruel. The mass of bismuth forms an opaque shadow and shows the outline of the cavity in which it lies. Thus the physician can see the size and position of the stomach in an X-ray photograph, or can trace a meal in the passage through the bowels. It must be remembered that, given internally, bismuth preparations turn the stools black.

Externally, as dusting powder, they are used, both for a cosmetic and in eczema and other moist conditions of the skin, being commonly mixed, in equal proportions, with starch powder or oxide of zinc, or both.

Metallic bismuth in a state of fine division is given by intramuscular injection, in the treatment of syphilis, and is often more effective than mercury or arsenic preparations.

BITES, STINGS, AND POISONED WOUNDS.—Bites of animals are in general to be treated as punctured or lacerated wounds (*see* WOUNDS), but seeing that animals' teeth are in general foul, suppuration is very apt to arise if the bite be deep. The bite of some reptiles, scorpions, spiders, etc., causes definite symptoms of poisoning, while, after the bites of several animals, especially the wolf and the dog, there is often a risk of hydrophobia. Wounds which are *septic*, *i.e.* poisoned by bacteria, are treated under WOUNDS.

Dog bites are generally treated with far more care than their seriousness deserves. Any simple dressing, such as boric lotion or carbolic lotion, may be applied on lint covered with guttapercha tissue, and the dressing renewed twice daily for a few days, till the wound is clean. If, however, there be fear of hydrophobia, active measures should be taken. (*See* HYDROPHOBIA.)

Snake bites are not necessarily poisonous, for not only are many snakes harmless, but persons can, like the snake-charmers of India, render themselves immune by the injection under the skin of gradually increasing doses of the poison. The principal poisonous snakes belong to the viper and cobra families, and all inject their poison through a pair of grooved or hollow teeth connected with poison glands. These include in Asia the cobra, the king cobra, the crait, the deboia, and

the phoorsa; in America the rattlesnake, the copperhead, and the moccasin; in South America the fer-de-lance and the coral snake; in Africa cobras, vipers, and the puff-adder; and in Australia the death-adder, tiger

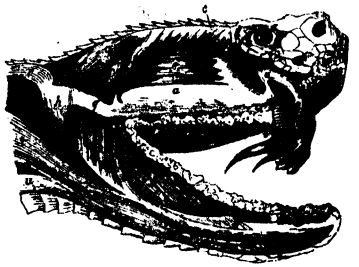


FIG. 73.—Head of the rattlesnake dissected. *aa*, Poison gland and its excretory duct leading to the root of the fang. The other letters indicate the various muscles which open the jaws, or which close them and compress the gland. (Miller's *Surgery*.)

snake, copperhead, brown snake, and black snake. The sea snakes of the Pacific and Indian Oceans are almost all poisonous. The adder of Europe is almost harmless to human beings, although dangerous to several animals. The symptoms of snake-poisoning are swelling and paralysis of the bitten part, with general depression, palpitation,

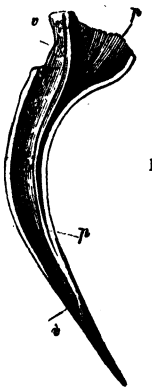


FIG. 74.—Poison fang magnified. *pp*, Pulp cavity of the tooth; *vv*, the canal along which the venom flows. (Miller's *Surgery*.)

difficulty of breathing, faintness, and later paralysis and convulsions, followed, in bad cases, by death. These symptoms appear within fifteen minutes to an hour after the bite. Only about 30 per cent of persons bitten by venomous snakes are believed to die, the remainder recover. After the bite of a deboia or of one of the rattlesnakes very severe suppuration may occur in the neighbourhood of the bite in people who recover. The treatment recommended by Calmette is to put a tight band at once between the bite and the body, so as to stop the circulation (the band may be left on for ½ hour); to make a cut ½ inch deep and 1 inch long following the bite; to press, wash, and suck the wound; and later to inject, into the tissues around, permanganate of potassium solution (1 in 100 of water) or chloride of lime (2 per cent), which destroys the poison. Spirit, sal volatile, strong tea, or coffee should be given by the mouth to stimulate the feeble heart. The person should rest quietly, and, if breathing becomes difficult, artificial respiration should be performed. A serum known as *antivenine* has been produced as an antidote to the poison of various types of snake, but unfortunately each kind of serum is useful only against the poison of the particular kind of snake. In any case antivenine is not likely to be procurable in an emergency. Poisonous fishes exist in most tropical waters, especially around the islands of the Pacific and Indian Oceans, and their venom may be conveyed to man either by poisonous stings or by their bite. The action of the poison is mostly a depressing one upon the heart, and in the case of some of the tropical fishes convulsions and even death may be produced.

Toads and salamanders secrete a milky fluid from the skin of the back which is irritating locally, and which, in small animals and weakly children, is said to kill if introduced by a wound.

Centipedes, scorpions, and tarantulas (large tropical spiders) kill their prey by poison, and can inflict a very painful, though probably seldom fatal, bite on human beings. The treatment is to apply a ligature as for snake bite at once, and to suck the wound or wash it well with a strong solution of permanganate of potassium. Some other substances have also a reputation as antidotes, such as ammonia, spirit of camphor, tobacco juice, turpentine, and camphor and chloral rubbed up together. An antitoxic serum has been prepared for use against scorpion bite in Egypt. If an abscess forms it is treated like an abscess from any other cause.

Harvest-bugs, fleas, lice, and mosquitoes often cause great irritation of the skin by their bite. Harvest-bugs may bury themselves in the skin and have to be picked out with a needle. Lice may be got rid of, if in the hair, by saturating this with petroleum or carbolic lotion (1 in 60) and wearing an oilskin cap over-night for three successive nights. They may be got rid of from the clothes by baking these in an oven or fumigating with burning sulphur for several hours, or by the use of Vermijelli and N.C.I. powder. (*See further under* INSECTS IN RELATION TO DISEASE.) Bites by mosquitoes or bugs are soothed by bathing with salt water or painting with sal volatile, oil, or laudanum, and they may be prevented to some extent by smearing the skin with camphor water, lime juice, or one of the oils of pennyroyal, lavender, cloves, or cinnamon.

Ants, bees, wasps, and hornets cause great irritation by the stings with which the females and workers are provided. Those of ants are allayed by eau-de-Cologne or ammonia. Bees, wasps, and hornets sometimes leave a part of their sting as well as poison in the skin, and this should be looked for first of all and pressed out. The sting of a wasp in the throat, the insect having been taken into the mouth in biting a fruit, has caused death owing to rapid swelling, which blocks the air passage. Many things give relief from the pain, such as ammonia, soap, 'blue bag', chloral and camphor, tobacco juice, or onion juice locally applied.

Jellyfish and hairy-caterpillars, the former by which they discharge threads and the latter by brittle, poisoned hairs, cause an itchy red rash after contact. It is relieved by vinegar or olive oil.

Nettle stings are relieved by bruised dock leaves or raw onion juice.

Arrow poison is sometimes dreaded when children have been playing with arrows from the East Indies. Unless, however, the arrow has been actually driven into the flesh, the amount of poison absorbed would probably be insufficient to do any harm. The wound should be washed out with permanganate of potassium solution. The poison on these arrows is sometimes one causing convulsions, in which the general treatment is that for strychnine-poisoning, or more generally it is of the nature of curare, causing paralysis, in which case, if the breathing should begin to fail, the proper treatment would be artificial respiration. (*See under* DROWNING.)

BITTERS.—The two most bitter substances are probably strychnine and quinine, which have other still more powerful properties. But when one speaks of 'bitters' one means substances of milder properties, which are used to stimulate the functions of the stomach and so give an appetite and aid digestion. Calumba, chiretta, gentian, and quassia are the chief pure bitters, others containing tannin and being also astringent.

BLACK DEATH is an old name for plague. (*See* PLAGUE.)

BLACK-DRAUGHT is a powerful purgative preparation, known also as compound senna mixture, and containing Epsom salts, senna, and liquorice. The dose is two to three tablespoonfuls.

BLACK DROP is another name for laudanum or tincture of opium. (*See* OPIUM.)

BLACK-HEADS (*see* ACNE).

BLACK MOTIONS are passed when there is great constipation, and when bismuth or iron is being taken; but the most common cause is blood changed by the digestive processes, and proceeding generally from ulceration somewhere in the stomach or bowels.

BLACK VOMIT is due to the presence of blood in the stomach. There may be dark masses, as in yellow fever, or a small amount of black sediment like coffee-grounds, as in ulcer of the stomach.

BLACK-WATER FEVER is an acute illness characterised by hæmoglobinuria ('black water'), jaundice, fever, vomiting, anæmia, and severe hæmolysis. It is in some way associated with malignant tertian malaria, and occurs in Central Africa, the Southern States of America, the West Indies, and some parts of Southern Europe.

The condition appears to be precipitated by quinine in persons living in or coming into a region where malignant tertian malaria is endemic, and has a mortality rate of between 20 per cent and 40 per cent.

Symptoms.—These are fever, rigor, nausea, bilious vomiting, epigastric discomfort, jaundice, and the passage of pinkish, red, or port-wine-coloured urine—hæmoglobinuria. Spleen and liver are enlarged and tender. After a few hours the temperature falls, there is profuse sweating, and the skin becomes jaundiced. Mild cases may recover in a day or two. Severe cases have a succession of attacks, and perhaps a third of all cases result in death.

Treatment.—Consists in (1) absolute rest in bed; (2) administration of plenty of alkaline fluids; (3) glucose given intravenously (and sodium bicarbonate if necessary); (4) blood transfusion, and subsequent remedies for anæmia. Careful nursing is most important. With regard to prevention, the avoidance of chill and fatigue, and the treatment of malaria, if present, by regular small doses of quinine with avoidance of large doses, or mepacrine, are of importance.

BLADDERS are sacs formed of muscular and fibrous tissue and lined by a mucous membrane, whose surface is covered by smooth cells, and which is united loosely to the muscular coat, so as to allow freely of increase and decrease in the contained cavity. Bladders are designed to contain some secretion or excretion, and communicate with the exterior by a narrow opening through which their contents can be discharged. In man there are two, the *gall-bladder* and the *urinary bladder*.

GALL-BLADDER.—This is situated under the liver in the upper part of the abdomen, and its function is to store the bile, which it discharges into the intestine by the bile duct. For further details see LIVER.

URINARY BLADDER.—This is situated in the pelvis, in front of the last part of the bowel. The bladder, in the full state, rises up into the abdomen and holds about a pint of urine. Two fine tubes, called the ureters, lead into the bladder, one from each kidney; and the urethra, a tube as wide as a lead pencil when distended, leads from it to the exterior, a distance of several inches.

Structure.—The wall of the bladder is similar in structure to that of the bowels, and consists of four coats. The inner surface is lined by a soft mucous membrane covered by epithelial cells of irregular shape. This is attached to the muscular coat by a loose, fibrous, submucous coat, in which run numerous blood-vessels. In the muscular coat the muscle fibres are arranged in several layers, and run in various directions, thereby adding greatly to the strength of the wall. On its upper and back part, the bladder possesses a covering of serous membrane, formed by part of the general peritoneal lining of the abdominal cavity, but this outermost coat does not extend down to the base of the bladder, where the latter lies in close contact with the other pelvic organs. The bladder is suspended in position by numerous ligaments, four of which are fibrous bands, while the remaining five are formed by thickened portions of the peritoneum. The base of the bladder is directed downwards and backwards, and in this part are the three openings of the ureters and urethra. The exit from the bladder is kept closed by a muscular ring, which is relaxed every time water is passed.

BLADDER, DISEASES OF.—For diseases of the gall-bladder see GALL-BLADDER. (*See also* URINE.) The urinary bladder is subject to several diseases, but, partly through its general freedom from disease, partly owing to its inaccessibility, as it lies deep in the pelvis behind the pubic bones, partly owing to general ignorance as to its site and functions, symptoms set up in it are very often attributed to the bowels and other organs. Diseased conditions in it are diagnosed in part by the symptoms they set up, in part by chemical and microscopical examination of the urine, and in the more obscure conditions by means of the cystoscope. The *cystoscope* consists of a narrow metal tube fitted up as a telescope, and bearing at its end a small electric lamp by which the cavity is lighted up. The instrument is introduced through the urethra, and shows any tumor or ulcer which may exist, and also whether blood in the urine comes from the bladder wall or runs out of the ureters from the kidneys. *Sounding* is another process, consisting in the introduction of a curved solid metal

rod, when the presence of a stone is suspected, against which the 'sound' can be felt or heard to strike. *Catheters* are tubes about the thickness of quills, which are made of metal, vulcanite, india-rubber, etc., and are used to draw off the water when it is not possible to expel this voluntarily, or, when the bladder is to be washed out for some diseased condition. (*See* CATHETERS.) The following are some of the chief diseased conditions:

CYSTITIS, or INFLAMMATION OF THE BLADDER. — **Causes.** — Bacteria live readily in the urine but they do not multiply in the healthy bladder. When some cause is present to weaken the bladder wall, or, when bacteria are introduced in large numbers, for example on a dirty catheter, they multiply inside this organ and set up inflammation. In the course of a severe chill a mild cystitis may develop, but gets well in a few days or weeks. A severer form may come on in typhoid fever, pneumonia, and other weakening diseases. There may be direct infection from neighbouring organs, as the rectum in cancer, the urethra in gonorrhœa. Any cause that prevents the free voiding of the urine, such as stricture or narrowing of the urethra, or enlargement of the prostate gland at the outlet of the bladder, which is a common occurrence in elderly men, may produce a chronic form of cystitis. A stone, if present, is apt by its irritation to do the same. One of the most frequent organisms found in the urine in cases of cystitis is the common colon bacillus, which produces an acid condition of the urine. Tuberculous cystitis may be found, due to the tubercle bacillus which produces a chronic ulcer on the bladder wall. It is a very difficult condition to treat. Another very chronic form is caused by bilharzia, a small parasitic worm which may settle in the minute blood-vessels of the bladder wall. This form is very common in Egypt and South Africa, and is sometimes found in those who have resided in these countries.

Symptoms.—Pain in the region of the bladder or in the small of the back, frequency of making water, and a condition of bad smell, turbidity, and whitish sediment in the water, are the chief facts noticed by the sufferer.

There may in acute cases be high temperature and shivering fits. In the chronic form the very frequent desire to pass small quantities of water is the most marked symptom.

Treatment.—Rest in bed, hot hip baths, and hot applications, like poultices or fomentations to the lower part of the abdomen or the fork, along with simple diet and large quantities of water to drink, may be all that is necessary. When pain is severe, various sedatives are given, and, when there is much pus in the water, the bladder is often washed out through a catheter with permanganate of potassium (1 in 5000), boracic acid solution (1 in 80), nitrate of silver (1 in 2000). (*See* DOUCHES.) In the chronic form similar treatment is adopted. Drugs like hexamine, salol, and benzoate of ammonium, which lessen decomposition in the urine, are also given, and the original cause, be it a stone, stricture, tuberculous ulcer, etc., must be removed. Cases due to the colon bacillus (the most frequent cause of cystitis) are greatly benefited or cured by administration of citrate of potassium in large doses for a time, followed by hexamine or mandelic acid along with benzoate of ammonium. Sulphanilamide is another valuable drug in the treatment of cystitis due to the colon bacillus.

NEURALGIC PAIN in the bladder is often periodic and associated with frequency of making water. It is very often due to dyspepsia and constipation.

STONE, or CALCULUS, in the bladder may be of any size up to that of a hen's or goose's egg, but those which set up symptoms severe enough to necessitate operation are seldom smaller than a cherry or a pigeon's egg. There are three varieties of stone: (*a*) URATIC, associated with acidity (*see* ACIDITY) or with the gouty constitution; (*b*) OXALIC, composed of oxalate of lime, and often associated with chronic dyspepsia and hypochondriasis; (*c*) PHOSPHATIC, which occur in long-standing cases of inflammation of the bladder, accompanied by constant decomposition of the urine.

Symptoms.—The symptoms of inflammation of the bladder, together with discomfort on movement, and sudden pain immediately after the

passing of water, are those generally found.

Treatment.—Various substances have been administered with the view of dissolving the stone, and these, which also prevent the formation of stones in persons suffering from acidity, are mentioned under ACIDITY. The chief are water in large amount, potash, lithia, soap, lime-water, phosphate of soda, diluted mineral acids, piperazine, and mineral waters like Wildungen, Contrexéville, and Vichy. In 1739 a secret remedy sold by Mrs. Joanna Stephens was considered so effectual in dissolving stones that the secret was bought by the British Government for £5000. It was found to consist of calcined eggshells, soap, and aromatic bitters—that is, its essentials were lime, phosphates, and alkalies. Those cases with a tendency to the deposit of oxalates are treated by attention to the diet and bitter tonics. When the stone is of any great size, it must be removed by surgical means, being either crushed by an instrument introduced through the urethra, and then washed out of the bladder in small fragments—the operation of *Lithotrity*—or removed intact through an opening which is made either through the fork into the base of the bladder, or through the lower part of the abdomen into the upper part of the bladder—the operation of *Lithotomy*. (*See* LITHOTOMY.)

TUMORS in the bladder are often the cause of large quantities of bright blood being passed with the urine. For their removal the bladder is opened through the lower part of the abdomen.

RUPTURE of the bladder may occur in old men who have long suffered from difficulty in passing water and cystitis, or in healthy persons owing to a blow or crush. (*See* ABDOMEN, INJURIES OF.)

BLAUD'S PILL is a pill containing carbonate of iron much used in the treatment of anæmia.

BLEEDER is a term applied to persons in whom it is difficult to stop bleeding when some small wound has been sustained. (*See* HÆMOPHILIA.)

BLEEDING (*see* HÆMORRHAGE *and* BLOOD-LETTING).

BLENORRHŒA (βλέννα, mucus; ῥέω, I flow) means an excessive discharge of mucus or slimy material from a surface, such as that of the eye, nose, bowel, etc. The word catarrh is used with the same meaning, but also includes the idea of inflammation as the cause of such discharge.

BLEPHARITIS means inflammation of the eyelids.

BLEPHAROSPASM means spasm of the eyelids.

BLINDNESS (*see* VISION).

BLIND SPOT (*see* EYE).

BLISTERS AND COUNTER-IRRITANTS.—These are employed in cases of both acute and chronic inflammation, on the principle proved by experiments on animals that irritation of the skin causes congestion of the parts immediately below the skin, while it relieves congestion of deep-seated organs, through an action upon the nerves that regulate the size of the minute blood-vessels.

Varieties.—Substances so employed are spoken of generally as counter-irritants, and divided into *rubefacients*, or substances which merely redden the skin and cause it to peel off; and *vesicants*, or blistering applications, when, in addition, they produce a collection of fluid under the horny layer of the skin; but there is no sharp division between them, most rubefacients producing blisters if left on long enough. A few substances produce pustules, or small collections of pus in the skin, for example, croton oil and ointment of tartrated antimony, but these *pustulants* are seldom used except in cases of chronic bronchitis. The chief *rubefacients* are: mustard, turpentine, cajuput oil, capsicum, tincture of iodine, and liniments of ammonia, chloroform, etc., and of *vesicants* we have cantharides or Spanish fly, pure acetic acid, ammonia, and chloroform.

The CAUTERY also is often used for this purpose. (*See* CAUTERY.)

Uses.—MILDER COUNTER-IRRITANTS are used in cases of bronchitis, congestion of the stomach with vomiting, vague rheumatic pain, sprains, and when a prolonged application is desired, so that some swelling or thickening due to chronic inflammation may be

absorbed, or some continued pain lessened.

BLISTERS are used (1) to subdue severer forms of pain and inflammation, for example, in pleurisy, pericarditis,

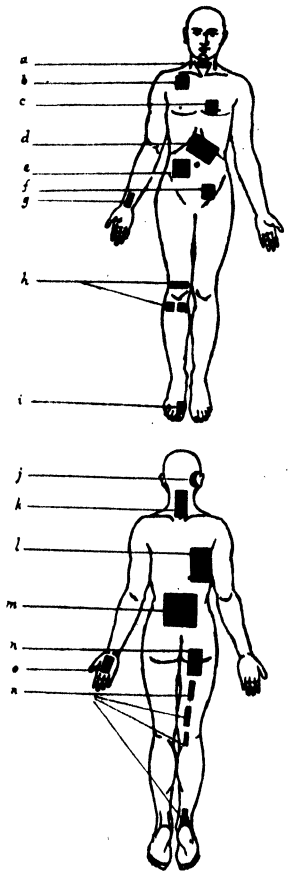


FIG. 75.—Diagram illustrating various positions where blisters, etc., are commonly applied. The larger areas correspond in size to weaker irritants, such as mustard leaves; the smaller indicate the size of blisters. *a*, For laryngitis; *b*, for phthisis; *c*, for pericarditis; *d*, for vomiting; *e*, for appendicitis; *f*, for ovaritis; *g*, *h*, *i*, *o*, for rheumatism or gout; *j*, for headache; *k*, for epilepsy; *l*, for pleurisy; *m*, for lumbago; *n*, for sciatica.

meningitis, and sciatica, in which case they are applied a little distance away from the seat of pain; and (2) to promote absorption of thickenings and effusions in joints, etc., in which case the blister is applied to the skin immediately over the affected part.

How to apply a blister or counter-irritant.—*Mustard* is made into a paste and spread on muslin or brown paper, and so applied directly to the skin for twenty to thirty minutes, until a warm glow is felt. Mustard leaves can also be purchased and similarly used after moistening. If a more powerful action be desired, mustard may be dusted thickly over the surface of a linseed-meal poultice, and this applied for a similar length of time. After-redness is less if muslin has been placed between the mustard and the skin. In children, ten minutes may be sufficient for the action of a mustard plaster, and one must be careful not to apply mustard too long in weak persons and children, or a slough may result. For a milder effect the paste may be made with equal quantities of mustard and flour. The skin should be sponged with warm water, dried, and anointed with a little vaseline after the mustard is removed.

Turpentine and *cajuput oil* are generally sprinkled, about a teaspoonful at a time, upon flannel cloths, which are then wrung out of hot water, and used for pain in the abdomen or back. (*See* POULTICES *and* FOMENTATIONS.)

Tincture of iodine is usually painted on the skin once or twice a day till the cuticle comes off in flakes, but just short of blistering. It is used over enlarged glands and joints, and also to a great extent in chronic lung diseases.

Cantharides blisters are produced by painting on Liquor Epispasticus (blistering fluid), or by applying cantharides plaster, of which the black surface is oiled and then placed against the dried skin, and which is secured with strips of adhesive plaster or with a bandage or handkerchief. Sometimes cantharides is applied in an ointment containing the powdered insects. Care must be taken not to apply a blister over a bony prominence in a person who is weakly or confined to bed, or healing may be very slow. Fig. 75 shows the sites in which blisters are oftenest ordered. The application is left in position for some hours (if large), or over night (if small), and, when it is removed, olive oil should be applied to remove any particles of cantharides still in the skin, and prevent another blister rising. The bleb should be pricked at once, but on no account

should the raised skin be cut away till the skin beneath is hard—that is, after two or three days. The blistered area should be dressed for a day or two with some simple ointment spread on lint.

In persons who are the subject of Bright's disease, and in the case of paralysed limbs, cantharides blisters are unsuitable applications.

Acetic acid, *ammonia*, and *chloroform* are used by soaking a piece of lint of the required size in one of these fluids, applying it, and covering with a watch-glass till the blister rises.

BLOOD is a fluid which circulates through the arteries, capillaries, and veins exchanging fluid and gases with the bodily tissues. The latter receive the products absorbed from the food and oxygen taken up by the blood in its passage through the lungs, while the blood removes from the tissues carbonic acid gas to discharge it in the lungs, and various waste products, of which it rids itself in its passage through the kidneys.

Composition.—The blood consists, in addition to the fluid, of corpuscles, minute bodies $\frac{1}{3000}$ of an inch, or less, in size. These are of three kinds: red

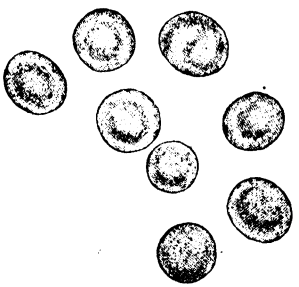


FIG. 76.—Red blood corpuscles. Magnified 800 times.

corpuscles, white corpuscles, and blood platelets. In the *fluid* are dissolved the various salts and proteins which nourish the tissues (*see* LYMPH), and also the waste products, such as uric acid, destined for removal from the body. The *red corpuscles* act as the carriers of oxygen; each is a disc, hollowed out on either surface, and contains a substance called hæmoglobin, which acts as a medium of interchange between the oxygen of the air in the lungs, and the tissues requiring it.

BLOOD

There are over 5,000,000 red corpuscles in every cubic millimetre of blood, the blood of women containing slightly fewer than that of men. The *white corpuscles* are of several different kinds, and wander through the walls of the small blood-vessels, upon occasion, into the tissues; here they have many functions to perform, of which the chief are

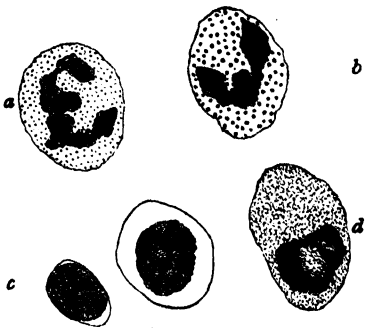


FIG. 77.—White blood corpuscles. *a*, Polymorph leucocyte; *b*, leucocyte with eosinophile granules; *c*, small and large lymphocytes; *d*, large mononuclear leucocyte. Magnified 1000 times.

the repair of wounds, the absorption of foreign bodies, and the destruction of bacteria; their dead bodies form, when in large numbers, the matter or pus of abscesses. Their number is less than 1 to 500 of the red corpuscles. The chief varieties of white corpuscles are those with a single large nucleus (large mononuclear), those with a nucleus consisting of several variously shaped parts (polymorphonuclear), and small corpuscles resembling those formed in the

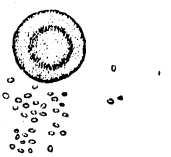


FIG. 78.—One red blood corpuscle with blood-platelets. Magnified 1000 times.

lymphatic glands (lymphocytes). Also they are classed according to whether the granules they contain stain with a blue alkaline dye (basophile) or with a red acid dye (eosinophile). The *blood platelets* are extremely minute, and perhaps play some important part in clotting.

Examination of blood.—The cor-

puscles of the blood may be counted. For this purpose a minute drop is drawn up into a special graduated tube provided with a bulb in which the blood is mixed with a suitable diluting fluid. A drop of this diluted blood is blown out upon a special glass slide on which have been ruled with a diamond a number of lines that divide the surface into areas of a 400th square millimetre in size. A cover glass is then lowered upon the drop and so supported on a raised glass rim that a definite distance ($\frac{1}{10}$ millimetre) separates it from the ruled surface. The slide is then placed under a microscope, the average number of corpuscles that have settled on each square is counted, and thus the number in one four-thousandth of a cubic millimetre is ascertained.

The hæmoglobin is estimated by taking a drop in a fine measured tube, diluting it with distilled water in a graduated tube till it assumes the same tint as a known standard, and then, by reading off the amount of water added, the percentage of hæmoglobin is got.

Dried films are also prepared by stroking the blood on slides and staining these, usually with aniline dyes, methylene blue, and eosine dissolved in methyl alcohol; in these dried films the corpuscles can be examined by a high magnifying power and a differential count can be made of the various forms.

Formation of blood.—The life of a corpuscle is probably about three or four weeks; at all events the blood-forming organs can restore the blood after extreme hæmorrhage to its normal state in this time. To renew the wear, as well as to make good losses by wounds, a constant manufacture is going on in the marrow of the smaller bones, in some glands, and also probably in the spleen.

Amount of blood.—This is about 1 lb. for every 14 lbs. of total body weight, so that a fairly heavy person has 12 to 14 lbs. of blood or about 5¼ pints. A loss of 5 lbs. has, however, been known to cause death.

Clotting of blood occurs when blood is shed, and is due to the formation of threads of fibrin, which, as it shrinks, squeezes out from its interstices a clear faintly straw-coloured fluid—serum. (For details of clotting *see* FIBRIN.)

Functions of blood.—The red corpuscles act as oxygen carriers, the white corpuscles have mainly a defensive action against the onset of disease. The fluid of the blood carries in solution various waste-products such as carbonic acid gas to be exhaled by the lungs, urea and salts to be removed by the kidneys; also it distributes foodstuffs, such as sugar and proteins absorbed from the intestine and elaborated by various glands; and it forms a general medium of communication between organs that are chemically interdependent, for example carrying to the stomach the materials for the gastric juice, to the muscles ferments formed in the pancreas, etc., and absorbing secretions needed for the general purposes of the body, like those of the thyroid gland and suprarenal bodies. (*See* CIRCULATION OF SECRETIONS.)

BLOOD GROUPS.—People are divided, in respect of a certain reaction of the blood, into four groups. This depends upon the capacity of the serum of one person's blood to agglutinate the red blood corpuscles of another's. The reaction depends on antigens in the red corpuscles and antibodies in the serum. There are two of each, the antigens being known as A and B. Anyone's blood corpuscles may have (1) no antigens, (2) antigen A, (3) antigen B, (4) antigens A and B: these are the four groups.

The practical importance is that, in blood transfusion, the person giving and the person receiving the blood should belong to the same blood group, or a dangerous reaction will take place from the agglutination.

BLOOD, DISEASES OF.—As the blood is the carrying medium for the whole body, it readily responds to diseased change in any part. After every meal its chemistry is markedly altered, and, in such conditions as diabetes and gout, it contains, in great excess, substances which are quite normal in small amount. Still more complex changes occur when bacteria or their products find their way into the blood, which possesses the power to produce various substances that destroy the bacteria or prevent the action of the poisons they form. (*See under* SERUM THERAPY.)

Even in so apparently trifling a con-

dition as habitual constipation, when the blood absorbs foul gases and waste substances from the bowels, there is great interference with bodily activity, and impairment of memory and intellectual power, together with indigestion, foul breath, loss of appetite, various pains and aches, and generally feeble health. There are also diseases affecting the corpuscles of the blood, of which the chief are anæmia and leucocythæmia. (See under these heads.)

BLOODLESSNESS (*see* ANÆMIA).

BLOOD-LETTING was a practice much in vogue for various ailments over half a century ago. Indeed many people had themselves bled regularly for the purpose of avoiding the bad health consequent on over-eating and over-drinking. It came, in time, to be so much abused—many sick people undoubtedly having died, not of the original disease, but of the excessive bleeding practised for its cure—that it fell into almost complete disuse. Many conditions are, however, much benefited by withdrawing blood either from the affected part or from the general circulation. The chief methods of bloodletting are three in number.

Vein puncture is employed when it is desired to obtain a small quantity of blood for analysis or the performance of various tests. For this purpose a hollow hypodermic needle is pushed into a vein, one of those at the bend of the elbow usually being chosen, while pressure by a band or by the fingers is exerted on the veins in the upper arm. If it is desired to obtain the serum of the blood, the blood is run off into a test tube and allowed to clot. If the blood is required for analysis, clotting may be prevented by adding to the tube, before the blood is drawn off, a few crystals of potassium oxalate or potassium citrate.

Venesection consists in the opening of a vein, usually, owing to its superficial position, one of the veins just above the bend of the elbow. After the desired amount has flowed out, a pad and tight bandage are used to stop the bleeding. This method is of use in cases of apoplexy, of failure of the heart from over-distension in drowning, heart disease, and the like, and also is sometimes employed in uræmia and acute fevers, where some disease-poison is circulating in the blood. An effect similar to that of general bleeding is produced by free purgation.

Cupping is used either as dry-cupping to draw blood to the surface, or as wet-cupping to withdraw blood from a congested area. (*See* CUPPING.)

Leeches were formerly used to draw about a tablespoonful of blood. After they are removed bleeding is generally free, and may be encouraged, if desired, by warm poultices. They are very seldom used at the present day.

BLOOD-POISONING is, in general, a very serious condition, and is known as 'septicæmia' or 'pyæmia', according as the sufferer is simply poisoned by substances circulating in the blood, or as he develops, in addition, abscesses at different points over his body, owing to bacteria deposited from the blood. There is a slighter form called 'sapræmia', in which the person becomes fevered and ill owing to the absorption of foul or putrid substances from the bowels or from wounds, but is not dangerously affected (*see* BLOOD, DISEASES OF), and there is a chronic form called 'hectic fever', in which constant absorption of poisonous material takes place from cavities in the lungs of consumptives, from diseased bones, etc. (*See* CONSUMPTION.)

Causes.—Wounds or inflamed areas, especially in bones, joints, and veins, may be invaded by specially virulent bacteria, or owing to great constitutional weakness of the person, for example, in alcoholics or diabetics, the bacteria may find a specially congenial soil for their growth. Women after delivery are specially liable to infection, suffering from the dreaded 'puerperal' fever.

Symptoms: — In septicæmia very high temperature, followed speedily by death, may be the only sign. In pyæmia there are, in addition, shivering (rigor), profuse sweating, pains in the joints and muscles, and the signs of abscesses at different points, which may last over days or weeks.

Treatment.—Antiseptic surgery has immensely reduced the frequency of blood-poisoning. Cases due to infection by streptococci (streptococcal septicæmia) have been successfully treated by the sulphonamide drugs—

sulphanilamide, sulphapyridine (M & B 693), sulphadiazine, sulphathiazole. Blood infection with staphylococci (staphylococcal septicæmia) is resistant to treatment with the sulphonamide drugs, but very good results have been achieved with penicillin (*q.v.*). Active surgical treatment by amputation, opening of abscesses, antiseptic douches, etc., according to circumstances, is also necessary.

BLOOD-PRESSURE is the name given to the pressure that must be applied to an artery, say in the arm, in order to stop the pulse in the vessel beyond the point of pressure. It is generally assumed to be equivalent to the pressure to which the blood is subjected by the force of the heart and the elasticity of the vessels, but it is also dependent on the thickness and hardness of the vessel wall, and on the volume of blood thrown out of the heart at each beat.

The blood-pressure is greatest at each heart-beat (systolic pressure) and falls somewhat between the beats (diastolic pressure). The systolic pressure in children is equal to that of a mercury column about 100 mm. high, in young adults about 120, and it increases with advancing age as the arteries get thicker and harder, being about 150 at the age of sixty.

The blood-pressure is raised by exposure to cold, by kidney disease, by disease of the blood-vessels (arteriosclerosis), by some disorders of the ductless glands, and to a slight extent in neurasthenia and melancholia. A blood-pressure of 180 is not uncommon in cases of chronic kidney disease, and it may, in advanced cases, be as high as 250 or occasionally even 300 mm. Mental worry combined with lack of sufficient exercise has also an important effect in producing raised blood-pressure. The pressure is below the normal as the result of warmth, *e.g.* after a hot bath, in exhaustion, weakening diseases, fevers, and generally in diseases of the heart.

The blood-pressure may be estimated roughly by the pressure with which it is necessary to apply the finger at the wrist in order to obliterate the pulse. It is more exactly measured by means of an instrument known as the *sphygmomanometer*. This consists of a flat rubber bag which is strapped round the arm, and of which the interior communicates by two tubes with a pressure gauge and with a hand pump. The bag is pumped up so as to constrict the arm, and the systolic pressure is taken as that at which the pulse disappears from the vessel further down the arm.

An abnormally high blood-pressure is often accompanied by disease of the arteries, so that persons with greatly raised pressure are specially liable to apoplexy. In cases associated with advanced disease of the kidneys, the heightened blood-pressure is to some extent a salutary matter, because the circulation of the blood through the diminished vessels of the kidneys is thereby increased. In such a case the general health of the patient is better while the pressure remains moderately high, and if it be reduced too much by drugs and other means the general health deteriorates. In cases where the pressure is excessive, however, it may be lowered to some extent by a saline purgative every morning, hot baths, low diet, and the administration of certain remedies, such as nitrites, iodide of potassium, thyroid extract, etc.

BLOOD-SPITTING or HÆMOPTYSIS. —For the means of distinguishing this from vomiting of blood see EXPECTORATION, for its treatment see HÆMORRHAGE.

BLOOD-TRANSFUSION (*see* TRANSFUSION OF BLOOD).

'BLOWING' OF CANS means the presence of gas in cans of food, the gas resulting from putrefaction or fermentation of the food, or from the action of fruit on the metal of the container, producing hydrogen. The ends of the can or tin bulge and give a tympanitic note on percussion. Blown cans should be got rid of.

BLUE DISEASE is a popular term for cyanosis. (*See* CYANOSIS.)

BLUE PILL, or MERCURY PILL, is a very favourite household purgative. It contains mercury, confection of roses, and liquorice. Not only is it purgative, but it also stimulates the activity of the liver. The dose is from 3 to 8 grains.

BOILS, or FURUNCLES, are small areas of inflammation starting in the

roots of hairs, and due to the growth of a micro-organism (generally that known as a staphylococcus). When a large number of boils form close together at one time the mass is called a 'carbuncle'.

Causes.—The essential cause is bacterial, as stated, but many circumstances predispose to the growth of bacteria around the sheath of the hair, within which they are constantly found, though harmless. Diabetics and the subjects of Bright's disease are specially troubled with boils, so that any one liable to recurrence of boils should submit himself to medical examination in case he may be suffering from one of these diseases. Persons who eat too much meat food, who are constipated, or who are recovering from an exhausting illness, are very liable to them. Friction, which irritates the hair roots, is a very important cause, and therefore boils are commonest on the back of the neck, on the forearm, and on the leg, while those who row or ride have them about the seat.

Symptoms.—A red swelling forms round a hair, and causes a good deal of irritation and scratching. It gets larger for some days, being, as a rule, not very painful, unless subject to chafing. When, however, the boil begins on the head, in the ear, or in the nose, where the tissues will not stretch readily, the pain may be very great. Even after two or three days the swelling may slowly subside, and the inflammation gradually pass off, the boil being said to 'abort'. In most cases, about the sixth or seventh day the top of the boil breaks, and some thin fluid, and perhaps matter, oozes out. The yellowish 'core', consisting of a small mass of dead tissue, is now seen occupying the interior of the boil, and this comes away about a couple of days later, after which the boil speedily heals. If the boil be not treated, however, the first is very apt to be followed by a crop of others in the neighbourhood, owing to the discharge from the first boil infecting other hairs. There is a special danger in boils of the upper lip and nose; for these may lead to inflammation within the head. Generally a boil, though its presence causes great annoyance, does not lead to fever or other general symptoms. But in boils of the ear, or about the face, there may be high temperature and great prostration, which are serious signs. Carbuncles are exhausting, and, in old people, very dangerous.

Treatment.—At first the boil should be kept as still as possible, and to this end a piece of antiseptic sticking-plaster, with a small hole cut in the centre, through which any discharge can pass, may be applied over the boil and kept in position for several days, when the boil very often aborts. Another method to prevent boils coming to a head is to paint the boil and a small area of skin round it night and morning for several days with strong tincture of iodine (10 per cent). If, however, the boil is painful, or if it is proceeding to suppuration, hot fomentations should be applied, or magnesium sulphate paste. Magnesium sulphate paste is very effective, but must be freshly made. Carbuncles, painful boils and boils about the lip and nose may become very dangerous and should on no account be squeezed or fingered. Heat may be applied, and sulphonamide drugs may be applied locally in the form of ointment. As penicillin is so effective against staphylococcal infection it will probably be used in the treatment of severe boils and carbuncles. General treatment in the direction of tonics, good food, avoidance of alcohol, and free daily evacuation of the bowels by a saline, such as Epsom salts or Seidlitz powder, is also necessary; and the taking of calcium sulphide in small doses often repeated ($\frac{1}{4}$ grain six times a day), or of yeast in larger doses, is said to prevent the formation of new boils. New boils are more effectively prevented from forming by rubbing powdered boric acid gently into the skin around the old boil twice a day after washing and drying.

BONE forms the framework upon which the rest of the body is built up. The bones are generally called the 'skeleton', though this term also includes the cartilages which join the ribs to the breast-bone, protect the larynx, etc.

Structure of bone.—Bone is composed partly of fibrous tissue, partly of bone earth (phosphate and carbonate of lime), intimately mixed together. As the bones of a child are composed to the

extent of about two-thirds of fibrous tissue, while those of the aged contain two-thirds of bone earth, one readily understands the toughness of the former and the brittleness of the latter. One speaks of *dense bone*, of which the shafts of the limb bones are composed, the bone being a hard tube surrounded by a

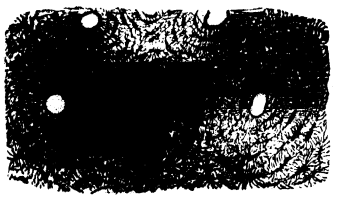


FIG. 79.—Transverse section of dried bone. The open spaces are Haversian canals surrounded by lamellæ; the lacunæ and canaliculi are shown blank. Magnified by about 200. (Turner's *Anatomy*.)

membrane, the 'periosteum', and enclosing a fatty substance, the 'marrow'; and of *cancellous bone*, which forms the short bones and the ends of long bones, in which a fine lace-work of bone fills up the whole interior, enclosing marrow in its meshes. The marrow of the smaller bones is of great importance. It is red in colour, and in it red blood corpuscles are formed. Even the densest bone is tunnelled by fine canals (Haversian canals) in which run small blood-vessels, nerves and lymphatics, for the maintenance and repair of the bone. Round

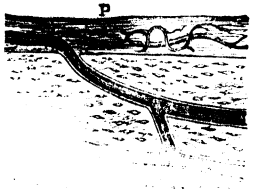


FIG. 80.—Vertical section of bone, splitting two Haversian canals. *P*, Periosteum on surface. Magnified by about 200. (Turner's *Anatomy*.)

these Haversian canals the bone is arranged in circular plates called 'lamellæ', the lamellæ being separated from one another by clefts, known as 'lacunæ', in which single bone-cells are contained. Even the lamellæ are pierced by fine tubes known as 'canaliculi' lodging processes of these cells. Each lamella is composed of very fine interlacing fibres.

Growth of bones.—Bones grow in thickness from the fibrous tissue and lime salts laid down by cells in their substance; while the long bones grow in length from a plate of cartilage (epiphyseal cartilage) which runs across the bone about half an inch or more from its ends, and which on one surface is also constantly forming bone till the bone ceases to lengthen about the age of sixteen or eighteen. The existence of this cartilage is important to bear in

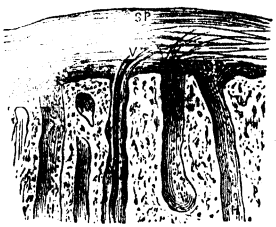
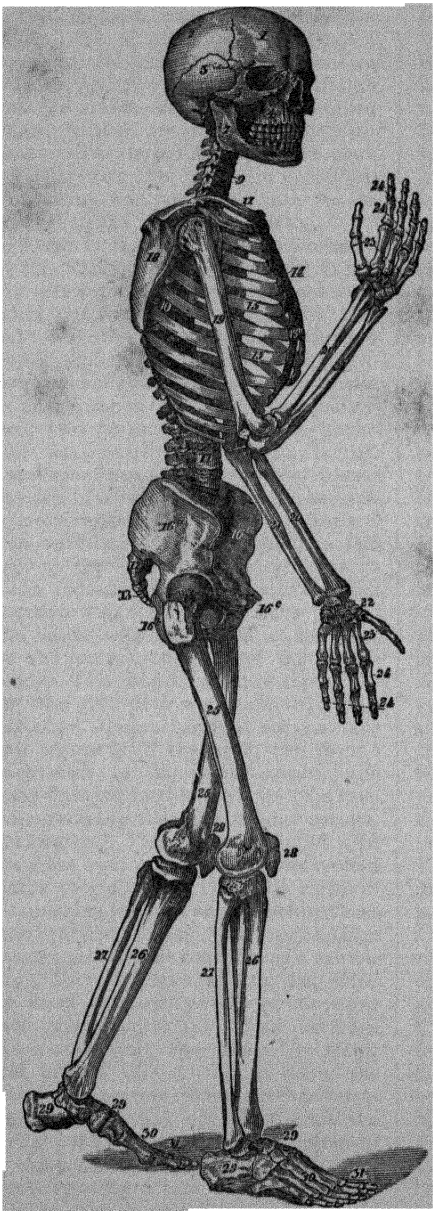


FIG. 81.—Surface of a growing bone. *SP*, Superficial fibrous layer of periosteum; *DP*, deep cellular layer forming bone; *V*, blood-vessel entering the bone; *HH*, Haversian canals. Magnified by about 200. (Turner's *Anatomy*.)

mind, because in children an injury to it may lead to diminished growth of the limb.

Repair of bone is effected by cells of microscopic size: some called osteoblasts, elaborating the materials brought by the blood, and laying down strands of fibrous tissue, between which bone earth is later deposited; while other cells, known as osteoclasts, dissolve and break up dead or damaged bone. When a fracture has occurred, and the broken ends have been brought into contact, these are surrounded by a mass of blood at first; this is partly absorbed and partly 'organised' by these cells, first into fibrous tissue and later into bone. The mass surrounding the fractured ends is called the 'callus', and for some months it forms a distinct thickening, which is gradually smoothed away, leaving the bone as before the fracture. If the ends have not been brought accurately in contact a permanent thickening results.

Varieties of bones.—Apart from the structural varieties, bones fall into four classes: (*a*) long bones like those of the limbs; (*b*) short bones composed of cancellous tissue like those of wrist and ankle; (*c*) flat bones like those of the



1. Frontal bone.
2. Parietal bone.
3. Temporal bone.
4. Upper jaw (maxilla).
5. Cheek-bone (malar bone).
6. Lachrymal bone.
7. Lower jaw (mandible).
8. Nasal bone.
9. Cervical vertebræ.
10. Thoracic vertebræ.
11. Lumbar vertebræ.
12. Sacral bone.
13. Coccygeal bone.
14. Sternum.
15. Ribs.
16. *a-c*. Pelvis.
17. Clavicle.
18. Scapula.
19. Humerus.
20. Radius.
21. Ulna.
22. Carpal bones.
23. Metacarpal bones.
24. Phalanges.
25. Femur.
26. Tibia.
27. Fibula.
28. Patella.
29. Tarsal bones.
30. Metatarsal bones.
31. Phalanges.

FIG. 82.—Human skeleton. (Schmeil's *Zoology*.)

skull; (*d*) irregular bones like those of the face or the vertebræ.

The skeleton consists of over 200 bones. It is divided into an AXIAL part, consisting of the skull, the vertebral column, the ribs with their cartilages, and the breast-bone, and an APPENDICULAR portion consisting of the four limbs. The hyoid bone in the neck, together with the cartilages protecting the larynx and windpipe, may be described as the VISCERAL skeleton.

AXIAL SKELETON.—The *skull* consists of the cranium, which has eight bones, viz. occipital, two parietal, two temporal, one frontal, ethmoid, and sphenoid; and of the face, which has fourteen bones, viz. maxillæ or two upper jaw-bones and one lower jaw-bone, two malar or cheek bones, two nasal, two lachrymal, two turbinal, two palate bones, and one vomer bone. (For further details *see* SKULL.) The *vertebral column* consists of seven vertebræ in the cervical or neck region, twelve dorsal vertebræ, five vertebræ in the lumbar or loin region, the sacrum or sacral bone (a mass formed of five vertebræ fused together and forming the back part of the *pelvis*, which is closed at the sides by the haunch-bones), and finally the coccyx (four small vertebræ representing the tail of lower animals). The vertebral column has four curves: the first forwards in the neck, the second backwards in the dorsal region, the third forward in the loins, and the lowest, involving the sacrum and coccyx, backwards. These are associated with the erect attitude, develop after a child learns to walk, and have the effect of diminishing jars and shocks before these reach internal organs, much as carriage springs protect the contents of a vehicle from injury. This is still further aided by discs of cartilage placed between each pair of vertebræ. Each vertebra has a solid part, the 'body' in front, and behind this a ring of bone, the series of rings one above another forming a bony canal, up which runs the spinal cord to pass through an opening in the cranium at the upper end of the canal and there join the brain. (For further details see SPINAL COLUMN.) The *ribs*, twelve in number, on each side, are attached behind to the twelve dorsal vertebræ, while in front they end a few inches away from the breast-bone, but are continued forwards by cartilages. Of these the upper seven reach the breast-bone, these ribs being called 'true ribs', the next three are joined each to the cartilage above it, while the last two have their ends free and are called 'floating ribs'. The *breast-bone* is shaped something like a short sword, about 6 inches long, and rather over an inch wide.

APPENDICULAR SKELETON. — The *upper limb* consists of the shoulder region and three segments—the upper arm, the forearm and the wrist with the hand, separated from each other by joints. In the shoulder lie the clavicle or collar-bone (which is immediately beneath the skin, and forms a prominent object on the front of the neck), and the scapula or shoulder-blade behind the chest. In the upper arm is a single bone, the humerus. In the forearm are two bones, the radius and ulna; the radius, in the movements of alternately turning the hand palm up and back up (called respectively 'supination' and 'pronation'), rotating round the ulna, which remains fixed. In the carpus or wrist are eight small bones—the scaphoid, semilunar, cuneiform, pisiform, trapezium, trapezoid, os magnum, and unciform. In the hand proper are five bones called metacarpals, upon which are set the four fingers, each containing the three bones known as phalanges, and the thumb with two phalanges.

The *lower limb* consists similarly of the region of the haunch and three segments—the thigh, the leg, and the foot. The haunch-bone is a large flat bone made up of three—the ilium, the ischium, and the pubes, fused together, and forms the side of the pelvis or basin which encloses some of the abdominal organs. The thigh contains the femur, and the leg contains two bones—the tibia and fibula. In the tarsus are seven bones: the astragalus (which enters into the ankle-joint), calcaneum or heel-bone, scaphoid, external, middle and internal cuneiforms, and the cuboid. These bones are so shaped as to form a distinct arch in the foot both from before back and from side to side. Finally, as in the hand, there are five metatarsals and fourteen phalanges, of which the great toe has two, the other toes three each.

Besides these named bones there are

BONE, DISEASES OF

others sometimes found in sinews called 'sesamoid' bones, while the numbers of the regular bones may be increased by extra ribs or diminished by the fusion together of two or more bones.

BONE, DISEASES OF.—Owing to the facts that most bones are deeply buried in the muscles, and that they contain in their earthy matter so much indifferent material, diseases in the bones are both apt to escape notice for a long time, and are actually much slower in their progress than similar diseases in other organs.

ACUTE INFLAMMATION is the disease which produces the most rapid effects. It is divided into acute *periostitis*, or inflammation of the surface of the bone and its enveloping membrane; acute *osteitis*, or inflammation of the bony substance itself; and acute *osteomyelitis*, or inflammation in the bone and its central cavity. These three form grades of severity, the condition having more marked symptoms, and requiring more serious operative treatment, the deeper it is situated in the bone.

Causes.—There has almost always been a fall or knock of some sort, and the person affected is, with very few exceptions, a boy or girl, the bone being chiefly liable to severe inflammation in the growing stage. The severer forms are further due to bacteria which are found in the pus in the bone. The slighter forms may be merely due to the irritation set up by the injury, or even to rheumatism or gout.

Symptoms.—In the slighter forms there is pain and tenderness to touch over some bone, which on examination is found swollen, but there are no general symptoms. In more serious cases severe pain comes on suddenly in a limb, one day perhaps after a slight accident. There is much fever, the temperature rising to 104° or 105° Fahr., and often shivering, and at night delirium. After two or three days the limb becomes swollen, hot, and tender to touch, and still later the skin becomes inflamed and red. If the condition be not treated, general blood-poisoning may result, or abscesses may form in other parts, and death may follow.

Treatment.—The slight forms require only rest, hot fomentations, and other soothing applications. The severer cases call for immediate surgical treatment, which consists usually in opening into the suppurating bone, as in the case of abscess elsewhere, or, in very bad cases, in amputation. There is almost always death of a portion of bone (sometimes the whole shaft of a long bone), and as the separation of the dead part takes long, the after treatment of the case is very tedious. Osteomyelitis is usually due to infection with a staphylococcus, and the treatment of this with penicillin holds out great promise.

CHRONIC INFLAMMATION includes several quite distinct conditions, viz. abscess, necrosis and exostosis, these conditions usually being due to injury, syphilis, or tuberculosis.

ABSCESS occurs generally in boys about the age of fourteen or fifteen, and the bone usually affected is one of those in the lower limb. The cause is either some local injury or local tuberculous disease.

Symptoms.—There is a painful swelling on the bone usually at the outer or inner side of the knee, and the temperature of the limb may be raised. The pain is generally worse at night and may prevent sleep. This may persist for months or years.

Treatment.—The only treatment is surgical, by having the abscess opened, after which relief is immediate, though healing may occupy some months.

NECROSIS means death of a bone. As stated above, it generally follows acute bone inflammation. It also follows severe fractures, occurs in matchmakers from the contact of phosphorus (*see* TRADE DISEASES), in syphilis, and occasionally at the end of some severe infectious disease like scarlatina or typhoid fever.

Symptoms.—Usually in the course of suppuration a passage is burst to the exterior, and remains as a constantly discharging 'sinus'. At the bottom of this lies the dead bone or 'sequestrum', and an operation must be performed for its removal. Usually about three to six months elapse after the original injury before it is loose and ready for removal. If it be not removed the sinus continues to discharge, and waxy disease of various internal organs is apt to come on.

EXOSTOSIS is an outgrowth upon a bone, which may be produced by long-continued irritation, *e.g.* the bony

growths on the inner side of the knee of those who ride much; or may be a symptom of syphilis; or may be of the nature of a tumor. (*See below.*)

SYPHILITIC DISEASE of bone in the secondary stage of this disease takes the form of 'nodes' or swellings due to localised inflammation of the periosteal membrane, and in the tertiary stage there are often areas of great hardening with necrosis of pieces of bone.

TUBERCULOUS DISEASE in bone as a rule occurs in young people, but it also is found now and then in a person well up in years (senile tuberculosis). It may occur (*a*) in the bones of the hand or foot, in which case very often several are affected; (*b*) in the ends of the long bones, when it is very apt to lead to disease of the neighbouring joint; (*c*) in the vertebræ, where it often results in curvature of the spine, or produces a chronic abscess. (*See* ABSCESS, CHRONIC.) 'Caries' is the name given to a crumbling condition of the bone produced by this disease.

Symptoms.—Generally the health is not first-rate. There may be a heredity of tuberculosis in other organs, *e.g.* of consumption. There are generally pain, tenderness, and swelling of the affected part. The whole limb, when a toe or finger is affected, may feel hot. Later the skin may get red and thin, and a chronic abscess form and burst, leaving a sinus. Or the condition may heal, leaving the bone only a little thickened. The progress is in any case slow, lasting many weeks or months.

Treatment.—Tonics and good food are all-important. Rest to the part affected and general exercise of the body in the fresh air are necessary. When the skin threatens to break, this should be anticipated by an operation, in which the diseased bone, etc., is all scraped away, or even amputation may be advisable in very bad cases. (*See further under* JOINTS, DISEASES OF.)

TUMORS.—CHONDROMA, a small tumor of cartilage and bone, grows sometimes under the nail of a finger or toe, and causes a good deal of pain and annoyance. It is easily removed, generally by splitting the nail, and does not return. CANCER rarely if ever begins in a bone, though secondary cancers of slow growth commonly develop inside bones, for example cancer of the breast is frequently followed by secondary cancer in the bone of the arm or elsewhere. SARCOMA is a tumour sometimes found, especially in the larger bones, causing the bone to break readily, or dilating it to a great size; amputation is necessary for its removal.

RICKETS is a disease of childhood in which the bones do not harden as they ought to do. (*See* RICKETS.)

ACROMEGALY is a disease in which the bones enlarge in size. (*See* ACROMEGALY.)

OSTEITIS is a general term applied to inflammatory conditions of bone. It includes *osteitis deformans*, in which the long bones become curved and the skull thickened; also *osteitis fibrosa*, in bones which become thickened and softened.

OSTEOMALACIA is a rare disease, affecting the poorer classes, especially women, and of these, women who have had many children in quick succession. It consists in a gradual loss of lime salts in the bones, so that these become soft and lose their proper form. It is due to lack of Vitamin D in the diet.

BONE-MARROW is a remedy used of late years in diseases of the blood. The red marrow of the smaller bones produces some at least of the red corpuscles of the blood, and it has been supposed that the administration of this red marrow, either raw in sandwiches or extracted in glycerin, is beneficial in pernicious anæmia.

BORACIC ACID, or BORIC ACID, is found in volcanic districts, or is prepared from borax. It is a mild antiseptic.

Uses.—It is used very widely for dressing wounds, either dusted on as powder or in a lotion (1 part in 30). This lotion, mixed with an equal quantity of warm water, makes an extremely good eye-wash for painful and inflamed eyes. Lint is sold ready soaked in boric lotion, dried, and generally dyed pink; it requires only to be dipped in water and applied. Offensive perspiration of the feet is checked by dipping the stockings in boric lotion and drying them before wearing. Boracic ointment is used for dressing ulcers or for lubricating instruments. Boric acid is given internally in dyspepsia due to fermentation, and in inflammation of the bladder in

10- to 20-grain doses thrice daily, but being an acid is apt to irritate the stomach. It is also frequently used as a preservative for milk and other foods, but in this case is apt to cause dyspepsia.

BORAX, or BIBORATE OF SODA, acts in much the same ways as boric acid, but has not its acid reaction.

Uses.—Its chief use is in the form of a lotion (about 1 part to 30 of water) in all forms of itching and chapping of the skin. In 'thrush' and other forms of irritation about the mouth in children the glycerin of borax, smeared on several times a day, is very soothing. To clean the mouth as well as soothe it, borax in honey wiped over the gums and tongue is very good. Borax is also given internally in epilepsy.

BORBORYGMUS (*βορβορύζω*, I rumble) means flatulence in the bowels.

BOROGLYCERIDE is a clear unctuous antiseptic, made by dissolving boric acid crystals in glycerin while hot.

BOTHRIOCEPHALUS (*βοθρίον*, a tip; *κεφαλή*, the head) is a parasitic worm. (*See* PARASITES.)

BOTULISM (*botulus*, sausage) is a term applied to a type of food-poisoning caused by the toxin arising from the presence in improperly preserved foods of the *Bacillus botulinus*. The condition sometimes affects a group of persons who have partaken of the same food, and the first symptoms come on a few hours after the food has been taken and consist of vomiting, abdominal pain, and difficulty of vision. Later, nervous symptoms consisting of double vision, drooping of the eyelids, weakness of the facial muscles, dilatation of the pupils, and dryness of the mouth and throat appear. The prognosis is extremely grave, the mortality rate being higher than 50 per cent.

Treatment.—If the condition is recognised at an early stage, it is well to administer an emetic followed by a large dose of castor oil in order to secure the expulsion of the poisonous food. Alcohol and strychnine are also given. Antitoxin, if available, should be administered.

BOUGIES are solid instruments for introduction into natural passages in the body either in order to apply medicaments which they contain or with which they are coated, or, more usually, in order to dilate a narrow part or 'stricture' of the passage. Thus we have urethral bougies, œsophageal bougies, rectal bougies, etc., made usually of flexible rubber or, in the case of the urethra, of steel.

BOUILLON is a broth or soup prepared from flesh. It is much used in various food preparations and also as a medium for cultivating organisms in bacteriological laboratories.

BOULIMIA, or BULIMIA (*βουλιμία*), means exaggerated appetite. (*See* APPETITE.)

BOVINE means something pertaining to or derived from a cow, *e.g.* the bovine tubercle bacillus which is apt to be communicated to children by the use of milk derived from tuberculous cows.

BOWELS (*see* INTESTINE).

BRACHIAL means 'belonging to the upper arm'. There are, for example, a brachial artery, and brachial plexus of nerves through which run all the nerves to the arm. The brachial plexus lies along the outer side of the armpit, and is liable to be damaged in dislocation at the shoulder.

BRACHYCEPHALIC means short-headed and is a term applied to skulls the breadth of which is at least four-fifths of the length. BRACHYCEPHALY is a characteristic of the Alpine race.

BRACHYDACTYLY is a term applied to the condition in which the fingers or toes are abnormally short.

BRADYCARDIA (*βραδύς*, slow; *καρδία*, the heart) means slowness of the beating of the heart with corresponding slowness of the pulse (below 60 per minute). (*See* PULSE.)

BRADYKINESIA is a term used to describe the condition in which the movements of the body and limbs are abnormally slow.

BRAIDISM, after James Braid, who introduced it into medicine, is another name for hypnotism. (*See* HYPNOTISM.)

BRAIN.—The brain and spinal cord together form the central nervous system, the twelve nerves passing on each side from the brain, and the thirty-one from the cord being called the peripheral nervous system, while the complex

chains of nerves and ganglia lying within the chest and abdomen, and acting to a large extent independently of the other two systems, though closely connected with them, make up the visceral or sympathetic system, and govern the activity of the viscera.

Divisions.—The brain in its simplest form in lowly vertebrate animals is a thickened part at the front end of the spinal cord, developed in order to govern the organs of special sense, viz. smell, sight, hearing, and taste, lodged near at hand. Higher in the scale, in fishes for example, there are marked bulgings of nervous matter forming the fore-brain, the mid-brain, and the hind-brain, and that part connected with the nerves of the eyes appears to be the highest governing part. In man, however, the part in front of this is specially developed, and not only forms the great bulk of the entire brain, but governs the activities of the rest. This part is called the 'cerebrum'. The brain may be divided into five parts :

(1) CEREBRUM, or *fore-brain* or *prosencephalon*. This forms the great bulk of the brain in amount and consists of

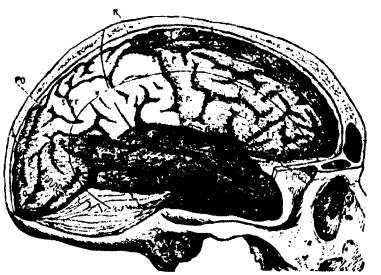


FIG. 83.—Side view of the brain in position within the skull. *F*, Frontal; *P*, parietal; *O*, occipital regions; *R*, fissure of Rolando; *S*, fissure of Sylvius; *PO*, parieto-occipital fissure. (Turner's *Anatomy*.)

two 'cerebral hemispheres' which occupy the entire vault of the cranium and are separated from one another by a deep cleft, the 'median longitudinal fissure'. At the bottom of this cleft the two hemispheres are united by a thick band of transverse nerve fibres, 'corpus callosum'. Other 'fissures' or 'sulci' make deep impressions, dividing the cerebrum into 'lobes'. Of these the chief are the fissure of Sylvius and the fissure of Rolando. The lobes of the cerebrum are the frontal lobe in the forehead region, the parietal lobe on the side and upper part of the brain, the occipital lobe to the back, the temporal lobe lying just above the region of the ear, the central lobe or 'island of Reil' lying at the bottom of the Sylvian fissure, and the falciform lobe on the surface towards the longitudinal fissure.

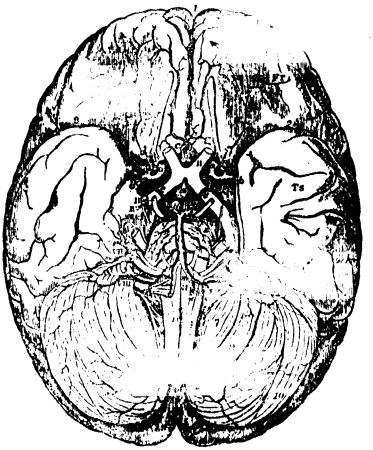


FIG. 84.—The base of the brain viewed from below, with its nerves and arteries. *Fr*, Frontal; *Ts*, temporo-sphenoidal; *Oc*, occipital lobes of cerebrum; *g*, placed on pons; *m*, on medulla; 7, 8, 9, 10, parts of cerebellum. (Turner's *Anatomy*.)

Numbers of shallower infoldings of the surface called 'furrows' or 'sulci' separate raised areas called 'convolutions' or 'gyri'. The outer $\frac{1}{8}$ inch or thereabouts of the cerebral hemispheres consists of grey matter largely made up of ganglion cells, while in the deeper part the white matter consists of medullated nerve fibres connecting different parts of the surface and passing down to the lower parts of the brain. Amongst the white matter lie several rounded masses of grey matter, the 'lenticular' and 'caudate' nuclei. In the centre of each cerebral hemisphere is an irregular cavity, the 'lateral ventricle', each of which communicates with that on the other side and behind with the 3rd ventricle through a small opening, the 'foramen of Monro'.

(2) BASAL GANGLIA, or *twixt-brain* or *thalamencephalon*, consists of two large masses of grey matter imbedded in the base of the cerebral hemispheres in man, but forming the chief part of the brain in many of the animals. Between these

masses lies the 3rd ventricle, from which the infundibulum, a funnel-shaped process, projects downwards into the 'pituitary body', and above lies the

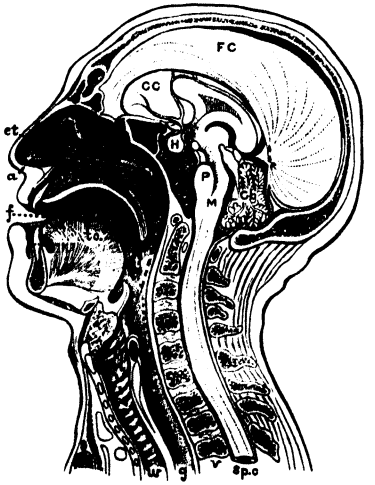


FIG. 85.—Vertical section through the middle of the head and neck. *Cb*, Cerebellum; *CC*, corpus callosum; *FC*, falx cerebri, the process of dura mater lying between the two cerebral hemispheres; *H*, pituitary body; *M*, medulla oblongata; *P*, pons Varolii; *Sp.c*, spinal cord; *v*, vertebral column. For other letters see AIR PASSAGES. (After Braune.)

'pineal gland'. This region includes the important *hypothalamus*.

(3) MID-BRAIN, or *mesencephalon*, is a stalk about ¾ inch long connecting the cerebrum with the hind-brain. Down its centre lies a tube, the 'aqueduct of Sylvius', connecting the 3rd and 4th ventricles. Above this aqueduct lie the 'corpora quadrigemina', and beneath it are the 'crura cerebri', strong bands of white matter in which important nerve fibres pass downwards from the cerebrum.

(4) CEREBELLUM and PONS VAROLII form the *hind-brain* or *epencephalon*. The pons Varolii is a mass of nerve fibres, some of which run crosswise and others are the continuation of the crura cerebri downwards. The cerebellum lies towards the back, being placed underneath the occipital lobes of the cerebrum.

(5) MEDULLA or BULB, also known as the *after-brain* or *metencephalon*, is the lowest part of the brain, in structure resembling the spinal cord, with white matter on the surface and grey matter in its interior. This is continuous through the large opening in the skull, 'foramen magnum', with the spinal cord. Between the medulla, pons, and cerebellum lies the 4th ventricle of the brain.

Structure.—The brain is made up of grey and white matter. In the cerebrum and cerebellum the grey matter is arranged mainly in a layer on the surface, though both have certain grey masses imbedded in the white matter. In the other parts the grey matter is found in definite masses called 'nuclei', from which the nerves spring. The grey matter consists mainly of cells in which all the activities of the brain commence. These cells vary considerably in size and shape in different parts of the brain, though all give off a number of processes, some of which form nerve fibres. The cells on the surface of the cerebral hemispheres, for example, are very numerous, being set in layers five or six deep. In shape these cells are pyramidal, giving off processes from the apex, from the centre of the base, and from various projections elsewhere on the cell. The grey matter is everywhere penetrated by a rich supply of blood-vessels, and the nerve cells and blood-vessels are supported in a fine network of fibres, known as neuroglia. The white matter consists of nerve fibres, each of which is attached, at one end, to a cell in the grey matter, while, at the other end, it splits up into a tree-like structure round another cell in another part of the grey matter in the brain or spinal cord. The fibres have insulating sheaths of a fatty material, which, in the mass, gives the white matter its colour, and they convey messages from one part of the brain to the other (association fibres), or, grouped into bundles, leave the brain as nerves, or pass down into the spinal cord, where they end near, and exert a control upon, cells from which in turn spring the nerves to the body. Both grey and white matter are bound together by a felt-work called 'neuroglia'. The general arrangement of fibres can be best understood by describing the course of a motor nerve fibre. Arising in a cell on the surface in front of the fissure of Rolando, such a fibre passes inwards towards the centre

of the cerebral hemisphere, the collected mass of fibres as they lie between the lenticular nucleus and ocular thalamus being known as the internal capsule. Hence the fibre passes down through the crus cerebri, giving off various small connecting fibres as it passes downwards. After passing through the pons it reaches the medulla, and at this point crosses to the opposite side (decussation of the pyramids). Entering the spinal cord, it passes downwards to end finally in a series of branches (arborisation)

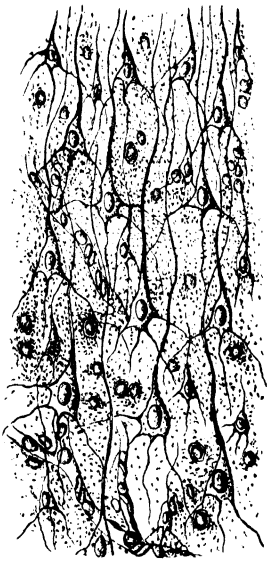


FIG. 86.—Vertical section through the cerebral cortex of the frontal region, showing the pyramidal cells and their processes. (Turner's *Anatomy*.)

which meet and touch (synapsis) similar branches from one or more of the cells in the grey matter of the cord. (*See* SPINAL CORD.)

Size.—The weight of the average male brain is 49½ ounces, of the female brain 44½ ounces, but brains have been found as heavy as 60 ounces. Although the weight of the brain is not in absolute proportion to intellectual power, on the whole the higher races have the heavier brains.

Functions.—The cerebrum is associated with the intellectual faculties in man, and also exerts a guiding influence over the rest of the nervous system. It

BRAIN

is not, however, necessary to actual life. If the cerebrum of a frog be destroyed it still breathes and its heart beats, it can hop if pinched, and swim if put in water, but when left alone it sits still till it perishes. If the same happen to a pigeon it can fly when thrown in the air, and can alight, but it does not fly

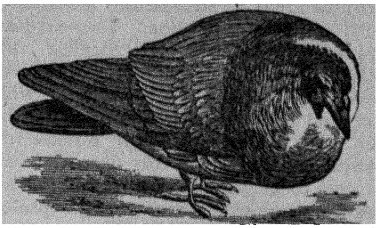


FIG. 87.—Pigeon after removal of the cerebral hemispheres. (*Ency. Brit.* vol. xix., Ninth Edition.)

away when threatened, nor will it take food, having lost even the instinct to preserve life. If, on the other hand, the cerebellum of a pigeon be destroyed, the bird cannot maintain its balance, the cerebellum being concerned in the regulation of muscular movements and in preserving the equilibrium.

Plato recognised three mental faculties, which he placed respectively in the liver, heart, and brain, these organs being supposed to secrete the 'animal spirits' appropriate to each faculty;

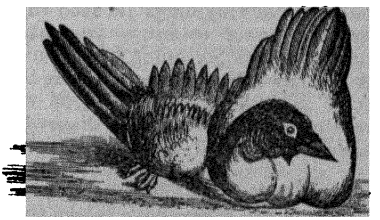


FIG. 88.—Pigeon after removal of the cerebellum. (*Ency. Brit.* vol. xix., Ninth Edition.)

and this view was accepted by the medical writers of antiquity. In the Middle Ages the Arabian physicians, however, following Galen's opinion, placed the different mental faculties in the several ventricles of the brain, this theory being adopted by Duns Scotus, Thomas of Aquin, and referred to by Burton in his *Anatomy of Melancholy*.

Descartes (*circa* 1647) had the fanciful idea that the pineal body was the seat of the mind, though this structure is now supposed to be the vestige of a

BRAIN

third eye. After his time it was fancied that the whole brain must act together in every process, from the fact that, in cases of severe injury to the head, much substance has been lost from some parts of the brain without impairment of any one definite function or memory.

But it has recently been proved that definite areas of surface are associated with definite functions. The earliest systematic attempt to localise the functions of the brain to certain areas was made by Gall and Spurzheim, who founded the system of 'phrenology' in the first quarter of the nineteenth century. Although this system was proved to be wrong both as regards the functions of the brain and the philosophic analysis of mental processes, still the criticism it called forth gave a great impetus to the attempt to localise the functions of the brain in definite spots. Between 1820 and 1840 it became established that the brain of persons who have lost the power of speech during life, shows some disease in the left frontal lobe after death, and in 1861 Broca made the first definite discovery in cerebral localisation, by proving that the faculty of speech is governed by a centre in the left inferior frontal convolution, named after him 'Broca's convolution'. His discovery was followed later by the important observation of Hughlings Jackson that certain forms of epilepsy, associated with movements beginning in a definite limb, are caused by disease affecting the part of the brain that borders on the fissure of Rolando, and this discovery has been confirmed and extended by many experimenters and physicians. Fritsch, Hitzig, Ferrier, Sherrington, Grünbaum, and others have shown that definite areas near the fissure of Rolando are associated with the movement of definite parts. (See Fig. 89.) Further, the occipital lobes are associated with the sense of sight, the temporal lobe with hearing, and the inner surface of the same lobe with taste and smell. The purely intellectual faculties probably are associated with the frontal lobes, which seem to govern nothing else. The functions of the cerebellum have been much disputed, but at least this is sure, that it has to do with the powers of balancing and of regulating movements. The medulla and pons have very important functions, governing many of the processes most essential to life, *e.g.* those of respiration, rate of

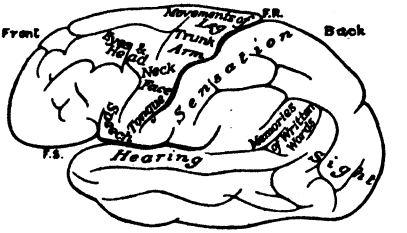


FIG. 89.—Diagram showing areas upon the left surface of the cerebrum associated with definite functions. *FR*, Fissure of Rolando; *FS*, fissure of Sylvius. (Partly after Osler.)

the heart, swallowing, vomiting, etc., and giving off all the nerves which arise from the brain except the first four.

Membranes.—The brain is separated from the skull by three membranes—the 'dura mater', a thick fibrous membrane; the 'arachnoid mater', a more delicate structure; and the 'pia mater', adhering to the surface of the brain, and containing the blood-vessels which nourish it. Between each pair is a space containing fluid on which the brain floats as on a water-bed. The fluid beneath the arachnoid membrane mixes with that inside the ventricles through a small opening in the 4th ventricle, called the 'foramen of Magendie'.

These fluid arrangements have a great influence in preserving the brain from injury.

Nerves.—The nerves which come off the brain are twelve in number:

I. Olfactory to the nose (smell).
II. Optic to the eye (sight).
III. Oculomotor, IV. Trochlear, VI. Abducent } to eye-muscles.
V. Trigeminal to skin of face.
VII. Facial to muscles of face.
VIII. Auditory to ear (hearing and balancing).
IX. Glossopharyngeal to tongue (taste).
X. Vagus to heart, larynx, lungs, and stomach.
XI. Spinal Accessory to muscles in neck.
XII. Hypoglossal to muscles of tongue.

Blood-vessels.—Four vessels carry blood to the brain, two internal carotid arteries in front, and two vertebral

BRAIN, DISEASES OF

arteries behind. These communicate to form a circle (circle of Willis) inside the skull, so that if one be blocked the others, by dilating, supply its place. The chief branch of the internal carotid artery on each side is the middle cerebral, and this gives off a small but very important branch which pierces the base of the brain and supplies the region of the basal ganglia with blood. The chief importance of this vessel lies in the fact that the blood in it is under specially high pressure, owing to its close connection with the carotid artery, so that hæmorrhage from it is very liable to occur and thus give rise to apoplexy. Two veins, the ' veins of Galen ', bring the blood away from the interior of the brain, but most of the small veins come to the surface and open into large ' venous sinuses ', which run in grooves in the skull, and finally pour their blood into the internal jugular vein that accompanies the carotid artery on each side of the neck.

BRAIN, DISEASES AND INJURIES OF.—The signs of brain disease are in general very indirect, being manifested by some defect in sensation or in the power of action, or by some peculiarity of conduct. The symptoms are more fully discussed under NERVOUS DISEASES. *See also* APHASIA, APOPLEXY, ENCEPHALITIS, EPILEPSY, HEADACHE, HYDROCEPHALUS, INSANITY, MENINGITIS, PARALYSIS. The following are some of the conditions more exclusively connected with the brain.

ABSCESS is a very serious condition. It results from wounds of the scalp which suppurate and in which the matter does not get free exit, or, far more commonly, from suppurating ear disease, in which the discharge from the ear has been stopped. The symptoms are rather vague, but there are always great headache and vomiting, with generally rise of temperature, and often some interference with vision. When the abscess lies in the temporal lobe the temperature is often below normal. The treatment should be prevention, by keeping every scalp wound clean, and by having every case of discharging ear disease under medical supervision. (*See* EAR, DISEASES OF.) When it is recognised that an abscess has occurred in the brain, it is customary to trephine the skull and evacuate the abscess, after which recovery often takes place.

ANÆMIA OF THE BRAIN is the cause of fainting when suddenly brought on by weakness of the heart's action. Anæmia of a more chronic type is a very frequent cause of sleeplessness in elderly persons, accompanied by weakness of mental power and drowsiness during working hours. It causes also headache, giddiness, and ringing in the ears. The treatment is complete rest in bed and administration of tonics, and abandonment of work for a time.

COMPRESSION OF THE BRAIN may be caused by the growth of a

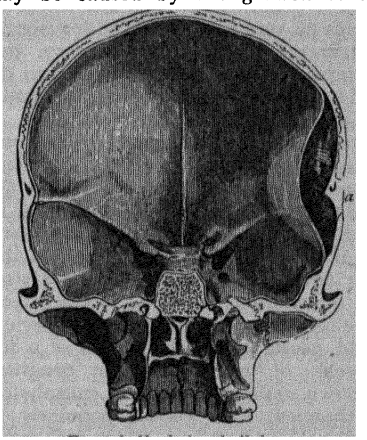


FIG. 90.—Front half of the skull from a case of compression of the brain. A large blood clot is seen at *a*, separating the dura mater from the skull as the result of tearing of the middle meningeal artery. (Miller's *Surgery*.)

tumor in the brain, a collection of blood between the brain and skull from injury of the membranes, or suppuration in the same locality from a neglected scalp wound or fracture of the skull. Unconsciousness coming on some hours after a blow on the side of the head is generally due to a fracture tearing one of the arteries in the membranes and producing a large clot between the skull and brain. The symptoms are vague, but, in addition to unconsciousness, there are generally difficulty of breathing, feeble pulse, and paralysis down one side of the body. The treatment is trephining of the skull to let out the blood or pus. The condition is extremely serious. (*See* TREPHINING.)

CONCUSSION is a bruising of part

of the brain as the result of a blow on the head (generally at the back) or a severe shake of the body. Cases vary in severity from mere giddiness and headache for an hour or two, to complete loss of consciousness lasting for weeks, and include those curious instances of lost memory for facts or even for personal identity which have been much used by novelists. The person lies unconscious and can be roused with difficulty. If he answers questions at all he does so irrelevantly, and shows great irritability of temper, going off to sleep again at once. He lies turned away from the light, with his knees drawn up on the body. Consciousness and convalescence come on very gradually, and for months there may be loss of memory, bad temper, and great susceptibility to the effects of alcohol. Recovery is generally good, but a tendency to epilepsy, or even insanity, may remain. The treatment is complete rest in a darkened room, fluid food, cold to the head ; the urine often requires to be drawn off by catheter, and purgatives are necessary.

BRAIN FEVER is a popular name for several conditions. One is a state of prostration following some severe mental strain, which is not very serious and passes off in the course of a few weeks of rest. Another condition known under this name is encephalitis lethargica, also known popularly as 'sleepy sickness', in which inflammatory changes accompanied by œdema and hæmorrhages take place in parts of the brain, causing a serious and often fatal disorder. (*See* ENCEPHALITIS LETHARGICA.) Another condition often called by this name is inflammation of the membranes of the brain or meningitis, which occurs most commonly in children or in persons suffering from tuberculosis, and which is a very fatal disease. (*See* MENINGITIS.)

HÆMORRHAGE into the brain causes apoplexy. (*See* APOPLEXY.)

LACERATION of the brain may occur in fracture of the skull. When the injury affects the upper part of the cerebrum, it is not of so great importance as the fact of whether the wound is kept clean and free from suppuration, although near the fissure of Rolando damage to the brain may result in paralysis of some limb. When it occurs at the base of the skull serious injury of the brain is apt to result, very often ending in death. (*See* FRACTURES.)

SOFTENING of the brain is a term used in a strictly scientific sense and in a popular sense. In the former case an actual area of brain tissue softens owing to its blood supply being cut off by plugging of its blood-vessels, or in consequence of some long-standing inflammatory process. The symptoms are then those of apoplexy, though not so sudden as if the cause were hæmorrhage. In the popular sense, when persons who have been the subjects of gout, alcoholism, or syphilis, especially elderly persons, become gradually dull in intellect, drowsy, absent-minded, emotional, and finally demented, in consequence of their diseased blood-vessels diminishing the blood supply to, and causing deterioration of, the brain, these symptoms are also attributed to 'softening of the brain'.

TUMORS of the brain produce very insidious and very complex symptoms, depending on the region they affect. Among the general symptoms are headache, giddiness, vomiting independent of food, and tenderness of the head on pressure. Blindness and mental symptoms come on later, owing to rise of pressure inside the skull. Sometimes these tumors are tuberculous or syphilitic in origin, when the general treatment for these diseases may be of some help, but otherwise little good can be done, except palliation of the pain and other symptoms by trephining to relieve the pressure. Occasionally a tumor produces definite 'localising' symptoms indicating its position in the brain. In such cases an operation may occasionally be performed for the complete and successful removal of the tumor.

BRAN is the meal derived from the outer covering of a cereal grain. It contains little or no carbohydrate, especially after it had been washed.

BRANDY (*see* ALCOHOL).

BREAD is usually prepared from wheat flour which contains about 15 per cent of water, 8 to 12 per cent of gluten (vegetable albumin), and about 70 per cent of starch together with small quantities of sugar and dextrin. The whitest flour is very deficient in

salts and Vitamin B1, because the husk and the germ of the wheat grain have been separated from it in the process of milling. The separated outer part of the grain, known as 'offal' or 'bran', contains about 15 per cent of nitrogenous substance, 3 per cent of fat, and 5 per cent of salts. In the separation of the bran, therefore, much nutritious material is lost, but at the same time the bread is rendered more digestible. When the entire grain is ground up, the resulting flour is known as 'whole meal'. In 'fine meal' or 'entire white flour' a portion of the bran only is removed. In 'standard flour' 20 per cent of the flour is removed as bran and the flour consists of 80 per cent of the grain. It has a distinctly brownish colour in consequence of the small amount of bran remaining in it. 'Patent grade flour' is almost pure white and is that most used by bakers for bread-making as it contains practically no bran, absorbs a large amount of water, and makes a large white loaf. Darker flours are sometimes bleached by electrical treatment in which ozone and nitrogen peroxide are produced. This does not appear to have any harmful effect. In 'aerated bread' carbonic acid gas is forced through the dough under pressure instead of the flour being fermented by the addition of yeast. A similar result is produced by baking powders.

Other grains used for bread-making are barley, which is slightly deficient in albuminous material but richer in mineral matter than wheat; rye, which produces a dark-coloured, sour bread equal in nutrition to that of wheat but somewhat liable to produce diarrhœa in those unaccustomed to it; oats, which produces a granular type of bread with laxative properties, that is much richer than wheat in fat and mineral matters; and maize, which is richer in fat but poorer in mineral matter than wheat, and of which the albuminous material seems to be defective in nutritive qualities.

With regard to nutritive value, wheaten bread contains on an average 9·2 per cent of protein, 1·3 per cent of fat, and 52·6 per cent of carbohydrate, giving a total calorie value per 100 grams of 260 calories. When bread is toasted so that water is driven off, the calorie value is raised to over 300 calories per 100 grams. Oatmeal (dry) has an average value of about 390 calories per 100 grams.

In the war of 1939– the extraction of the wheatberry was increased from 72 per cent to 85 per cent. By the end of 1943 most flour had barley or a mixture of groats and barley added to it. Calcium carbonate, in the form of prepared chalk, was added to flour—7 oz. to a 280 lb. sack. Two pounds of dried skimmed milk was also added to each sack.

BREAK-BONE FEVER is another name for dengue.

BREASTS, or MAMMARY GLANDS, are found in the most highly developed class of animals, called the Mammalia, for the purpose of suckling the young. As a rule they are confined to the female sex, though the male has rudimentary nipples, and, even in man, individuals occur in the male sex who have well-developed glands and have been known to produce milk. These glands are developed in the skin of the chest, and, in the full-grown female, extend from the second rib above to the sixth or seventh below, being at the centre about 2 inches thick. There is usually one on each side, but small supplementary breasts are occasionally found in the armpit or low down on the abdomen. In the centre is a dark patch, called the 'areola', which surrounds the nipple. This areola darkens during pregnancy. This, together with enlargement of the whole breast and dilatation of its veins, forms an important and early sign of this condition. In structure each breast consists of from twelve to twenty compartments, each of which contains a system of branching tubes lined by cells that form the fatty and fluid materials composing the milk. In each section the tubes open on the surface of the nipple by a single small tube, or duct, of which therefore there are twelve to twenty in all. Between these gland tubes lie muscle fibres (which give the breasts their firmness), fibrous tissue, and fat (which is specially plentiful in elderly women).

BREASTS, DISEASES OF.—These glands go through great changes during the course of life, becoming considerably enlarged about the age of puberty,

afterwards congested at each monthly period, then undergoing great development during pregnancy, so as to be double the usual size during the time of suckling, and finally, with advancing years, undergoing gradual absorption, though, in stout persons, their actual size increases from deposit of fat. Owing to this variability these organs are very frequently affected by several diseases.

ACUTE INFLAMMATION AND ABSCESS.—**Causes.**—This sometimes occurs in young infants, but is rare except in mothers during the period of suckling a child, and is most common in those who have just borne their first child. Some tenderness of one nipple or defect in its shape or size is generally responsible for the condition, the child on this account being put too much on the other breast, and the affected one becoming in consequence distended, while its nipple is blocked by dried-up milk in one or more of its ducts. The result is congestion of the affected portion of the breast and the ready growth of bacteria in its interior. Passing congestion, producing swelling and tenderness, sometimes appears in boys or girls at the time of puberty, but rarely goes on to abscess.

Symptoms.—Discomfort in some part of the breast, with increased hardness and fullness, usually towards the lower edge, is first noticed, and, if treatment be then begun, the majority of cases do not go on to abscess. If the condition remains untreated, distinct pain next comes on, especially when the infant sucks, along with redness, swelling, and heat, the general signs of abscess. Finally, the skin over one spot, usually about a couple of inches from the nipple, turns purple, and here the abscess bursts.

Treatment.—When, owing to tenderness in, or insufficient development of the nipple, the child does not take one breast, either this should be regularly emptied by a breast pump to avoid tenseness, or the medical adviser should be consulted as to the weaning of the child. Tender nipples are often relieved by bathing with weak carbolic lotion (1 in 40), by smearing on glycerin of borax, or by dressing with lint steeped in boracic lotion (1 in 30), or boracic lint covered with gutta-percha tissue, while the infant is not on the breast. If a part of the breast is getting hard, the breast must be supported either by a suitably shaped plaster beneath the breast (*see* ADHESIVE PLASTERS), or by a bandage passing alternately round the waist beneath the breast, and over the opposite shoulder from beneath the breast. (*See* BANDAGES.) Warm moist cloths may be applied to soothe the discomfort, and the breast should be emptied by a breast pump. If the hardness be increasing, and if pain comes on, the

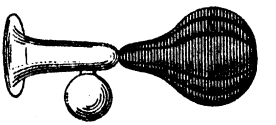


FIG. 91.—Exhauster for relieving breast of milk.

child must be weaned, and the secretion of milk stopped by taking doses of Epsom salts or other purgative, and by applying to the breast some preparation of belladonna. When an abscess has formed, it is opened like an abscess elsewhere, and this should be done early, otherwise the matter is apt to burrow into other parts of the breast. (*See* ABSCESS.)

CHRONIC INFLAMMATION, or MASTITIS, may take the form of a chronic abscess, but, more commonly, it consists of simple swelling and pain in one part of the breast, often erroneously believed to be cancer by the affected person.

Symptoms.—This inflammation is often associated with some disturbance of the pelvic organs and menstrual irregularity. Pain is the most important symptom, being frequently very severe and generally widespread over the breast, up to the neck, and down the inside of the arm. One or more swellings are generally visible on the breast, though their outline cannot readily be felt. There may be general ill-health, with loss of sleep and of appetite.

Treatment.—The condition is made much worse by the patient allowing her mind to dwell on it and by constant handling of the swelling, so that when the breast is completely covered up by some soothing plaster, such as belladonna plaster, complete recovery may speedily take place. Sometimes, if the pain is very severe, in elderly women,

removal of the breast is advisable, even though no serious disease be present.

NEURALGIA may be very painful during pregnancy, in pelvic disorders, or in general troubles like anæmia and rheumatism. It is treated like neuralgia elsewhere.

CRACKED NIPPLES are sometimes very troublesome. For their treatment see under Acute Inflammation above. When there is a chronic eczematous condition, a metal or vulcanite nipple-shield should be applied and fixed with plaster or tapes.

TUMORS.—In consequence of the fact that the breast is one of the organs most frequently attacked by cancer, many women render themselves unnecessarily unhappy over some swelling in the breast, taking for cancer what is often simply chronic inflammation, or a cyst or adenoma, the two latter being common non-malignant growths. In every case, immediately a woman discovers a small nodule in her breast she should consult a surgeon. If the swelling be not cancer—and usually it is not—her mind will be relieved, and the treatment, whether by operation or not, will not in general necessitate the removal of the breast. If cancer be present, then the earlier an operation be done the more chance there is of a complete cure. In such cases it is now the practice to remove the entire breast, part of the muscle under it, and the glands and fat of the armpit, because the cancer is apt to have long rootlets or secondary growths in neighbouring glands.

BREATH, DISORDERS OF.—The composition of the breath and the changes that air undergoes when it is breathed are stated under the heading AIR; the manner in which breathing is effected is described under RESPIRATION. (*See also* BREATHLESSNESS, CHEST, DISEASES OF, *and* LUNGS, DISEASES OF.)

BAD BREATH, or HALITOSIS, is sometimes extremely unpleasant to those around the subject of the trouble, though the smell may be extremely foul without the person himself being conscious of it.

Causes.—Frequent causes are bad teeth, chronic tonsillitis, constipation, and indigestion. Besides these an excessively fœtid condition is caused by bronchiectasis (*see* LUNGS, DISEASES OF), by ulceration about the bones of the nose, and by a peculiar disease of the nose, known as ozœna, in which smelling crusts constantly form there. (*See* NOSE, DISEASES OF.)

Treatment.—Bad teeth should be stopped or pulled, and the spaces between the teeth kept clean by brushing after each meal. (*See* TEETH.) Constipation is a very common cause, gases from putrefaction of food in the intestine being absorbed into the blood and excreted by the lungs. (*See* CONSTIPATION.) In one form of tonsillitis, small cheesy pellets of secretion collect in the hollows of the tonsils and putrefy; the tendency to this is lessened by cutting the tonsils, or by using daily some solvent or antiseptic gargle. (*See* GARGLES.) Indigestion with furred tongue is also credited with being a frequent cause of bad breath. (*See* DYSPEPSIA.) The smell may be temporarily relieved by placing a small drop of some essential oil, such as cloves, occasionally on the tongue, or by various scented sweets.

BREATHLESSNESS may be due to any condition which renders the blood impure or deficient in oxygen, and which therefore produces excessive involuntary efforts to gain more air.

Causes.—*Bloodlessness* is one of the most frequent causes; and difficulty in breathing among young persons during violent exercise like running is often due to enlarged tonsils and *adenoid growths* in the back of the throat.

Many diseased *conditions of the lungs* diminish the area available for breathing, *e.g.* pneumonia, consumption, emphysema, bronchitis, collections of fluid in the pleural cavities, and pressure by a tumor or aneurysm.

Pleurisy causes short, rapid breathing to avoid the pain of deep inspiration.

Narrowing of the air passages may produce sudden and alarming attacks of difficult breathing, especially among children; *e.g.* in laryngismus, croup, asthma, and diphtheria (see these headings).

Almost all *affections of the heart* cause breathlessness when the person undergoes any special exertion.

Among the *general diseases* which may

interfere with breathing, the uræmia of Bright's disease and the coma at the end of diabetes must be noted.

Treatment.—In young girls who become breathless on very slight exertion the treatment is generally that for bloodlessness. (*See* ANÆMIA.) Adenoids in the throat and the method of their removal are mentioned under NOSE DISEASES. For the treatment of breathlessness in stout people, see CORPULENCE. In all conditions of breathlessness due to disease of a lung, the patient finds most ease in breathing when he lies upon the affected side. In most inflammatory conditions of the air passages much relief is gained from steam inhalations. The subjects of heart disease, if able to go about, should not unduly exert themselves, and are benefited by one of the special heart tonics mentioned under HEART DISEASES. Patients confined to bed by a cardiac affection are frequently unable to lie down, and must be provided with a comfortable bed-rest. Their difficulty of breathing is often due to bronchitis (*see* BRONCHITIS), or to collection of fluid in the chest (*see* DROPSY), which requires special and energetic treatment. In breathlessness recurring every night morphia is helpful, and strychnine is of especial value in relieving a person struggling for breath in some serious heart or lung disease. For breathlessness with lividity, oxygen inhalation is often usefully employed.

BRIGHT'S DISEASE is a term applied to a class of diseases of the kidneys which have as their most common symptom the presence of albumin in the urine, and frequently also the presence of dropsy. These associated symptoms, in connection with kidney disease, were first described in 1827 by Dr. Richard Bright. Since that time the subject has been investigated by many able physicians, and it is now well established that the above-named symptoms may be dependent on various causes. (*See* ALBUMINURIA.) Further, one or both of these symptoms may be absent in cases of Bright's disease which are readily recognisable as such from other symptoms.

The terms nephritis and inflammation of the kidneys are applied to the same condition. It is usual to subdivide Bright's disease or nephritis into several types—

Acute Bright's Disease;
Subacute Bright's Disease;
Chronic Parenchymatous Bright's Disease (affecting secreting tissues first);
Chronic Interstitial Bright's Disease (affecting supporting tissues first).

ACUTE BRIGHT'S DISEASE is also known as ACUTE DESQUAMATIVE NEPHRITIS.

Causes.—An acute attack frequently follows exposure to cold, or arises as a complication of some acute disease such as erysipelas, diphtheria, and especially scarlet fever, of which it is one of the most frequent consequences. Chill to the surface of the body is the direct cause in many cases, but probably this is only effective in regard to kidneys which are already damaged by some other influence. Occasionally inflammation of the kidneys follows on taking an acute poison like phosphorus, corrosive sublimate, or turpentine. In this form of the disease the kidneys become congested, their blood-vessels being at first engorged with blood, while the cells of the tubules or the glomeruli degenerate, and these become distended and obstructed by accumulation of the epithelial cells separated from their surface. These cells glued together by the products of inflammation, and small masses of blood corpuscles which have collected in the tubules, are washed out of the kidney by the urine and form a deposit which, on microscopic examination, is seen to consist of *casts* of the uriniferous tubules. In some cases the glomeruli are chiefly affected, in others the tubules; usually both types of structure are involved.

Symptoms.—The symptoms to which the condition gives rise are usually of a severe character, although frequently cases of acute Bright's disease, occurring for example in the course of scarlet fever, are so mild as to escape notice at the time, and only cause trouble when the condition becomes chronic in later life. Vomiting very frequently ushers in the attack, pain in the back of a moderate degree is also a common symptom, and there is frequently for the first day or two a slight febrile disturbance. Dropsy, varying

in degree from slight puffiness under the eyes to an accumulation of fluid distending the body cavities and causing serious embarrassment to respiration, is a very common accompaniment. The digestion is almost invariably disordered, the appetite is poor, and the patient is troubled with headache. The urine is reduced in quantity, is of dark, smoky, or blood-stained colour, and, when it is tested, is found to contain a large amount of albumin, while under the microscope blood corpuscles with hyaline and epithelial casts, as above mentioned, are found in abundance.

This state of acute inflammation, if very severe, may lead to stoppage of the excretion of the urine to such an extent that waste products accumulate in the blood and paralyse vital activity. Death is then generally preceded by severe headache followed by unconsciousness and frequently by convulsions, a condition known as 'acute uræmia'. Even in extreme cases, however, energetic treatment may save the patient's life. Death may also result from interference with the action of the heart and lungs caused by excessive dropsy. More frequently the acute disease partially subsides and gradually results in the establishment of subacute or chronic Bright's disease. In other cases an arrest of the inflammatory action occurs, the urine increases in amount, the blood and later the albumin and other abnormal constituents disappear from the urine, the dropsy subsides, the strength returns, and the disease entirely disappears.

Treatment.—The greatest care must be taken of a person showing for the first time the symptoms of acute Bright's disease, because, although the condition is seldom fatal in a first attack, if it be allowed to pass on to the chronic form, the person must in future live the life of a semi-invalid, or, at all events, is very greatly limited in the extent of his activities. The patient must remain in the equable temperature of bed, carefully protected from all chance of chill, and is usually placed directly between blankets and clothed in woollen garments. It is essential to maintain the free action of the skin, and to this end, in addition to confinement in bed, hot-water bottles, hot-air baths, or hot wet packs which produce free perspiration are administered, particularly if an onset of uræmia threatens. (*See* BATHS.)

Free movement of the bowels is also important in order to help the elimination of waste products from the body and so ease the work of the kidneys. For this purpose either a saline purge is administered every morning, or a dose of some aperient such as compound jalap powder is administered each night. The acutely inflamed kidney should be rested by restricting the quantity of fluid taken during the day, and by cutting down nitrogenous foods. Milk should therefore be omitted in the first few days of acute nephritis. But carbohydrates and fats may be given, toffee, for example, being much appreciated by children. Barley water, with milk added as the patient improves, can also be taken. Various alkaline drinks, such as lemonade, orange juice, and citrate of potassium in water, make the urine less acid. After the first week or ten days it is well to add bread and such starchy foods as boiled rice, sago, arrowroot, or cornflour to the diet.

Local means of relieving congestion of the kidneys, such as warm fomentations upon, or cupping of, the loins may be adopted. Drugs to stimulate sweating and the kidneys are recommended less than formerly. Hot sponging, followed by friction with warm, dry towels, will encourage the skin to act. If acute uræmia threatens, a hot-air bath may be of great help.

When dropsy is a troublesome feature, the abolition of salt from the diet and the substitution of salt-free bread and of potatoes, fresh butter, fruit, and green vegetables for the milk is recommended by some authorities. During the period of convalescence from this disease special care must be exercised in the avoidance of animal food in large quantity, of alcoholic stimulants, and of chills to the surface of the body. A change for a time to a dry, warm climate is often beneficial.

SUBACUTE BRIGHT'S DISEASE is the name applied to that type of the disease in which the acute form is passing off with unusual slowness, or in which the whole kidney is so much damaged that recovery is impossible and the patient is in transition from the acute to the chronic form. The kidney

is large and white, the superficial part or cortex, which contains the secreting tubules, being especially swollen; the cells of these tubules break down and undergo fatty or granular degeneration and are subsequently discharged in the urine as fatty and granular casts. The blood at this stage generally disappears from the urine or recurs only from time to time.

Symptoms.—The patient in this stage becomes pale, bloodless, is particularly prone to dropsy, has much albuminuria, and is often greatly reduced in flesh and strength. The other symptoms of the acute stage, such as headaches, also persist or come and go.

Treatment.—Treatment is similar to that for the acute form, but, owing to the patient's weak and bloodless condition, it is generally necessary to increase the amount of animal food in the diet. This is particularly the case when the heart is showing signs of weakness and the dropsy in consequence is tending to increase. In such cases the diet mentioned below as 'medium protein diet' under the chronic form may be had recourse to. The elimination of salt from the diet is at this stage often very necessary, and drugs which have the effect of stimulating the heart and raising the blood pressure are generally required.

CHRONIC PARENCHYMATOUS BRIGHT'S DISEASE is the form in which the secreting tissue of the kidney has greatly degenerated and the epithelial cells of the tubules have changed in character, losing to a great extent their special secretory powers. There is no sharp line of demarcation between the subacute Bright's disease and the early stage of this chronic type, the difference being merely one of degree and of duration. The kidney at first is large in size (*large white kidney*), but as time progresses there is a gradual increase of the supporting fibrous tissue and the kidney shrinks so as to become smaller than normal (*small white kidney*).

Symptoms.—This stage of kidney disease may have developed quite insidiously, following upon some unrecognised or forgotten attack of acute nephritis, and the patient's attention is frequently called to it by some symptom not directly referable to the kidneys, such as persistent headache or dyspepsia, or dropsy which tends to be present especially in the morning on the face, and to disappear as the day advances. When the urine is examined it is found to contain a large quantity of albumin, and, under the microscope, hyaline and granular casts are found in the deposit. Symptoms connected with the circulation are also frequently found, such as oppression in the chest with palpitation or unduly forcible action of the heart consequent upon the hypertrophy which it has undergone. A person in this condition is liable at any time, as the result of a chill or indiscretion in diet, or from some infection such as a septic throat, to develop a serious attack of acute Bright's disease with uræmic symptoms. Even without a repetition of acute attacks, the degenerative process in the kidney tends with the progress of time to get worse, although the person who is subject to the disease may, by careful regulation of his life and avoidance of the causes which would tend to precipitate an acute attack, indefinitely postpone a serious issue in many cases. In the later stages of the disease, which, on account of the special tendency to dropsy, is often referred to as the *hydræmic* type of nephritis, there is great liability to temporary dimness of vision from dropsy of the retina, to dyspepsia and diarrhœa from dropsy of the mucous membranes of the digestive organs, and to pleurisy and collections of fluid in other serous membranes.

Treatment. — The treatment of chronic Bright's disease, in which the degeneration of the secreting cells is the chief feature, includes particularly medicines directed towards enabling the skin and bowels to overtake as much as possible of the excretory functions of the damaged kidneys, and at the same time to lessen the damaging effects which high blood-pressure produces on the heart and blood-vessels and to prevent the occurrence of dropsy. The patient should be well clothed and protected from chills, and he should so arrange his occupation that it is mainly conducted indoors. A change to a warm climate for winter is beneficial in many cases. The use of a daily saline aperient, such as Epsom salts or sulphate of soda, is of great importance.

When dropsy is actually present, the patient is treated very much in the same way as in the case of acute Bright's disease. The dropsical fluid often requires to be removed by mechanical means, as by puncturing the legs with Southey's tubes, or by aspiration of the abdominal or pleural cavities, according to the position in which the fluid is chiefly collected. With regard to diet, these patients in whom the constant loss of albumin constitutes a great drain upon the system, and who therefore suffer from the defects of low vitality, generally require to take a fair amount of protein (meat) in the dietary. The following *medium protein diet* is one containing a considerable amount of vegetable salts, which have a soothing action upon the damaged kidney tissues, and also it contains about 50 grams of protein and provides quite sufficient material (2400 calories) for a sedentary occupation.

Breakfast.—Grape-fruit or orange; sugar, ½ oz.; porridge or cornflour, 1 oz.; cream, 2 oz.; bread, 1 slice; butter, ½ oz.; fruit, 4 oz.

Lunch.—Grape-fruit or orange; sugar, ½ oz.; meat, 2 oz.; rice, 2 oz.; vegetables, 5 oz.; salad oil, ½ oz.; bread, 1 slice; butter, 1 oz.

Dinner.—Green vegetables, 5 oz.; 1 egg; potato, 3 oz.; salad oil, ½ oz.; tinned fruit, 3 oz.; cream, 2 oz.; sugar, ½ oz.; bread, 1 slice; butter, 1 oz.

At times, especially in the more advanced stages of the disease, the patient, when confined to bed, is benefited by taking at intervals a diet composed only of rice, arrowroot, cornflour, vegetables such as cabbage, cauliflower, turnip, carrot, onion, lettuce, rhubarb, spinach, tomato, sweet and acid fruits, sugars, jam, and other foods like butter, olive oil, and cream. These contain a minimum of nitrogenous food. A *low protein diet* containing about 25 grams of protein and providing 1200 calories is provided by the following:

Breakfast.—Grape-fruit or orange; sugar, ½ oz.; porridge or cornflour, 1 oz.; cream, 2 oz.; bread, ½ slice; butter, ½ oz.

Lunch.—Vegetables, 10 oz.; rice, 1½ oz.; sugar, ½ oz.; bread, ½ slice; butter, ½ oz.; tinned fruit, 3 oz.

Dinner.—Vegetables, 10 oz.; potato, 3 oz.; bread, ½ slice; butter, ½ oz.; tinned fruit, 3 oz.

Various drugs have been tried with a view to curtailing the loss of albumin, but none has proved of great utility. The person who is the subject of chronic Bright's disease in any form is, by reason of his low vitality and the accumulation of waste products in his tissues, more liable to all forms of disease, so that he must protect himself with great care, and the symptoms of disease in other organs must be treated as they arise. There is a special tendency to bloodlessness, and for this reason tonics containing some preparation of iron are administered from time to time.

CHRONIC INTERSTITIAL BRIGHT'S DISEASE.—This form of the disease may be the final stage of the last-mentioned type, but it very often also comes on insidiously, and, in a person who has had no special symptoms of acute or chronic Bright's disease, it may be found developed to an advanced form in middle life. The kidney is hard and reduced in size. Its secreting structures have to a considerable extent been obliterated by the development of fibrous tissue (*cirrhotic or granular contracted kidney*), and frequently the blockage of the secreting tubules has resulted in the production of numerous cysts. This type is associated with a general degenerative change in the blood-vessels all over the body combined with increase in size (hypertrophy) of the heart produced by a rise in the general blood-pressure. In some cases this arterial disorder has proceeded to an extreme extent in the kidneys. Blood-vessels having become completely filled up here and there, the kidney tissue in places has disappeared, with the resulting formation of deep dimples on its surface (*arteriosclerotic kidney*).

Still another form of chronic Bright's disease is the *waxy* or *amyloid kidney*, in which, as the result of some chronic general disease such as syphilis or tuberculosis, the vessels and interstitial tissues of the kidney as well as of other organs become the seat of waxy disease. This form of disease is not now so frequent as formerly.

Symptoms.—Severe headaches and a general and insidious deterioration in the nutrition of the body leading to increasing thinness form the earliest

symptoms of this condition. The patient may also notice that he is passing an unusual quantity of clear, low-coloured urine. The hypertrophy of the heart, leading to palpitation, forcible cardiac action, or a feeling of oppression in the chest, also very often attracts the person's attention. The high blood-pressure which is invariably present in this type of the disease leads to interference with the functions of other organs, and indeed the condition of the kidneys may be unsuspected until an attack of apoplexy draws attention to the serious degeneration of the blood-vessels. The blood-pressure may be raised from the normal 130 mm. or thereabouts to 170, 180, or even well above 200 mm. in advanced stages. Hæmorrhages frequently take place into the retina, producing more or less permanent interference with the vision. In this type of the disease the serious degeneration of the kidneys leads to failure in excretion of all those waste products of which the kidney should get rid, with the exception of water. As a result of their accumulation in the blood and tissues, the patient is particularly liable to the occurrence of symptoms of poisoning which go by the name of uræmia (*see* URÆMIA); and, in consequence of this accumulation of nitrogenous materials in the blood, the condition is then referred to as *azotæmic nephritis*.

Treatment.—The general treatment which has been outlined for chronic parenchymatous nephritis applies also to this type of the disease, and the patient must take the same care with regard to avoidance of chills and the careful regulation of diet and habits so as to throw as little strain as possible upon the damaged kidneys. Generally speaking, the diet must be specially restricted, and from time to time, when the patient is suffering from symptoms such as headache and dyspepsia to a high degree, he is greatly benefited by confinement for a week or thereabout to bed on the low protein diet above mentioned. The form of diet known as *basic diet*, which consists practically entirely of vegetable foods, may be taken for prolonged periods while the patient is going about. The following arrangement of meals provides over 2000 calories and suffices for a man doing sedentary work:

Breakfast.—1 glass orange juice; baked apple with cream; small slice of fat bacon; ½ slice toast with butter; milk, ½ pint.

Lunch.—1 glass orange juice; baked potato with butter; salad; ½ slice bread; milk, ½ pint; fruit.

Dinner.—1 glass orange juice; vegetable cream soup; potatoes with butter; peas or carrots; ½ slice bread; fruit salad; nuts.

Various drugs, such as nitro-glycerin, nitrite of soda, and iodide of potassium, are given to lower the blood-pressure; and hot baths may be taken for the same purpose. In this form of the disease also the most important points in treatment are the daily movement of the bowels and the protection of the skin from chills.

BROMETHOL is the name introduced by the *British Pharmacopœia* for the product used in substitution for the German drug avertin. It is a basal anæsthetic and is administered by the rectum.

BROMIDES are salts of bromine. The bromides of potassium, sodium, strontium, and ammonium are used in medicine, the first being slightly more depressing and the last more stimulating than bromide of sodium. They act chiefly on depress activity, and dull sensibility of the brain. They are useful for nervy or hysterical people, and are often given as a mild hypnotic.

Uses.—Sleeplessness due to mental labour and worry is greatly helped by bromides often combined with other drugs, the dose being 20 grains or more at bedtime. Epilepsy and other nervous convulsive affections are treated by long courses of bromide. Maniacal attacks, delirium, neuralgia, all yield to it, especially when combined with other drugs like chloral, opium, hyoscyamus. It has the disadvantage of tending to produce an eruption, especially about the face, which, however, is lessened when the bromide is combined with a small dose of arsenic. It must not be taken recklessly, or its use may become a habit. As a result of taking bromide for a long time some people may show symptoms of a disturbed balance of mind, which pass off when the drug is omitted.

BROMIDROSIS (*βρῶμος*, stench; *ἱδρώς*, sweat) means the excretion of evil-smelling perspiration. (*See* PERSPIRATION, DISORDERS OF.)

BROMISM is the name given to a group of symptoms consisting of acne on the face, mental dullness, sleepiness, weakness, unsteady gait, and bad breath, which shows that too much bromide is being taken.

BRONCHIAL TUBES (*see* AIR PASSAGES, LUNGS).

BRONCHIECTASIS (*βρόγχος*, windpipe; *ἔκτασις*, lengthening). (*See* LUNGS, DISEASES OF.)

BRONCHIOLECTASIS is the term applied to the morbid dilatation of the bronchioles as a result of disease of their walls.

BRONCHIOLES is the term applied to the finest divisions of the bronchial tubes.

BRONCHIOLITIS is a name sometimes applied to bronchitis affecting the finest bronchial tubes, also known as capillary bronchitis.

BRONCHITIS (*βρόγχος*, windpipe) means inflammation of the mucous membrane of the bronchial tubes. Well known as one of the most common diseases of the climate of Great Britain, bronchitis exists in either an *acute* or a *chronic* form.

(*a*) ACUTE BRONCHITIS, like other inflammatory affections of the chest, generally arises as the result of exposure to cold, particularly if accompanied with damp, or of sudden change from a heated to a cool atmosphere. It may also arise as the result of inhaling irritating dust or vapours. Great numbers of bacteria are commonly found in the expectoration, and the products formed by these are presumably responsible for aggravating the condition.

Symptoms.—The symptoms vary according to the severity of the attack, and more especially according to the extent to which the inflammatory action spreads in the bronchial tubes. The disease usually manifests itself at first in the form of a catarrh, or common cold; but the accompanying feverishness and general constitutional disturbance proclaim the attack to be something more severe, and symptoms denoting the onset of bronchitis soon present themselves. A short, painful, dry cough, accompanied with rapid and wheezing respiration, a feeling of rawness and pain in the throat and behind the breast-bone, and of oppression or tightness throughout the chest, mark the early stages of the disease. In some cases, from the first, symptoms of the form of asthma known as the *bronchitic* are superadded, and greatly aggravate the patient's suffering. (*See* ASTHMA.)

After a few days, expectoration begins to come with the cough, at first scanty and viscid or frothy, but soon becoming copious and of purulent character. In general, after free expectoration has been established the more urgent and distressing symptoms abate; and, while the cough may persist for a length of time, often extending to three or four weeks, in the majority of instances convalescence advances, and the patient is ultimately restored to health, although there is not infrequently left a tendency to a recurrence of the disease on exposure to its exciting causes.

When the ear or the stethoscope is applied to the chest of a person suffering from such an attack as that now described, there are heard in the earlier stages snoring or cooing sounds, mixed up with others of wheezing or fine whistling quality, accompanying respiration. These are named dry sounds or rhonchi, and they are occasionally so abundant and distinct as to convey their vibrations to the hand applied to the chest, as well as to be audible to a bystander at some distance. As the disease progresses these sounds become to a large extent replaced by others of crackling or bubbling character, which are termed moist sounds or râles. Both these kinds of abnormal sounds are readily explained by a reference to the pathological condition of the parts. One of the first effects of inflammation upon the bronchial mucous membrane is to cause some degree of swelling, which, together with the presence of a tough secretion closely adhering to it, tends to narrow the tubes. The respired air as it passes over this surface gives rise to the dry or sonorous breath sounds, the coarser being generated in the large, and the finer or wheezing sounds in the small divisions of the bronchi. Before long, however, the discharge from the bronchial mucous membrane becomes more abundant and less glutinous, and

accumulates in the tubes till dislodged by coughing. The respired air, as it passes through this fluid, causes the moist râles above described. In most instances both moist and dry sounds are heard abundantly in the same case, since different portions of the bronchial tubes are affected at different times in the course of the disease.

Such are briefly the main characteristics presented by an ordinary attack of acute bronchitis running a favourable course.

The case is, however, very different when the inflammation spreads into, or when it primarily affects the minute ramifications of the bronchial tubes which are in immediate relation to the air-cells of the lungs, giving rise to that form of the disease known as *capillary bronchitis*. When this takes place all the symptoms already detailed become greatly intensified, and the patient's life is placed in imminent peril in consequence of the interruption to the entrance of air into the lungs, and thus to the due aeration of the blood. The feverishness and restlessness increase, the cough becomes incessant, the respiration extremely rapid and laboured, the nostrils dilating with each effort, and evidence of impending suffocation appears. The surface of the body is pale or dusky, the lips are livid, while breathing becomes increasingly difficult, and is attended with suffocative paroxysms which render the recumbent posture impossible. Unless speedy relief is obtained by coughing and expectoration, the patient's strength gives way, somnolence and delirium set in, and death ensues. All this may be brought about in a few days, and such cases, particularly among the very young or the aged, sometimes prove fatal within forty-eight hours.

During life, in addition to the auscultatory signs present in ordinary bronchitis, there generally exist in this form of the disease abundant fine moist râles at the bases of both lungs; and the appearance of these organs after death shows the minute bronchi and many of the air-cells to be filled with matter similar to that which had been expectorated, and which has thus acted as a mechanical hindrance to the entrance of the air and caused death by asphyxia.

Acute bronchitis must at all times be looked upon as a severe and even serious ailment, but there are certain circumstances in which its occurrence is a matter of special anxiety to the physician. It is pre-eminently dangerous at the extremes of life, and mortality statistics show it to be one of the most fatal of the diseases of those periods. This is to be explained not only by the well-recognised fact that all acute diseases tell with great severity on the feeble frames alike of infants and aged people, but more particularly by the tendency which bronchitis undoubtedly has, in them, to assume the capillary form, and when it does so to prove quickly fatal. The importance, therefore, of early attention to the slightest evidence of bronchitis among the very young or the aged can scarcely be overrated.

Bronchitis is also apt to be very severe when it occurs in persons who are addicted to intemperance. Again, in those who suffer from any disease affecting directly or indirectly the respiratory functions, such as consumption or heart disease, the supervention of an attack of acute bronchitis is an alarming complication, increasing, as it necessarily does, the embarrassment of breathing. The same remark is applicable to those numerous instances of its occurrence in children who are, or have been, suffering from such diseases as have always associated with them a certain degree of bronchial irritation, such as measles and whooping-cough.

One other source of danger of a special character in bronchitis remains to be mentioned, viz. collapse of the lung. Occasionally a branch of a bronchial tube becomes plugged up with secretion, so that the area of the lung to which this branch brings air ceases to be inflated on inspiration. The small quantity of air imprisoned in the portion of lung gradually escapes, but no fresh air enters, and the part collapses and becomes of solid consistence. Increased difficulty of breathing is the result, and where a large portion of lung is affected by the plugging up of a large bronchus, a fatal result may rapidly follow, the danger being specially great in the case of children. Fortunately, the obstruction may sometimes be removed by vigorous coughing, and relief is then obtained.

Treatment.—With respect to the

treatment of acute bronchitis in those mild cases which are more of the nature of a simple catarrh little else will be found necessary than confinement in a warm room, or in bed, for a few days, and the use of light diet, together with warm diluent drinks, warm milk being specially beneficial. Additional measures are, however, called for when the disease is more markedly developed. Medicines to allay fever and promote perspiration, such as the well-known Mindererus spirit, combined with antimonial or ipecacuanha wine, are highly serviceable in the earlier stages. Later on, with the view of soothing the pain of the cough, and favouring expectoration, mixtures containing squill or tolu, with the addition of some opiate, such as the ordinary paregoric (compound tincture of camphor), may be advantageously employed. The use of opium, however, in any form should not be resorted to in the case of young children without medical advice, since its action on them is much more potent and less under control than it is in adults. From the outset of the attack the employment of warm applications to the chest in the form of fomentations or poultices affords great relief. In children, rubbing the chest with some stimulating liniment such as camphorated oil has a similar effect.

In the earlier stages few remedial measures are of greater value than the frequent inhalation of steam. This is accomplished readily enough in the case of adults by the use of an inhaler or simply by breathing over an open-mouthed vessel containing boiling water. In children, in whom this plan cannot be carried out in the same manner, there is in general no difficulty in surrounding them with an atmosphere of steam by erecting over the bed or cot a tent, formed by a screen and blanket, under which can be led the orifice of a tin kettle heated by a spirit-lamp, and provided with a spout 2 or 3 feet long. Various drugs of soothing or expectorant qualities, such as tincture of benzoin, spirit of chloroform and menthol, can also be added to the water in the kettle, or poured upon a sponge which is placed in the end of the spout, and so inhaled in the steam.

The relief to the cough and breathing, and the aid to expectoration afforded by this simple plan are often surprising, and the cases are rare where it cannot be borne.

Should the cough persist for a length of time, and the disease threaten to

FIG. 92.—Inhaler for bronchitis.

become chronic, counter-irritant applications to the chest in front and behind, in the form of stimulating liniments or painting with tincture of iodine, will be rendered necessary.

When the bronchitis is of the capillary form, the great object is to maintain the patient's strength, and to endeavour to secure the expulsion of the morbid secretion from the fine bronchi.

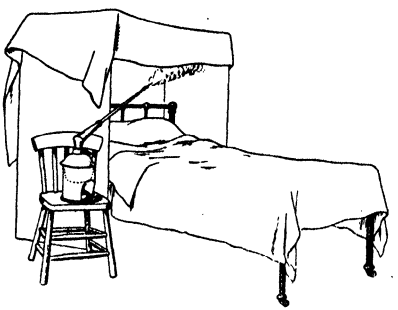


FIG. 93.—Bronchitis tent and steam kettle.

In addition to the remedies already mentioned, stimulants are called for frequently; and should the cough be ineffectual in relieving the bronchial tubes, the administration of an emetic dose of sulphate of zinc, or especially of ipecacuanha wine, often clears out the expectoration, when the patient vomits, and so gives great relief.

During the whole course of any attack of bronchitis attention must be paid to the due nourishment of the patient by

light, warm articles of diet; and during the subsequent convalescence, which, particularly in elderly persons, is apt to be slow, tonics and stimulants may have to be prescribed.

(*b*) CHRONIC BRONCHITIS.—**Causes.**—This form of the disease may arise as the result of repeated attacks of the acute form, or it may exist altogether independently. It occurs more frequently among persons advanced in life than among the young, although no age is exempt from it. The usual history of this form of bronchitis is that of a cough recurring during the colder seasons of the year, and in its earlier stages, departing entirely in summer, so that it is frequently called 'winter cough'. In many persons subject to it, however, attacks are apt to be excited at any time by very slight causes, such as changes in the weather; and in advanced cases of the disease the cough is seldom altogether absent.

Chronic bronchitis may arise secondarily to some other ailment. This is especially the case in Bright's disease of the kidneys, and in heart disease, in both of which maladies it often proves a serious complication.

Symptoms.—The symptoms and auscultatory signs of chronic bronchitis are on the whole similar to those pertaining to the acute form, except that the febrile disturbance and pain are much less marked. The cough is usually more troublesome in the morning than during the day. There is usually free and copious expectoration of a thin frothy fluid, and occasionally this is so abundant as to constitute what is termed *bronchorrhœa*.

Chronic bronchitis leads to alterations of structure in the affected bronchial tubes, their mucous membrane becoming thickened or even ulcerated, while occasionally permanent dilatation of the bronchi takes place, often accompanied with profuse fœtid expectoration. In long-standing cases of chronic bronchitis, the nutrition of the lungs becomes impaired, and dilatation of the air-sacs (*emphysema*) and other complications result, giving rise to more or less constant breathlessness and leading to deformity of the chest (*barrel-shaped chest*). Chronic bronchitis is liable, in some instances, particularly when accompanied with loss of flesh and strength, to be mistaken for consumption; but the physician who carefully regards the history of the case and observes the physical signs and symptoms, will in general be able to distinguish the one disease from the other. In this, too, the examination of the sputum for the presence of the tubercle bacillus is of great importance, the discovery of this organism at once indicating the tuberculous nature of the malady.

Chronic bronchitis does not often prove directly fatal, nor is it necessarily inconsistent with long life. Its chief danger lies in the tendency to intercurrent acute attacks, particularly in the aged; and in this manner it very frequently causes death.

Treatment.—The treatment to be adopted in chronic bronchitis depends upon the severity of the case, the age of the patient, and the presence or absence of complications. Attention to the general health is a matter of prime importance in all cases of the disease, more particularly among persons whose avocations entail exposure, and tonics with cod-liver oil will be found highly advantageous. The use of a respirator, from which pine oil and other aromatic substances can be inhaled, is occasionally useful. In those aggravated forms of chronic bronchitis where the slightest exposure to cold air brings on fresh attacks, it may become necessary, where circumstances permit, to enjoin confinement to a warm room, or removal to a more genial climate during the winter months.

When expectoration is difficult, such remedies as squill combined with carbonate of ammonia may prove useful. When, on the other hand, expectoration is excessive, astringents are called for. The inhalation of vapour containing iodine or turpentine or menthol is often followed by marked benefit in this way. Where breathlessness accompanies the disease, relief is often obtained from the use of iodide of potassium, or of ethereal preparations. Counter-irritation of the chest with mustard, turpentine, or croton liniment is generally attended by good results.

In the aged, and in weak persons, stimulants are an indispensable part of the treatment. Acute attacks of the disease, which are so apt to arise in the chronic form, must be dealt with on the

principles already indicated in treating of acute bronchitis.

BRONCHOPHONY (βρόγχος, windpipe; φωνή, voice) means the resonance of the voice as heard by auscultation over the site of the large bronchial tubes, and, in diseased conditions, conveyed beyond these by cavities or solidification of parts of the lung.

BRONCHO-PNEUMONIA (*see* PNEUMONIA).

BRONCHOSCOPE (βρόγχος, windpipe; σκοπέω, I examine) is an instrument constructed on the principle of the telescope, which on introduction into the mouth is passed down through the larynx and windpipe and enables the observer to see the interior of the larger bronchial tubes.

BRONCHUS (βρόγχος, windpipe), or bronchial tube, is the name applied to tubes into which the windpipe divides, one going to either lung. The name is also applied to the divisions of these tubes distributed throughout the lungs, the smallest being called bronchioles.

BRONZED SKIN is one of the symptoms of Addison's disease. (*See* ADDISON'S DISEASE.)

BROW AGUE is a term used to denote both frontal neuralgia or tic douloureux (*see* NEURALGIA) and migraine or megrim. (*See* MIGRAINE.)

BRUCELLA ABORTUS is a bacterium closely related to *Brucella melitensis*, the causative organism of Malta or undulant fever. *Br. abortus* causes infectious abortion in cattle, and is excreted in cow's milk, whence it finds its way into the human intestinal tract, giving rise to the most troublesome disease, undulant fever. Attempts are being made by vaccination to control *abortus* fever in cattle; and by pasteurisation of milk to prevent human infection.

BRUCELLA MELITENSIS is the name of a bacterium present in the milk of the goats of Malta and causing Malta or undulant fever among those drinking the milk. Undulant fever is common along the shores of the Mediterranean.

BRUCELLIASIS or BRUCELLOSIS (*see* BRUCELLA, MALTA FEVER).

BRUISES, or CONTUSIONS, are more or less extensive injuries of the deeper parts of the skin and underlying tissues, accompanied generally by outpouring of blood from damaged vessels, but unattended by corresponding open wounds.

Varieties.—An extensive bruise may be accompanied by a wound, in which case the injury is known as a 'contused wound.' (*See* WOUNDS.)

The simplest type of bruise is one in which the deeper layers of the skin only are damaged, causing a slight bluish discoloration due to the tearing of minute vessels and the escape of blood into the cellular spaces of the skin. As the result of a severe blow, the muscles may be bruised and torn without any wound in the skin, and the resulting effusion of blood may cause a large swelling which sometimes, though not usually, results in the formation of an abscess. When a bone is bruised, as by a kick on the shin or by a fall upon the knee or elbow, changes similar to those which follow an actual fracture are produced and a permanent thickening of the bone very frequently results. Bruises of this type are of great importance, because an effusion of blood into the cavity of a joint leads to stiffness lasting some weeks, which may, if absorption of the blood be not complete, remain in some degree permanent owing to the formation of adhesions. (*See* ADHESIONS *and* JOINTS, DISEASES OF.) Further, it is held by many authorities that some slight injury of this nature is in many cases the starting-point of the tuberculous disease which frequently attacks the bones of children. Severe bruises of internal organs, as from a crush or run-over accident, sometimes occur even when the skin has escaped injury and shows no mark. (*See* ABDOMEN, INJURIES OF.) Bruising of the brain or spinal cord sometimes occurs in consequence of a severe shaking, as in a railway accident, and is known as 'concussion'. (*See* BRAIN, DISEASES OF; NEURASTHENIA.)

Appearance of a bruise.—The extent of a bruise and the depth of its tint depend upon the amount of blood which has escaped from the vessels, and this

again varies according to the violence of the blow and peculiarities of the person injured. In some diseases, like scurvy, extensive bruises are produced by little or no violence. Sometimes a bruise is so sharply limited that it gives a distinct impression of the instrument with which it has been inflicted, while in other cases the blood runs downwards and produces a black mark at some distance from the injured part, as seen, for example, in the blackness beneath the eye which may follow an injury of the forehead or temple.

The colour of a bruise is at first black or bluish, later becoming brown, and finally changing to yellow, which fades away as alterations take place in and absorption occurs of the blood pigment. The time occupied in disappearance of a bruise depends largely upon the amount of blood effused, but in moderate bruises ten days or a fortnight must elapse before the injury ceases to be noticeable.

Treatment of slight bruises consists chiefly in preventing the effusion of blood after an injury, by means of cold compresses firmly fixed in position by suitable bandages. Ice may also be applied with good results. If it be not convenient to apply cold, various astringent substances may be used in the form of evaporating lotions kept in contact with the part for eight or ten hours; thus a cloth may be wrung out of Goulard's water and applied to the bruise, or the skin may be painted with hazeline or tincture of arnica. In painful bruises one of the best applications is lead and opium lotion. (*See* GOULARD'S WATER.) The injured part, if a limb, should be elevated in a sling or on a couch.

Mere surface bruises and abrasions are benefited by application of hazeline, or if the skin be much ruffled or ingrained with dirt it is well to apply for a few days a piece of boracic lint in the form of a water-dressing. (*See* POULTICES.)

BRUIT and MURMUR are words used to describe several abnormal sounds heard in connection with the heart, arteries, and veins on auscultation.

BUBO (*βουβών*, the groin) means a swelling of a lymphatic gland in the groin in venereal disease or in the plague. (*See* PLAGUE.)

BUCHU is a remedy derived from the leaves of *Barosma betulina* and similar plants. It contains volatile oil and mucilage and is administered especially in inflammatory conditions of the bladder. The infusion of buchu is given in doses of 1 to 2 ounces.

BULB is a term used to signify either the globe of the eye, or the medulla oblongata or hindmost part of the brain.

BULIMIA (*see* BOULIMIA).

BULLA is another word for blister.

BUNDLE OF HIS.—This is a bundle of special muscle fibres which pass from the auricles to the ventricles of the heart and which form the pathway for the impulse which makes the ventricles contract, the impulse originating in the auricles.

BUNIONS (*see* CORNS AND BUNIONS).

BUNYAN-STANNARD ENVELOPE (*see under* BURNS).

BURNS and SCALDS.—Burns are injuries caused by dry heat, scalds by moist heat, but the two are similar in symptoms and treatment. Severe burns are also caused by contact with electric wires, and by the action of acids and other chemicals. The burn caused by chemicals differs from a burn by fire only in the fact that it is more favourable than the latter, because the chemical destroys the bacteria on the part, so that less suppuration follows.

Severe and extensive burns are most frequently produced by the clothes, for example of a child, catching fire. This applies especially to cotton garments, which blaze up quickly. It should be remembered that such a flame can immediately be extinguished by wrapping the person in a woollen article or simply by laying on the floor so as to lessen the draught of air. Severe scalds are usually produced by escape of steam in boiler explosions.

Degrees of burns.—The French surgeon Dupuytren divided burns into six degrees, according to their depth.

1ST DEGREE.—There is simply redness. Such burns may be painful for a day or two. Similar effects are produced by prolonged exposure to sunlight and to X-rays.

2ND DEGREE.—There is great red-

ness, and the surface is raised up in blebs. There is much pain, but healing occurs without a scar.

3RD DEGREE.—The scarf-skin or epidermis is all peeled off, and the true skin below is in part destroyed, so as to expose the endings of the sensory nerves. This is a very painful form of burn, and a scar follows on healing.

4TH DEGREE.—The entire skin of an area is destroyed, with its nerves, so that there is much less pain than in the last form. A scar forms, later contracts, and may produce great deformity.

5TH DEGREE.—The muscles also are burned, and still greater deformity follows.

6TH DEGREE.—A whole limb is charred. It separates as in gangrene.

Symptoms.—For the first two days the chief symptoms are pain, varying with the 'degree' of the burn, and in severe cases 'shock'. (*See* SHOCK.) It is said that even superficial burns of as much as one-third of the skin-surface are always fatal. After forty-eight hours, in cases of the 3rd and higher degrees, inflammation of the part and fever are very apt to come on, and, in extensive burns over the head, chest, or abdomen, there is great risk of inflammation in the membranes covering the internal organs beneath the burn. Such conditions as bronchitis, pneumonia and pleurisy are apt to develop when the burns are over the chest, and meningitis in the case of burns about the head and neck. Albuminuria is very frequently found owing to congestion of the kidneys. In burns about the face and mouth œdema of the larynx is a dangerous complication accompanied by the risk of suffocation. Later, when the burnt parts slough away there is much suppuration until the gap finally heals. All through this stage there is, in extensive burns, a liability to death from ulceration of the bowels or from general blood-poisoning. Healing is slow, and if the burn is deep, there is often terrible deformity.

The danger of burns depends chiefly upon their surface extent and to a less degree upon the depth of the burn. Burns over the chest, abdomen or head are much more dangerous than larger burns on the limbs. The age is also a matter of importance, because children and old people are more liable to succumb to shock in the early stage of the burn than are adults of full health and strength. At a later stage the presence or absence of septic changes is the most important factor in regard to recovery.

Treatment.—Slight burns are soothed by protecting them from the air with a dressing (*e.g.* gauze, wool, and bandage). For severer burns it is important that any dressings applied should be of such a nature as (*a*) to relieve pain, (*b*) prevent septic changes, and (*c*) aid the healing of the resulting ulcer. If pain is very severe, it may be necessary to inject some soothing remedy such as morphia. The treatment of shock, if it is present, must at this stage be undertaken on the general principles applicable to this condition. (*See* COLLAPSE.) The clothing must in the first place be carefully removed, the whole of the burned area being gently but thoroughly washed with a mild, warm, antiseptic lotion, such as warm boracic lotion. By this means the charred clothing is separated. The burn may thereafter be treated on one of three distinct lines:

(1) *Dry dressing.*—One of the most widely used forms of dressing for large burns consists in spraying or painting the surface with a 20 per cent solution of tannic acid in water, which is allowed to dry; or strips of lint may be wrung out of this solution and laid on the burn. A thick layer of wool is afterwards applied over the region of the burn. The tannic acid treatment may be combined with application of silver nitrate and/or various aniline dyes. A favourite application is 'triple dye'—gentian violet, brilliant green, and flavine. Sulphonamide drugs have been applied to control sepsis. To stop the escape of fluid from the injured capillaries and lymph vessels into the tissue spaces, pressure-dressings have been applied. For first-aid treatment probably the best course is to cover the burn with a clean, dry, sterile dressing. Tannic acid applications are less in favour than formerly, and a cream, containing among other things, sulphanilamide and cetyl trimethyl ammonium bromide, is preferred as a first aid remedy.

(2) *Wet dressing* is sometimes used for burns, especially of the limbs, either by wrapping the burnt area in strips

of lint wrung out of warm boracic lotion which are covered by mackintosh, or by immersing the whole limb in a bath containing boracic lotion.

The most recent advance is to keep the burnt part continuously in contact with a solution of electrolytic hypochlorite. The solution is contained in a specially coated transparent silk envelope—the Bunyan-Stannard envelope—which can be applied round a limb or sealed to the body. The results are said to be very good, especially in the treatment of burns of the hands.

(3) *Oily dressings* are sometimes used, but as they are difficult to remove and are apt to favour septic changes, they should only be employed in the case of small and superficial burns. Such a dressing may be conveniently made of carron oil, which contains lime-water and linseed oil in equal parts with five per cent of eucalyptus oil for its antiseptic properties. (*See* CARRON OIL.) For small burns, a cream known as Glasgow No. 9, and containing, among other constituents, cetyl trimethyl ammonium bromide and sulphanilamide, is now (1944) recommended.

At a later stage, when the direct effect of the burning injury has passed away and the burn is a healing ulcer, some simple dressing such as boracic lotion or an ointment spread on lint, such as zinc or boracic ointment, is commonly employed.

Children sometimes scald the mouth and gullet by drinking from the spout of a kettle, and for this, teaspoonful doses of a mixture of cod-liver oil and lime-water, from time to time, give relief.

The rapidly fatal result which sometimes follows upon extensive superficial burns is explained in some cases by general shock to the nervous system. This makes it of great importance to maintain quietness and to relieve pain as much as possible at the very beginning of the treatment. Another explanation which has been advanced to explain death in cases where there does not seem to be a great amount of shock, is that some poisonous substance is produced in the burnt tissues which is absorbed, and produces a general toxic effect. For this reason, some surgeons make it a practice in the case of very extensive burns in children to transfuse the patient with fresh blood obtained from another person at an early stage of the treatment.

BURSÆ are natural hollows in the fibrous tissues, lined by smooth cells and containing a little fluid. They are situated at points where there is much pressure or friction, and their purpose is to allow free movement without stretching or straining the tissues, for example on the knee-cap or the point of the elbow, and, generally speaking, where one muscle rubs against another or against a bone. They develop also beneath corns and bunions, or where a bone comes to press in an unwonted manner on the skin.

BURSITIS means inflammation within a bursa. Acute bursitis is of the nature of an abscess, being produced

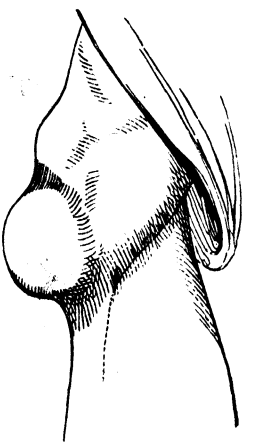


FIG 94.—Housemaid's knee. (Miller's *Surgery*.)

by injury of a bursa, especially on the knee or elbow, when the prominent part of the joint becomes swollen, hot, painful, and red. It is treated as an abscess. (*See* ABSCESS.)

Chronic bursitis is due to too much movement of or pressure on a bursa. For example, the condition of 'housemaid's knee' is a chronic inflammation of the patellar bursa in front of the knee, due to too much kneeling. This condition may consist in either a collection of fluid in the bursa, or, less frequently, in thickening of its walls, producing in either case an elastic swelling

over the joint, with pain. In the former case, rest of the limb, with counter-irritation (*see* BLISTERS) over the swelling, or injection of some irritant substance into its interior, forms the treatment; in the latter case, removal by operation.

Chronic bursitis about the sinews round the wrist and ankle is generally called a 'ganglion'. (*See* GANGLION.)

BUTTER (*see* DIET).

BUTYL CHLORAL HYDRATE is similar to chloral hydrate but has a special action upon the fifth cranial nerve, and is much used for facial neuralgia.

BYSSINOSIS is a pneumoconiosis (*q.v.*), or chronic inflammatory thickening of the lung tissue, due to the inhalation of cotton dust in factories. Lung disease in cotton operatives in the U.S.A. has been shown to be due to the action of bacterial toxin in the inhaled cotton dust, and from cotton in bad condition large numbers of motile, Gram-negative, capsulated bacilli have been isolated. It is just possible that this American observation has some bearing on the causation of byssinosis.

C

CABBAGE is a vegetable much used in Great Britain. Cabbage consists to the extent of about 5 per cent of carbohydrates, the remainder being largely indigestible vegetable fibre and water. It is a good source of vitamin C. (*See* DIET.)

CACAO is the name given to the seeds of *theobroma cacao*, which yield cocoa, chocolate, and cocoa butter.

CACHET means an oval capsule, generally made of rice paper, for enclosing a dose of unpleasant medicine. Cachets are softened by moistening with water prior to swallowing.

CACHEXIA (*κακός*, bad ; *ἕξις*, condition) is the feeble state produced by serious disease, especially by the growth and ulceration of a cancer.

CACODYLE is the name given to certain organic compounds of arsenic which have been used both internally and by hypodermic administration for various chronic diseases, such as tuberculosis, exophthalmic goitre, pernicious anæmia, cancer, malaria and various skin affections.

CACOLET is the name given to a chair suspended from a pack-saddle for transporting wounded.

CACTUS, or CEREUS, is a tropical plant of which the extract and tincture have been used as a cardiac tonic.

CADAVERIC RIGIDITY is the stiffness which comes on after death. (*See* DEATH, SIGNS OF.)

CÆCUM (*cæcum*), or CECUM, is the dilated commencement of the large intestine lying in the right lower corner of the abdomen. Into it the small intestine and the appendix vermiformis open, and it is continued upwards through the right flank as the ascending colon.

CÆSAREAN SECTION means the delivery of a child by opening the abdomen and womb from in front. It is supposed to get its name from the reputed fact that Julius Cæsar was so delivered. It is not necessarily fatal to the mother, and is performed when delivery by the natural passage is highly dangerous to mother and child, for example, because of bony deformity of the pelvis ; also when the mother has died just before labour, so as to save the child.

CAFFEINE is a white crystalline substance obtained from coffee, of which it is the active principle. It is identical with theine, the active principle of tea. Citrate of caffeine is used as a stimulant to heart and kidneys in doses of 2 to 5 grains in water. Granular effervescent citrate of caffeine forms a good, non-intoxicating stimulant in headache due to tiredness.

CAISSON DISEASE affects workers in compressed air. Its chief symptoms are pains in the joints and limbs, pain in the stomach, headache and dizziness, and paralysis. Sudden death may occur. The condition is caused by the accumulation of bubbles of nitrogen in the nervous system.

CAJUPUT OIL is a green oil with camphor-like smell, much used for rubbing over diseased and painful joints. Spirit of cajuput in teaspoonful doses is useful for severe colic.

CALABAR BEAN is another name for physostigma.

CALAMINE, or CARBONATE OF ZINC, is a mild astringent used to soothe and protect the rough and weeping skin in eczema, as calamine lotion or ointment.

CALCANEUM is the name of the heel-bone or os calcis.

CALCICOSIS is the term applied to disease of the lung caused by the inhalation of marble dust by marble-cutters.

CALCIFEROL, or VITAMIN D_2, is a crystalline substance extracted from irradiated ergosterol, and has the same action as vitamin D. (*See* VITAMIN.)

CALCIFICATION is the process of deposit of lime salts. This occurs in old scars, as for example in the scars left by healed tuberculosis.

CALCIUM is the metal present in chalk and other forms of lime. The chief preparations used in medicine are calcium carbonate (precipitated), calcium chloride, calcium hydroxide (slaked lime), liquor of calcium hydroxide (lime-water), calcium lactate and calcium phosphate. (*See* LIME.) Calcium lactate is much used in states of general debility, especially at the menopause; it is often given along with parathyroid extract for the relief of chilblains. Calcium gluconate is freely soluble in water and is used for similar conditions by injection in doses of about 15 grains.

CALCULI (*calculus*, a pebble), is the general name given to concretions in the bladder or kidney, in the gall-bladder, or in the hands and feet as in gout.

CALIX (*calix*) means a cup-shaped cavity, the term being especially applied to the recesses of the pelvis of the kidney which collect drops of urine.

CALLIPER SPLINT is one that is applied to the broken leg in such a way that in walking the weight of the body is taken by the hip bone and not by the foot.

CALLOSITIES (*callosus*, thick-skinned) are thickenings of the outer skin or cuticle. (*See* CORNS.)

CALLOUS ULCER (*see* ULCER).

CALLUS is the new tissue formed round the ends of a broken bone. (*See* FRACTURES.)

CALOMEL, or SUBCHLORIDE OF MERCURY, is not to be confounded with corrosive sublimate or perchloride of mercury, a far more active drug and deadly poison. (*See* MERCURY.)

CALORIE, or CALORY, is the name applied to a unit of energy. Two units are called by this name—the small calorie, gram calorie, or standard calorie is the amount of heat required to raise one gram of water one degree centigrade in temperature; the large calorie or kilocalorie, which is used in the study of dietetics and physiological processes, is the amount of heat required to raise one kilogram of water one degree centigrade in temperature. The number of calories required to carry on the processes necessary for life and body warmth, such as the beating of the heart, the movements of the chest in breathing and the chemical activities of the secreting glands, is for an adult person of ordinary weight somewhere in the neighbourhood of 1600 calories. For ordinary sedentary occupations an individual requires about 2500 calories, for light muscular work slightly over 3000 calories, and for hard continuous labour about 4000 calories daily.

CALUMBA ROOT is one of the best pure bitters. (*See* BITTERS.) The dose of infusion of calumba is a tablespoonful in water.

CALVARIA, or CALVARIUM, is another name for the skull cap or vault of the head.

CALX is another name for lime or chalk. It is also the anatomical term for the heel.

CAMPHINE is another name for oil of turpentine.

CAMPHOR is a solid, crystalline, oily substance distilled from the wood of a species of laurel grown in Japan and Formosa. It is sold in the form of cubes, or in powder known as flowers of camphor. It has many uses, being antiseptic, sedative when applied externally as well as repellent to lice and other forms of insect life; while internally it is an expectorant, relieves griping, produces perspiration, and stimulates the action of the heart.

Uses.—Externally, it is frequently worn in small bags or placed among bed-clothes to keep off fleas, lice, and other insect pests, and so diminish the risk of certain infectious diseases which these carry. In gout, and various painful skin conditions, it is rubbed up with chloral, menthol, thymol, or salol to form an oily liquid which can be smeared over the surface with great relief. Liniment of camphor and camphorated oil (1 oz. camphor in 8 oz. olive oil) are likewise very useful in painful conditions or as mild counter-irritants to produce a warm glow when rubbed into the chest in bronchitis and similar conditions.

Internally, spirit of camphor in 5 to 30 drop doses and camphor water in tablespoonfuls are used to relieve spasms like hiccough and colic, to check

diarrhœa, to ward off colds in the head, and to act as a heart stimulant.

Dissolved in oil camphor is frequently used by hypodermic injection in the treatment of pneumonia and other serious conditions in which heart failure threatens to take place.

CANALICULUS means a small channel, and is applied to the minute passage leading from the lacrimal pore on each eyelid to the lacrimal sac on the side of the nose and also to any one of the minute canals in bone.

CANCELLOUS is a term applied to loose bony tissues as found in the ends of the long bones.

CANCER (*cancer*, a crab), **CARCINOMA** (*καρκίνωμα*) **and SARCOMA** (*σάρκωμα*) are general names for forms of tumor to which the term 'malignant' is applied, because they destroy the general health, break down the organs in which they grow, after apparent removal tend to grow again, and by rapid spread lead usually to death in some months or years. Cancer or carcinoma is composed mainly of epithelial cells, or cells similar to those of skin or of the mucous membrane lining the stomach and bowels, or of secreting glands; but these cells are imperfect in form and arrangement, although they generally retain their

FIG. 95. — Hard cancer (scirrhus) of the breast, showing masses of imperfect cells surrounded by fibrous tissue. Magnified 40 times.

characters sufficiently to allow of the organ from which they have come being recognised when a section of the cancer is examined under the microscope. A sarcoma is a tumor developing in the connective tissue of bones, muscles, sinews, etc., and in structure resembling imperfect connective tissue.

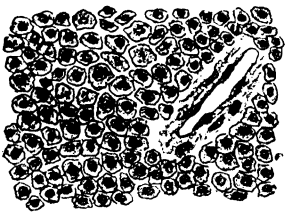


FIG. 96.—Small round-celled sarcoma, showing the simple cellular nature of its tissue. Magnified by 300. (Thoma's *Pathology*.)

Sarcoma is less common than cancer in the proportion of about one case of the former to twenty of the latter; and sarcoma is rather less malignant in its character than cancer, although different forms of both types of tumor vary much in this respect.

Cancers are classified mainly according to the structure they present on microscopic examination. A cancer growing on skin surface is generally known as an EPITHELIOMA; for example, these occur frequently on the lip. A cancer arising in the stomach or intestine and presenting an appearance resembling imperfectly formed gland tubules is known as ADENOCARCINOMA. A cancer composed almost entirely of cells without supporting tissue is known as a SOFT CANCER; and one in which the cells are much compressed and obliterated by development of fibrous tissue is known as a HARD or SCIRRHUS CANCER. These occur particularly in the breast. Various degenerations also occur in cancers, such as glue-like degeneration, COLLOID CANCER, cystic degeneration, calcareous degeneration, etc. Sarcoma is classified into ROUND-CELLED SARCOMA, SPINDLE-CELLED SARCOMA, etc., according to the microscopic appearances.

Causes.—The cause of malignant growths is still undiscovered. Many theories have been advanced, and, considering the fact that cancer is gradually becoming more frequent, it has become of great importance to establish the nature of the cause as a first step towards prevention and treatment. Much has been done in the last few years by various cancer research labora-

tories to increase our knowledge as to the distribution of cancer in the animal kingdom and among different races, and also to study the mode of spread and conditions of growth in this disease. It has been found that cancers occur in animals as well as among human beings, and that no race is exempt from the disease. It appears, however, that the disease occurs more commonly in civilised communities than among more primitive races. It has been found by experiments on animals that cancer can be transferred directly from one animal to another by inoculating a healthy animal with a small piece of cancerous tissue, and it has further been found that, when transferred in this way through a long succession of animals, the type of cancer produced remains always the same. An important step was taken by the Japanese workers who found that cancer could be produced in experimental animals by painting the skin with tar. British workers then isolated the actual chemical substance in tar which produces the cancer, and it was found that this substance is chemically similar to substances present in the healthy body. Does some chemical twist take place and make these normal substances carcinogenic or cancer-producing ? Another important factor to be investigated is infection. Many micro-organisms have been incriminated, but the only one that has stood the test of serious investigation is a filter-passing virus. For example, there is a type of cancer in fowls which is caused by a filter-passer. Another factor in the causation of cancer is the influence of the hormones of the ductless glands. It appears, for example, that the female sex hormone has an effect on the development of breast cancer. Still another factor is heredity. All this, and other work, suggests that cancer is not one disease with one cause, but an abnormal reaction of the tissues to a variety of exciting agents. Some scientists have supposed that no external cause is necessary, but that in early or embryonic life parts of the developing body come to rest, only to start sudden and irregular growth at a later period of life. The structure of some cancers, in which a cancerous growth develops in one part of the body resembling an embryonic structure or some other organ at a distance, lends support to this view. It would appear as if the cause of cancer growth were a complicated one, in which several factors, including degeneration or scar formation in the tissues and at the same time some external cause of the nature of an organism, were at work.

Several facts, though not to be regarded as direct causes, are important considerations in the origin of the disease.

INJURY.—Smoking a clay pipe has been observed to bring on cancer of the lip, constant alcoholic indulgence to favour cancer of the throat and stomach, while a scar, *e.g.* of an old ulcer, is not infrequently the starting-point. Chimney-sweeps, paraffin workers and workers in some other special employments have a great liability to cancer of the skin, apparently from long-continued irritation. It has also been found by experiments on animals that the prolonged application of tar to an area of skin may result ultimately in development of cancer. There does not seem any reason to suppose that cancer follows mechanical damage caused by a blow or wound, although there is ground for the belief that sarcoma occasionally follows some severe injury, such as fracture of a bone.

INFECTION.—It is unquestionable that the inhabitants of certain districts suffer more from cancer than those of others. Houses get the name of 'cancer houses' when one person after another living in them gets the disease. It is frequently noted that a husband and wife are successively affected by this disease.

HEREDITY.—It seems to be established that the children, especially women, of parents who have died of cancer, show slightly more than the average liability to the disease, though this fact is greatly exaggerated in the popular mind.

AGE.—Cancer is extremely rare before middle life, the commonest age being between fifty and sixty years. Although cancer is tending to increase in prevalence, there appears from the returns of the Registrar-General for England to be no tendency for the number of persons affected below the age of forty-five years to rise, and cancer is now more a disease of old age

than formerly. Sarcoma is commoner in younger persons.

SEX.—From the report for 1936 of the Registrar-General for England, it appears that out of 66,354 deaths in this country from cancer, 31,590 were among males and 34,764 among females. Among males the order in frequency of the organs affected was: digestive organs 19,099, respiratory organs 3744, genito-urinary organs 3679, mouth 2847, skin 661, and other organs 1560. Among females the greater number of cases is largely due to cancer of the breast and womb, deaths being caused by cancer of various organs as follows: digestive organs 16,794, breast 7079, uterus 4348, other female genital organs 2153, respiratory organs 1231, mouth 637, skin 497, and other organs 2025.

HEALTH AND HABITS.—Persons who have been throughout life healthy and robust are on the whole oftenest affected in old age; and members of long-lived families are specially liable to the disease in later life. Poverty and bad food are not at all causes, because cancer is said to be commoner among the richer classes, especially among those who eat much animal food.

Symptoms.—These vary according to the organs with which the growth interferes, thus a cancer of the stomach tends to cause dyspepsia and, it may be, severe pain; a cancer in the bowels is apt to lead to gradually increasing obstruction, which may produce either diarrhœa or constipation; a cancer affecting the jaw is apt to set up neuralgia; when the growth originates in the womb, flooding is one of the principal early symptoms; when pressure is exercised upon a vein, dropsy results, and so forth. When the growth takes place on the surface there is a hard swelling, which in time is liable to break down and ulcerate. In any case, the growth tends to spread by the lymphatic vessels, and the glands in the neighbourhood soon become affected by secondary growths if the original one be not speedily removed. This applies especially to cancer, and is one reason why cancer is so liable to return after apparently complete removal. Sarcoma tends less to spread along the lymphatic vessels, but occasionally minute fragments are carried away to distant organs in the circulating blood. When a cancer begins to ulcerate by invading the skin or an internal mucous membrane, a state of very bad health and weakness, called cachexia, results. The duration of symptoms of cancer is extremely variable. When the stomach is affected, these seldom last much longer than six months. When the breast is affected, the duration may be very much longer, especially if the main part of the growth has been removed, and life is then frequently prolonged for several years. The same applies to cancer of the rectum, when an artificial opening is made so that the growth is not irritated by the passage over it of intestinal contents.

Mortality.—The following table, compiled from the annual returns of the Registrar-General for England, shows the steady increase in the number of reported deaths from cancer at five-yearly intervals in the fifty years following 1880 in England and Wales:

Year.	Deaths.	Death-rate per Million Living.
1881 . . .	13,542	520
1886 . . .	16,243	590
1891 . . .	20,117	692
1896 . . .	23,521	764
1901 . . .	27,487	842
1906 . . .	31,668	913
1911 . . .	35,902	1103*
1916 . . .	40,630	1161*
1921 . . .	46,022	1215*
1926 . . .	53,220	1362*
1931 . . .	59,346	1484*
1936 . . .	66,354	1625

* From 1911 onwards these rates are standardised for age, so as to take into account the rapidly increasing number of elderly persons in the population.

It is evident, from the table given above, that the number of deaths recorded from cancer has in fifty years increased more than four times, though the population is only one and a half times as large (increase from 26,046,000 in 1881 to 40,839,000 in 1936). Even when due allowance is made for the fact that many more people now reach advanced ages than formerly, the death-rate from this cause is almost three times that which it was fifty years ago.

Below the age of twenty-five there are very few deaths from cancer; from twenty-five to fifty-five the death rate from this cause among women exceeds that among men, but at later ages the rate among men is in excess. Cancer

in parts other than the reproductive organs is more prevalent among men at all ages.

The organs in which cancer has chiefly increased are the stomach, intestine, breast, and the respiratory organs.

Cancer now stands second in importance as a cause of death, having in 1936 caused 66,354 deaths as compared with 126,584 due to organic heart diseases, while tuberculosis accounted for 28,268, and respiratory diseases, including bronchitis and pneumonia, for 50,338, apoplexy for 27,599, and 'old age' for only 17,089.

The increase in cancer is partly explained by the fact that diagnosis is now more precise and many deaths are registered as due to cancer which formerly would have been attributed to 'old age', 'obstruction of the bowels', etc.; and partly by the fact that more people now reach the ages at which cancer prevails.

Treatment.—It should be strongly urged that any person advanced in years finding a hard swelling under the skin should consult a surgeon. In the event of the swelling not being cancer, mental relief will be gained; and if it be cancer, there is at an early stage the chance of the only completely successful remedy at present known, that is thorough removal. The improvement of modern surgical technique and early diagnosis lead now to the possibility of operations which greatly prolong the life of persons affected by cancer, and in some cases permit of permanent recovery. In the case of internal cancers, *e.g.* of the stomach and bowels, attempts at complete removal have not, taking all cases together, attained a great measure of success, but much can be done in the way of operations designed for relief of symptoms which thus prolong life. Much greater success has attended modern operations for complete removal of cancers of the breast and womb.

Many cures have from time to time been vaunted, such as arsenic paste, turpentine, injections of trypsin, adrenaline, lead salts, etc., but these have all proved almost entirely useless on trial. In many cases much benefit accrues from combined treatment by surgery, X-rays, and radium. (*See* RADIUM, *also* RADIOTHERAPY *under* X-RAYS.)

At a late stage the internal administration of morphia and other sedatives, as well as the application of various antiseptic and soothing dressings, relieves the pain and discomfort of the patient, and life may last for many years.

CANCRUM ORIS (*cancrum*, a sore; *oris*, of the mouth), also called WATER-CANKER or NOMA, is a gangrenous ulcer about the mouth which affects weakly children, especially after some severe disease, such as measles. It is due to the growth of bacteria in the tissues.

CANINE TEETH, or EYE-TEETH (*see* TEETH).

CANKER is a name applied to small ulcers which form about the mouth and lips as the result of some local irritation, *e.g.*, a jagged tooth, or in a condition of dyspepsia and deteriorated general health. (*See* MOUTH DISEASES.)

CANNABIS INDICA, or INDIAN HEMP, also known in India as GUNJAH, and in other parts of the East as BHANG and HASHISH, consists of the flowering tops of *Cannabis sativa*.

Action.—It is, in small doses, a stimulant and intoxicant, and in larger doses a narcotic. In the stage of intoxication persons under its influence become much more excited than do the devotees of alcohol, and one name of the drug, hashish, is associated with the name of the sect of 'Assassins', whose crimes were perpetrated in the fury induced by the drug. Others, according to their temperament, show an access of politeness, and 'salaam' to bystanders till exhausted, while still others become extravagantly merry, losing the sense of personality and assuming extraordinary attitudes. Finally sleep comes on, attended by dreams of a sensuous character.

Uses.—It is used in combination with other anodyne and soporific drugs to relieve spasm and dull pain, especially in neuralgia, migraine, asthma, colic, and pain originating in the ovaries or womb. It is also given for sleeplessness, especially when associated with delirium. Its use may become a habit, which must be broken — like the morphia habit.

CANNED FOOD. Food which is preserved in cans or bottles constitutes an increasing part of food supply. Such foods are particularly useful for military and naval use. They also permit of convenience in storage and transport, so that a greater variety of food becomes available than could otherwise be obtained. This particularly suits the convenience of people living in places remote from centres of population and enables them to obtain food at times of the year when fresh articles are unobtainable. The cost of living is thereby greatly cheapened and a better form of food is obtained than could be furnished by the older methods of salting, drying, etc. It must be remembered, however, that in the process of preparation and by long keeping, the foods lose some of their vitamins, but modern methods preserve the vitamins of fruit and vegetables to a very much greater extent than formerly. As canned foods shrink in preparation, they contain more nourishment than fresh foods, for example 2 lb. of tinned meat may be regarded as practically equivalent to 3 lb. of fresh meat. Foods should be preserved naturally, that is without the use of chemical preservatives such as formalin, boric acid and salicylic acid, which even in small quantities are deleterious to health. The syrup which is used for the preservation of fruits is of course harmless, and the nitre which is often added to preserve the colour of beef is also devoid of any harmful property.

If the can shows bulging of the lid and bottom, known as 'blowing', this usually means that the contents have putrefied or fermented, with development of gas, and when tapped with the finger-nail such tins emit a drum-like, hollow sound.

Dangers of canned foods.—The chief danger associated with canned meat, fish, etc., is that of decomposition; while in the case of fruits and vegetables the danger consists in the acids they contain acting on lead contained in the solder or tin plating so as to cause lead-poisoning. Food poisoning from eating canned meat is usually caused by bacteria of the Salmonella group or by the toxins of *B. botulinus*, which causes botulism (*q.v.*). It is important to examine the tin for the presence of flaws which may have been produced by rusting or mechanical injury, thus admitting air with bacteria.

Examination of canned food.—It is important to avoid cheap brands of canned foods and especially those which do not bear a maker's name. Generally speaking good cans contain good food. The punched-out can with little soldering is preferable to a can built up of several pieces of metal. In the case of fruit especially the action of acids on the metal can be prevented by lacquering on the inside of the tin. Also, in the case of fruit, bottles are preferable to cans.

The signs of decomposition in meat contained in cans are the following: (1) Blowing, producing bulging of the lid and bottom, with the change of note on tapping the tin; (2) a stale odour when the tin is opened, which is noticed especially an hour or so after the air has gained access; (3) softness or loss of firmness in the meat; (4) a faded or brownish colour of the contents.

CANNULA, or CANULA, is a tube for insertion into the body designed to fit tightly round a trocar, a sharp, pointed instrument which is withdrawn from the cannula after insertion, so that fluid may run out through the latter.

CANTHARIDES, or SPANISH FLY, is a powder made of the body and wings of a dried beetle, *Cantharis vesicatoria*, which inhabits Spain, Italy, Sicily, and Southern Russia.

Action.—It is an irritant, firstly, to the part with which it is brought in contact, whether the skin surface or the stomach, and, secondly, to the genital and urinary organs by which it is discharged from the body. The latter effect, which causes difficulty in passing urine, is called 'strangury'.

Uses.—Its chief use is for blistering (*see* BLISTERS), and it may be applied as a plaster, in a paste, or painted on in ethereal solution called liquor epispasticus. Very small doses are sometimes given to stimulate the action of the kidneys.

CANTHUS (*κανθός*) is the name applied to the angle at either end of the aperture between the eyelids.

CAPILLARIES are the minute vessels which join the ends of the arteries to the commencement of the veins. Their walls consist of a single layer of fine, flat transparent cells, bound together at the edges, and the vessels form a

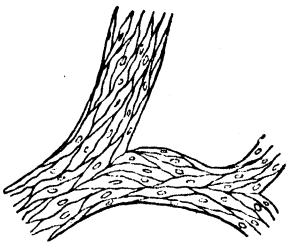


FIG. 97.—The endothelial cell wall of capillaries from the retina. Magnified by 300. (Turner's *Anatomy*.)

mesh-work all through the tissues of the body, bathing the latter in blood with only the thin capillary wall interposed, through which gases and fluids readily pass. These vessels are less than $\frac{1}{1000}$ inch in width. (*See* BLOOD *and* CIRCULATION.)

CAPSICUM, or CAYENNE PEPPER, consists of small orange-coloured pods containing whitish seeds. It is irritating when applied either internally or to the skin.

Uses. — Externally the powdered pepper is used in an ointment, or in the form of 'Chilli paste', to rub over sprains and bruises, the discoloration of which it helps to remove. Internally, tincture of capsicum is given for some forms of dyspepsia, and is useful (in 15-drop doses before meals) to allay the craving for alcohol.

CAPSOLIN is the name of a counter-irritant preparation containing capsicum, camphor, oil of turpentine, and cajuput and croton oils.

CAPSULE (*capsula*, a little box) is a term used in several senses in medicine. The term is applied to a soluble case, usually of gelatine, for enclosing small doses of unpleasant medicine. The term is also applied to the fibrous or membranous envelope of various organs, as of the spleen, liver, or kidney. It is also applied to the ligamentous bag surrounding various joints and attached by its edge to the bones on either side.

CAPUT MEDUSÆ is the term describing the abnormally dilated veins that form round the umbilicus in cirrhosis of the liver.

CARAGHEEN, or IRISH MOSS, is the name applied to a food-stuff derived from a kind of sea-weed, *Chondrus crispus*. It is pleasantly soothing and nutritive and is administered in chronic bronchial affections and in diarrhœa and dysentery. Half an ounce of the moss is added to 1½ pints of water and boiled down to 1 pint.

CARAWAY FRUIT, generally called caraway seed, is used to prepare caraway water and caraway oil. A tablespoonful of the former or 2 drops of the latter on sugar is useful for checking colic, griping pains in children, and flatulence.

CARBACHOL, or CARBAMYLCHOLINE CHLORIDE, is a drug which has the same action as the drug originally introduced under the proprietary name DORYL. Its action is to stimulate the parasympathetic nervous system, and it is given, for example, for paralysis of the gut and for retention of urine due to atony.

CARBO is the Latin name for charcoal. (*See* CHARCOAL.)

CARBOHYDRATE is the term applied to an organic substance in which the hydrogen and oxygen are usually in the proportion to form water. Carbohydrates are all, chemically considered, derivations from simple forms of sugar and are classified as monosaccharids (*e.g.* glucose), disaccharids (*e.g.* cane sugar), polysaccharids (*e.g.* starch). Many of the cheaper and most important foods are included in this group, which comprises sugars, starches, celluloses, and gums. When one of these foods is digested, it is converted into a simple kind of sugar and absorbed in this form. In the disease known as diabetes, the most marked feature consists of an inability on the part of the tissues to assimilate and utilise the carbohydrate material. Each gram of carbohydrate is capable of furnishing slightly over 4 calories of energy. (*See* DIET.)

CARBOLIC ACID, or PHENOL, is a coal-tar preparation, first introduced into medicine by Lord Lister some time prior to 1867.

Action.—Carbolic acid first paralyses

and then destroys all forms of life, having a specially destructive action upon lowly organisms like bacteria, It has a softening action upon tissues, pus, etc., and it also vaporises readily, so that it has much greater penetrating power than alcohol, perchloride of mercury, and other powerful antiseptics, which have a hardening action that retards their germicidal power. It dulls pain greatly, when applied to an inflamed part, by benumbing the nerves around.

It must never be forgotten that pure carbolic acid, or even a weak lotion too long applied, may painlessly kill the skin, and cause it to slough. This effect is lessened by smearing the damaged part with glycerin or with oil.

Internally it has similar actions, and even in moderate doses it is a poison, being first of all an irritant and on absorption a narcotic.

Carbolic oil was formerly much used (1 part of carbolic acid in 10 parts of olive oil), but Koch showed that it had little power in killing germs.

Carbolic acid is used as a standard antiseptic for comparison of the power of other substances to kill germs.

Uses.—The chief use is external as an antiseptic in operations, and as an application to ulcers and other wounds. (*See* ANTISEPTICS, ULCERS, WOUNDS.) The common strength for external application is carbolic acid 1 part, water 40 parts to 60 parts. As a disinfectant 1 in 20 of water (or 5 per cent) is the convenient strength, and is used to put in the bottom of the sputum-dish of consumptives, to steep the sheets soiled by typhoid-fever cases, to swab the floors and walls of sick-rooms, etc. At the present time lysol is more commonly used for this purpose. In toothache arising from a tooth with a cavity, pain is quieted by a small plug of wool dipped in pure carbolic acid. The pure acid is frequently used to purify and at the same time to soothe the interior of carbuncles and boils after they have been opened. In earache due to boils the ear may be syringed with warm carbolic lotion (1 in 40); or it may be used in the form of ear drops, consisting of 10 grains of carbolic acid in 3 drams of glycerin.

CARBOLIC ACID POISONING, due to accident or suicide, became fairly common with the use of the acid for disinfection and dressing wounds. No bottle containing carbolic lotion should ever be kept near other medicine bottles, as a few teaspoonfuls may cause death.

Carbolic acid poisoning may also come on slowly through gradual absorption from dressings by a wound. The urine generally is black for a day or two before the case gets serious.

Symptoms.—If the acid has been swallowed there is a sense of burning about the mouth and throat, followed by numbness, and the skin and mucous membrane of the mouth show white where the acid has touched them. Unconsciousness and stupor soon come on, and death follows usually in a few hours.

Treatment.—Olive oil, or any fatty substance like milk or cream, should be administered at once, and the stomach washed out or emptied by an emetic in several tumblerfuls of tepid water. Large doses are also given internally of Epsom salts or sulphate of magnesium, which combines with the carbolic acid and renders it harmless.

CARBON (*carbo*, coal) (*see* CHARCOAL).

CARBONATES OF SODA, POTASH, LITHIA, etc. (*see* ALKALIES).

CARBONIC ACID, or CARBON DIOXIDE, is the gas formed by the tissues and exhaled by the lungs. (*See* AIR *and* VENTILATION.) It effervesces from aerated waters and sparkling wines, and is used in baths for stimulation to the skin. (*See* BATHS.) Carbon dioxide in cylinders, combined with oxygen, is used to control breathing in anæsthesia and in cases of carbon monoxide poisoning. (*See* COAL-GAS.)

CARBONIC OXIDE, or CARBON MONOXIDE (*see* COAL-GAS).

CARBON TETRACHLORIDE is a colourless liquid with strong odour, used against hook-worms and other parasites in doses of 30 to 60 minims.

CARBOXYHÆMOGLOBINÆMIA is the term applied to the state of the blood in carbon monoxide poisoning, in which this gas combines with the hæmoglobin, displacing oxygen from it.

CARBROMAL is a white powder with soporific action, also known as uradal and adalin, given in doses of 5 to 15 grains.

CARBUNCLE (*carbunculus*, a small coal) is a term used in two senses. In its proper sense it means a mass formed by an aggregation of boils. (*See* BOIL.) Formerly the word was also used as a synonym for anthrax. (*See* ANTHRAX.)

CARCINOMA (καρκίνωμα, a gnawing sore) is another name for cancer.

CARDAMOMS, TINCTURE OF, is a bright red fluid, prepared from the seeds of *Elettaria repens*, useful to relieve spasm and flatulence, and much used to colour medicines.

CARDIA (καρδία, the heart) is a term applied to the upper opening of the stomach which lies immediately behind the heart.

CARDIAC DISEASE (*see* HEART).

CARDIAZOL is a synthetic organic drug, $(CH_2)_5CN_4$, or pentamethylenetetrazol, introduced as a heart stimulant and now largely used to produce convulsions in the insane, especially those with mental depression, and apparently with good results. The *British Pharmacopœia* name for cardiazol is LEPTAZOL.

CARDIOLOGY is the term applied to that branch of medical science devoted to the study of the diseases of the heart.

CARDIOSPASM means the spasmodic contraction of the muscle surrounding the opening of the œsophagus into the stomach: also termed ACHALASIA OF THE CARDIA.

CARIES (*caries*, decay) is a process of gradual decay in bones, analogous to ulceration in the soft tissues. (*See* BONE, DISEASES OF, *and* TEETH.)

CARLSBAD SALT is the salt derived from Carlsbad water with aperient properties. An artificial Carlsbad salt can be prepared by taking sodium sulphate 22 parts, potassium sulphate 1 part, sodium chloride 9 parts, sodium bicarbonate 18 parts, and mixing. If 53 grs. of the salt be added to 1 pint of water, a fluid closely resembling the natural Carlsbad water is obtained.

CARMINATIVES (*carmen*, a charm) are remedies which relieve griping and expel flatulence. (*See* ANTISPASMODICS.)

CAROTENE is a colouring matter of carrots, other plants, butter, and yolk of egg, and is the precursor of Vitamin A, which is formed from carotene in the liver. (*See* VITAMIN.)

CARPUS is the Latin term for the wrist, composed of eight small bones firmly joined together with ligaments, but capable of a certain amount of sliding movement over one another.

CARREL-DAKIN TREATMENT, CARREL-DAKIN FLUID (*see* HYPOCHLOROUS ACID).

CARRIERS OF DISEASE (*see* INFECTION).

CARRON OIL is a creamy fluid used for dressing burns. It is named from iron-works at Carron in Scotland, where it was first used as a mixture of linseed oil and lime-water in equal parts.

CARTILAGE is a hard but pliant substance forming parts of the skeleton, *e.g.* the cartilages of the ribs, of the larynx, and of the ears. Microscopically, cartilage is found to consist of cells

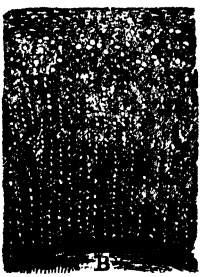


FIG. 99.—Vertical section through the articular cartilage covering the end of a bone *B*. The cells in the deeper part are seen arranged in rows. (Turner's *Anatomy*.)

arranged in twos or in rows, and embedded in a ground-glass-like material devoid of blood-vessels and nerves. The end of every long bone has a smooth layer of cartilage on it where it forms a joint with other bones (articular cartilage), and in young persons up to about the age of sixteen there is a plate of cartilage (epiphyseal cartilage) running right across the bone about half an inch from each end. The latter, by constantly thickening and changing into bone causes the increase in length of the bone. (*See* BONES.) In some

situations there is found a combination of cartilage and fibrous tissue, as in the discs between the vertebræ of the spine. This fibro-cartilage combines the pliability of fibrous tissue with the elasticity of cartilage. The bones of fishes are mostly formed of cartilage. Cartilage when boiled for a long time yields a substance like gelatine. For cartilages of the knee, see KNEE.

CARUNCLE is the name applied to any small fleshy eminence whether normal or abnormal.

CASCARA SAGRADA is the bark derived from *Rhamnus purshiana*, or *Rhamnus frangula*, from which a liquid and a solid extract of powerful purgative action are prepared. It is one of the most useful remedies for habitual constipation, owing to its mild action. The full dose for one administration is a teaspoonful of the fluid extract or about 4 grains of the solid. But it is best taken in small doses of 5 or 10 drops of the fluid extract after each meal, or night and morning; gradually this may be decreased and finally left off, the bowels continuing regular in action. The elixir of cascara is a pleasanter preparation, of which the dose is ½ to 1 teaspoonful, or concentrated fluid extract may be taken in capsules.

CASCARILLA is an aromatic bitter tonic derived from the bark of *Croton eluteria*. (*See* BITTERS.) The dose of the infusion of cascarilla is a tablespoonful or more, and of the tincture a teaspoonful. The dry bark has been used as a substitute for tobacco during attempts to break off the habit of smoking.

CASEATION (*caseus*, cheese) is a process which takes place in the tissues in tuberculosis and some other chronic diseases. The central part of a diseased area, instead of changing into pus and so forming an abscess, changes to a firm cheese-like mass which may next be absorbed or may be converted into calcareous deposit and fibrous tissue, and so healing result with the formation of a scar.

CASEIN is that part of milk which forms cheese or curds. It is produced by the union of a substance, 'caseinogen', dissolved in the milk, with lime salts also dissolved in the milk, the union being produced by the action of rennin, a ferment from the stomach of the calf. The same change occurs in the human stomach as the first step in the digestion of milk, and therefore when milk is vomited curdled it merely shows that digestion has begun.

CASSIA is a dried pulp obtained from the pods of *Cassia fistula*, which is used as a mild aperient.

CASTOREUM is a strong-smelling, brownish substance obtained from the beaver, *Castor fiber*. It is an antispasmodic, and is used in the treatment of colic, hysteria, etc., in doses of 10 to 30 grs.

CASTOR OIL is a thick colourless oil pressed from the seeds of *Ricinus communis*, the castor-oil plant. Owing to its general action over the whole intestine it is perhaps the best purgative for a single administration, though, in consequence of the fact that its action is often followed by slight constipation, it is unsuitable for frequently repeated use.

The dose for an adult is from one teaspoonful to two tablespoonfuls. To a child one year old a teaspoonful may be given. The cup in which it is given should be scalded out with hot water, of which a little remains in the bottom; the oil is next poured in, and upon it a little brandy or whisky. The oil may be then swallowed without leaving much taste behind. Lemon juice also helps to remove the taste.

CASTRATION (*castratio*) is the term applied to an operation for removal of the testicle or ovary.

CASTS of hollow organs are found in various diseases. Membranous casts of the air passages are found in diphtheria and in a form of bronchitis, and are sometimes coughed up entire. Casts of the interior of the bowels are passed in cases of mucous colitis associated with constipation, and casts of the microscopic tubules in the kidneys passed in the urine form one of the surest signs of Bright's disease.

CATALEPSY (from κατάληψις, a seizure) is a term applied to a nervous affection characterised by the sudden suspension of sensation and volition, accompanied with a peculiar rigidity of the whole or of certain muscles of the

body. The subjects of catalepsy are in most instances females of highly nervous or hysterical temperament. The exciting cause of an attack is usually mental emotion operating either suddenly, as in the case of a fright, or more gradually in the way of prolonged depression. Sometimes the typical features of the disease are exhibited in a state of complete insensibility, together with a statue-like appearance of the body, which will retain any attitude it may be made to assume during the continuance of the attack. In this condition the whole organic and vital functions appear to be reduced to the lowest possible limit consistent with life, and to such a degree as to simulate actual death. The attack may be of short duration, passing off within a few minutes. It may, however, last for many hours, and in rare instances persist for several days; and it is conceivable that in such cases the appearances presented might be mistaken for real death, as is alleged to have occasionally happened. Catalepsy is sometimes associated with epilepsy and with grave forms of mental disease. From what has been stated it follows that the successful treatment of such a disease as catalepsy must depend upon the due recognition of both its corporeal and mental relations. (*See* ECSTASY, HYSTERIA, SLEEP.)

CATAMENIA (καταμήνια) is another term for menstruation.

CATAPHORESIS (καταφορέω, I carry down) is the term applied to a method of treatment by introduction of medicine through the unbroken skin by means of an electric current. (*See* IONIC TREATMENT.)

CATAPLASM (κατάπλασμα) is another name for poultice.

CATAPLEXY is the term applied to a condition in which the patient has a sudden attack of weakness and falls to the ground, where he remains immobile, speechless, but fully conscious. (*See also* NARCOLEPSY.)

CATARACT (*cataracta*, a waterfall or portcullis) is an opacity of the crystalline lens of the eye more or less completely obscuring vision.

Causes and Varieties.—The most common form is *senile cataract*, which begins about the age of fifty in eyes which may have been perfectly healthy. Contrary to what is generally supposed, heredity has very little to do with its causation. In every eye, the lens from childhood onward slowly hardens and loses its power of focusing for near objects, and in the cataractous eye there is a special hardening and rapid shrinking at the centre of the lens, which leads to splitting up and gradual disintegration of the lens, with consequent loss of transparency. Senile cataract then has nothing to do with loss of general health, or with disease of the rest of the eye. *Cataract in children* may be found at birth, and there may or may not be other disease of the eye, so that the result of operation is not so promising. *Diabetic cataract* appears sometimes in persons suffering from diabetes. It is quite an ordinary cataract, and yields good results on operation, but, like all operations on diabetic persons, its cure has risks of its own. *Black cataract* is one in which the lens is black in colour from blood pigment. The result of operation is unpromising, because there is often disease of other parts of the eye which has destroyed vision. *Partial cataracts* of various forms occur, obscuring vision in one direction but not requiring operation. *Posterior polar cataract* is one at the back of the lens, and is a rare form which is important because it follows disease in the back of the eye, and, though there is impairment of vision, this is not due to the cataract nor cured by its removal. It comes on in fairly young persons. *Cataract from injury* (*traumatic cataract*) is caused by almost any wound of the lens, and sometimes by severe blows on the eye.

Symptoms.—The first thing noticed is the appearance of motes in the vision, not floating, like those seen by almost every healthy eye against a white background, but stationary.

Bright objects are seen multiplied, especially bright lights at a distance in the dark. A moderate degree of short-sightedness may come on, which is relieved for a time by spectacles. Gradually increasing blindness is the most apparent symptom, and in the early stages the person may be less blind in the dusk than in bright light,

because, the centre only of the lens being affected, a clear part round the edge admits the rays of light when the pupil, *i.e.* the opening in the iris, dilates, as it does in dull light.

Finally, when the cataract is well advanced, it becomes visible to by-standers as a ground-glass-like mass filling up the pupil.

Treatment.—No medicines or eye-washes or ointments are of any use against cataract. Atropine drops, which dilate the pupil, are much resorted to by quacks, because their use is followed for a time by better vision, for the reason given above. The cataract is unaffected by such applications, and can be removed only by operation. A delay of months or years must often take place after sight begins to fail before the cataract is '*ripe*', *i.e.* before the lens is hardened throughout sufficiently to be completely removed, though many cataracts in old people admit of successful removal by operation even when they are unripe. In all cases the eyes may be freely used so long as it is possible to do so. There is a great variety of operations, but the chief are—(*a*) *extraction* of the lens by a broad opening made near the edge of the clear cornea, removal of a piece of the iris, and finally opening of the capsule of the lens, which is then gently squeezed out; (*b*) extraction of lens and its capsule intact by a similar broad incision, grasping of the front of the capsule with special forceps and gently tearing away of the capsule from its attachments; and (*c*) *discission* or tearing of the capsule of the lens by a needle or needles passed through the cornea, so as to admit the fluid which is found in the front part of the eye filling the space between the cornea and lens, and which dissolves the lens when admitted into its substance. Extraction is done in the great majority of cases, discission is suitable only for the soft cataracts of young persons. The operation is usually done without chloroform, and is very safe and successful even in very old persons, though demanding great skill. After removal of the lens, at least two pairs of spectacles must be used, one for distant vision, and one for reading.

Sometimes after an operation for cataract disappointment is experienced because the sight is not restored. In such cases the retina also is diseased, and though the removal of the cataract admits light to the eye, the defective retina is unable to perceive objects clearly. To avoid this the eyes should be carefully examined by an expert before the cataract becomes sufficiently dense to obscure the back of the eye.

CATARRH (κατά, down; ῥέω, I flow) is a term employed to describe a state of irritation of the mucous membranes, particularly those of the air passages, associated with a copious secretion of mucus. This complaint, so prevalent in damp and cold weather, usually begins as a nasal catarrh or coryza, with a feeling of weight about the forehead and some difficulty in breathing through the nose, increased on lying down. Fits of sneezing, accompanied with a profuse watery discharge from the nostrils and eyes, soon follow, while the sense of smell and to some extent that of taste become considerably impaired. There is usually present some amount of sore throat and of bronchial irritation, causing hoarseness and cough. Sometimes the vocal apparatus becomes so much inflamed (laryngeal catarrh) that temporary loss of voice results. There is always more or less feverishness and discomfort, and frequently an extreme sensitiveness to cold. After two or three days the symptoms begin to abate, the discharge from the nostrils and chest becoming thicker and of purulent character, and producing when dislodged considerable relief to the breathing. On the other hand, the catarrh may assume a more severe aspect and pass into some form of pulmonary inflammation. (*See* BRONCHITIS *and* CHILLS AND COLDS.)

The term catarrh is also applied to describe a state of irritation, accompanied by abnormal secretion of mucus, in the stomach (*see* DYSPEPSIA), in the bowels (*see* DIARRHŒA *and* INTESTINE, DISEASES OF), in the bladder (*see* Cystitis *under* BLADDER DISEASES), and in other mucous surfaces.

CATATONIA (κατά, according to; τόνος, bracing) is a term applied to a symptom of mental disease in which the patient remains rigidly in the same position, behaving very much like a statue. Catatonia minor is a term ap-

plied to the group of symptoms occurring in the mental disease dementia precox, in which the patient shows peculiar mannerisms, continuing to repeat the same words or actions.

CATECHU is a reddish extract from the leaves of the *Uncaria gambier*, containing much tannin and acting as a powerful astringent. Compound catechu powder, containing catechu, kino, rhatany, cinnamon and nutmeg, and tincture of catechu are given in diarrhœa, and catechu lozenges are useful in relaxed sore throat.

CATGUT is used in surgery for tying cut arteries and stitching wounds. It is made from the fibrous coat of the intestines of animals, especially of the sheep, requires very careful purification, and in the tissues is gradually absorbed, as it is itself an animal substance. Chromic catgut is sterilised and impregnated with chromic oxide which hardens it and delays its absorption; formalin catgut is similarly hardened by boiling in alcohol and formalin; iodine catgut is similarly treated with a strong solution of iodine; and silverised catgut is impregnated with silver to give it resisting qualities.

CATHARTICS (*καθαρτικόν*) (*see* PURGATIVES) are substances which produce an evacuation of the bowels.

CATHETERS (*καθετήρ*) are tubes used for passing along the 'urethra', the narrow passage from the bladder to the exterior, in order to draw off urine, when for some reason the natural voidance is impossible. The tube is about 14 inches long, open at one end (the outer end) and closed at the other (the point), near which is an oval opening in the side (the eye). Catheters are, in England, graduated according to an arbitrary scale, numbers 6 to 10 being those in most common use.

Varieties.—*Rigid* catheters are generally made of silver, silverised metal, or glass; the greater part is straight, but there is a sweeping curve towards the point. These require for use a considerable knowledge of anatomy, and since great damage may be done by unskilful manipulation they are suited only for a surgeon's use. A rigid catheter may often be passed where a softer one fails, especially where there is a 'stricture', or narrowing of the urethra. *Flexible* catheters are made of linen or silk web covered with an elastic material, or of hard black rubber. They soften in hot water, but are spoiled by boiling. This

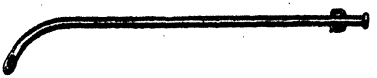


FIG. 100.—Metal catheter.

form (gum-elastic catheter) is that generally used by those elderly persons in whom the prostate gland blocks the outlet from the bladder. *Enamel* catheters are made of fabric thickly coated with composition and may be boiled for sterilisation. These have to a great extent displaced the flexible catheters formerly used. *Soft* catheters are made of red india-rubber. They are used in cases where there is no obstruction to the passage, but where the urine, owing to weakness or paralysis of the bladder, for example, in cases of fractured spine, cannot be passed. They can be easily purified, as they do not spoil by boiling. *Self-retaining* catheters are made of soft rubber with an enlargement near the inner end which expands when the stilet, on which the catheter has been introduced, is removed.

The *Eustachian catheter* is a smaller instrument, of similar shape, but open at both ends. It is used to pass along the floor of the nose into the Eustachian tube, in order to inflate the middle ear with air, or to introduce into it some volatile medicaments.

Use.—Purification is most important, because inflammation of the bladder is very apt to be caused by bacteria introduced on a soiled catheter. Rigid and soft catheters should be boiled each time before use, and then handled as little as possible, and only by perfectly clean hands. Just before introduction the urethral opening is washed and the point of the catheter dipped in an antiseptic lubricant, such as boracic ointment or antiseptic jelly. The flexible catheter is passed straight on without force, the soft catheter introduced by a slight screwing movement. After use the catheter is dipped at once into hot water and then wiped clean of

grease, and a stream of antiseptic lotion is passed through it by means of a syringe. To keep a gum-elastic catheter clean and ready for use it should be suspended in, or laid full length in, a glass vessel containing perchloride of mercury lotion (1 in 4000), which is washed off the catheter immediately before use with hot sterile water. But perchloride of mercury lotion must not touch a metal catheter, which it corrodes. A catheter must be at once discarded when it gets rough or begins to break, otherwise a fragment may remain in the bladder and provide a nucleus round which a stone can form.

CAUL (*see* AMNION).

CAUSTICS and CAUTERIES (*καίω*, I burn) are bodies used to burn diseased tissues, the former by chemical action, the latter by their high temperature.

Varieties.—The chief chemical caustics in use are acetic, lactic, chromic, carbolic, and nitric acids, caustic soda and caustic potash, arsenic in paste, and nitrate of silver or lunar caustic. Of cauteries there are Corrigan's button cautery, the red-hot iron, the galvano-cautery, consisting of a platinum point heated by an electric current, and Paquelin's cautery, which has a hollow metal point kept hot by benzine constantly blown into it. A recently introduced method of cauterisation is that practised by diathermy. (*See* DIATHERMY.)

Uses.—Caustics are used to destroy warts, small tumors, etc. The cautery is used, mildly heated, as a counter-irritant instead of a blister in sciatica, neuralgia, rheumatic pains, etc. (*See* BLISTERS.) The galvano-cautery is much used to reduce inflamed tissues about the nose and throat. The Paquelin's cautery or red-hot iron is much in vogue for removal of small growths, conversion of foul ulcers and poisoned wounds into healthy burns, and operations upon very vascular organs like hæmorrhoids.

CAVERNOUS BREATHING indicates a peculiar quality of the respiratory sounds heard on auscultation over a cavity in the lung.

CAVITY. — There are three great cavities of the body: those of the head, the thorax or chest, and the abdomen. The head and abdomen are each lined by a smooth membrane, which allows of movements of the contained organs, while the thorax has three such membranes enveloping the heart and right and left lungs respectively. Cavities are also produced in various organs by diseases of a destructive type, especially in the lung in pulmonary tuberculosis. (*See* ABSCESS *and* CONSUMPTION.)

CELLS (*cella*, a cell in a honeycomb) are the microscopic particles which build up the tissues, of which they are the smallest structural divisions. The term was originally applied in botany to the hollow particles of which plants are built up, and was extended to include the corresponding structures in

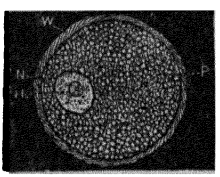


FIG. 101.—Type of a simple cell, the ovum of a sheep. *W*, Cell wall; *P*, protoplasm or yelk; *N*, nucleus; *NL*, nucleolus. (Turner's *Anatomy*.)

animal bodies, though these are seldom hollow.

Every cell consists essentially of a cell-body of soft albuminous material called 'protoplasm', in which lies a kernel or 'nucleus' which seems to direct all the activities of the cell. Within the nucleus may be seen a minute body, the 'nucleolus'; and there may or may not be a 'cell-envelope' around all.

Cells vary much in size, ranging in the human body from $\frac{1}{10000}$ inch to about $\frac{1}{100}$ inch. But the egg of a hen is still a simple cell, though enormously distended by food material.

All animals and plants consist at first of a single 'cell' (the egg-cell, or *ovum*), which begins to develop when fertilised by the sperm-cell derived from the opposite sex. Development begins by a division into two new cells, then into four, and so on till a large mass is formed. These cells then arrange themselves into layers, and form various tubes, rods, and masses which represent in the embryo the organs of the fully developed animal. (*See* FŒTUS.)

When the individual organs have been laid down on a scaffolding of cells, these gradually change in shape and in chemical composition. The cells in the nervous system send out long processes to form the nerves, those in the muscles become long and striped in appearance, and those which form fat become filled with fat droplets which distend the cells. Further, they begin to produce, between one another, the substances which give the various tissues their special character. Thus, in the future bones, some cells deposit lime salts, and others form cartilage; while, in tendons, they produce long white fibres of a gelatinous substance. In some organs the cells change little, thus the liver consists of columns of large cells packed together, while many cells, like the white blood corpuscles, retain their primitive characters almost entire.

Thus it appears that cells are the active agents in forming the body, and they have a similar function in repairing its wear and tear. Tumors, and especially malignant tumors, have a highly cellular structure, the cells being of an embryonic type, or, at best, forming poor imitations of the tissues in which they grow.

CELLULAR TISSUE is an old name for the loose fibrous tissue, which forms, so to speak, packing between the skin and muscles and round the different organs.

CELLULITIS means an inflammation taking place in cellular tissue. (*See* ABSCESS *and* ERYSIPELAS.)

CELLULOSE is a carbohydrate substance forming the skeleton of most plant structures. It is colourless, transparent, insoluble in water and is practically unaffected by digestion. In vegetable foods it therefore adds to the bulk, but it is of no value as a food-stuff. It is found practically in a pure state in cotton-wool.

CENSOR is a term applied to the mental influence which prevents certain subconscious thoughts and wishes from coming into consciousness unless they are disguised so as to be unrecognisable.

CENTRE is a term applied to a collection of nerve cells which give off nerve fibres and control some particular function, *e.g.* the speech centre and vision centre in the brain.

CERATE (*cera*, wax) is a medicinal preparation, intended for external application, made with a basis consisting of wax in whole or in part which can be spread on the skin without melting, *e.g.* camphor cerate, cantharides cerate.

CERCOMONAS is the term applied to a genus of minute protozoan animals found in the intestine and other cavities of man and animals. One form is said to be responsible for occasional cases of diarrhœa.

CEREAL (*cerealis*) is the term applied to any plant of the nature of grass bearing an edible seed, such as wheat and oats. Cereal foods consist mainly of carbohydrates. (*See* FARINACEOUS FOODS.)

CEREBELLUM and CEREBRUM (*see* BRAIN).

CEREBRO-SPINAL FEVER is another name for cerebro-spinal meningitis. (*See under* MENINGITIS.)

CEREBRO-SPINAL FLUID is the fluid within the ventricles of the brain and bathing its surface and that of the spinal cord. It is normally under a pressure of 60 to 150 mm. of water and contains 0 to 5 lymphocytes per c.mm. In each 100 c.c. of cerebrospinal fluid there are normally between 10 to 20 mg. of protein (mostly albumin), 50 to 80 mg. of glucose, and 725 to 750 mg. of chlorides.

CERECLOTH means linen or cotton cloth impregnated with wax and made antiseptic for use in dressing wounds.

CEREVISIA is the Latin name for yeast.

CERUMEN is the Latin name for the wax-like secretion found in the external ear.

CERVICAL (*cervicalis*) means anything pertaining to the neck, or to the neck of the womb.

CERVICITIS means inflammation of the cervix uteri or neck of the womb.

CERVIX UTERI is the neck of the womb or uterus and is placed partly above and partly within the vagina.

CETRARIA, or ICELAND MOSS, is a substance much used in the form of decoctions, jellies or lozenges in irritable states of the mouth and throat.

CEVITAMIC ACID is the American term for vitamin C or ascorbic acid.

CHAFING OF THE SKIN occurs in infants at the natural folds, *e.g.* groins, armpits, elbows, where two moist surfaces constantly rub one another; in stout elderly people at similar positions; and generally where the clothes cause friction or pressure, as in the armpits or on the feet of those who walk great distances.

To prevent chafing the folds the skin should be kept specially clean by washing with warm water and superfatted soap, carefully dried, and then dusted with fuller's earth or any dusting-powder, such as a mixture of starch, zinc oxide, and subnitrate of bismuth in equal parts.

CHALAZION (χαλάζιον) is a small swelling of the eyelid, formed by the distension of a gland with secretion.

CHALICOSIS (χάλιξ, gravel) is a term applied to a disorder of the lungs found amongst stone-cutters, and due to the inhalation of fine particles of stone.

CHALK (*see* CRETA *and* LIME).

CHALK-STONES (*see* GOUT).

CHALONE (χαλάω, I loosen), or *colyone*, is an organic substance formed by the cells of one organ, which after being absorbed into the circulation produces an effect upon the cells of some other organ at a distance to inhibit or prevent them from forming their proper secretion.

CHALYBEATE tonics or waters (χάλυψ, steel) are those containing salts of iron. (*See* IRON.)

CHAMOMILE TEA is a 'bitter' made by infusing half an ounce of dried chamomile flowers in half a pint of boiling water for fifteen minutes and then straining. It is used cold in wineglassful doses.

CHANCRE (French word) means the primary lesion of syphilis.

CHANCROID means a soft or non-syphilitic venereal sore.

CHANGE OF LIFE (*see* CLIMACTERIC *and* MENSTRUATION).

CHAPPED HANDS (*see* CHILBLAINS).

CHAPPED LIPS (*see* LIPS).

CHAPPED NIPPLES (*see* BREASTS).

CHARCOAL, or CARBON, is obtainable in two forms, bone-charcoal and wood-charcoal. They are made by burning bones or wood without access of air, the bone-charcoal being afterwards purified from bone-earth by washing with hydrochloric acid. Bone-charcoal, which has much finer pores than wood-charcoal, has the same properties, and these in addition that it destroys vegetable dyes, and so is a bleacher, and that it destroys alkaloidal poisons, and so may be given as an antidote to morphia, strychnine, etc. (half an ounce of charcoal neutralising about 1 grain of poison). The mode of action of charcoal is that it is porous, and so absorbs discharges, etc., with which it comes in contact, and that, in its dry state, it has the power of condensing in its pores large quantities of oxygen, which combines with organic substances, like evil-smelling gases, to form simpler, innocuous substances.

Uses.—Dry charcoal forms a good application in poultices to foul ulcers, the charcoal being sprinkled dry on the surface of a linseed poultice. Internally it is given in 20- to 60-grain doses by cachets, or in charcoal biscuits, to relieve dyspepsia associated with flatulence, and must be taken dry.

CHARCOT-LEYDEN CRYSTALS are sharp crystals found in the sputum of those suffering from asthma, and of those affected by some blood diseases.

CHARCOT'S DISEASE is the name applied to a swelling and disorganisation of the joints which comes on late in locomotor ataxia.

CHARPIE is linen waste, formerly used to absorb discharges, but now replaced by absorbent cotton-wool.

CHAULMOOGRA OIL is a volatile oil obtained from the seeds of an Asiatic shrub, *Gynocardia odorata*, and used in cases of leprosy. The oil is both applied externally and given internally or by intravenous injection mixed with olive oil. The esters of the

fatty acids derived from this and similar oils have a destructive action upon the bacilli of leprosy and tuberculosis, and have been used with success in the treatment of leprosy.

CHEILOSIS is the term applied to an eczematous condition of the lips, especially at the angles of the mouth, and believed to be due to deficiency in the diet of one of vitamins in the vitamin B2 complex — probably riboflavin. ANGULAR STOMATITIS and PERLÈCHE are other terms used to describe the condition, which may be associated with a red, sore tongue ; fine desquamation at the junction of nose and lip, just inside the nose, and in the ears ; eczema of the scrotum and perineum.

CHEIROPOMPHOLYX is the term applied to a disease of the skin in which little blisters filled with clear fluid suddenly appear on the hands and sometimes on the feet.

CHELOID (*χηλή*, a claw) is a peculiar sort of tumor formation starting in scars, especially in those of burns. It consists of an overgrowth of scar tissue, and gets its name from its claw-like offshoots, which pucker up the surrounding skin. It is found especially over parts where the skin is stretched, like the front of the chest, and is sometimes painful, sometimes painless. Often these growths disappear spontaneously after a period of activity. Massage, application of radium, or electrolysis sometimes aids their disappearance.

CHELSEA PENSIONER (*see* CONFECTIONS).

CHEMOSIS (*χήμη*, a hole) means swelling of the conjunctival membrane, that covers the white of the eye, leaving the cornea depressed. (*See* EYE.)

CHEMOTAXIS (*χημεία*, chemistry ; *τάξις*, arrangement) means the property possessed by certain cells of attracting or repelling other cells.

CHEMOTHERAPY means the treatment of disease by chemical substances, and since 1935 has become especially to denote the treatment of various bacterial infections by sulphanilamide, sulphapyridine, and related chemical compounds.

A further highly important development was made known in 1940, through the brilliant research of Professor Warrington Yorke and his British colleagues—namely, the chemotherapy of TRYPANOSOME infections. The new drugs—the aromatic diamidines—have already been successfully tried out on human cases of trypanosomiasis, or sleeping sickness. The most active of the new drugs is diamidino-stilbene.

The latest addition to the 'new chemotherapy' is penicillin (*q.v.*), an extract from the common mould *Penicillium notatum*.

CHENOPODIUM OIL, distilled from American wormseed, is used against round-worms and hook-worms in doses of 3 to 15 minims.

CHEST, or THORAX, is the upper part of the trunk. It is enclosed by the breast-bone and rib-cartilages in front, by the twelve ribs at each side, and

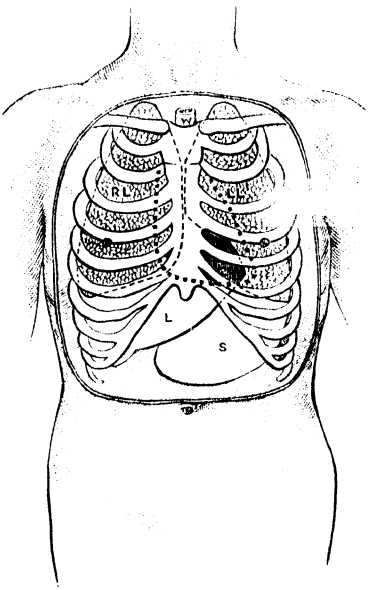


FIG. 102.—Chest with the skin and muscles removed from the front, showing the position of heart and lungs. *H*, Heart ; *LL*, left lung ; *RL*, right lung ; *W*, windpipe ; *L*, liver ; *S*, stomach.

by the hinder parts of these along with the spinal column behind. Above, it is continued by an opening a few inches wide, through which pass the windpipe, gullet, and large blood-vessels, into the root of the neck ; while, below, its

cavity is separated from that of the abdomen by a thin dome-shaped plate of muscle, the diaphragm or midriff. Between each pair of ribs lie two thin muscular layers, the intercostal muscles, which fill up the spaces between the ribs, and move the chest wall in respiration. Its outlines are further covered and moulded behind by four layers of muscles, sometimes several inches thick, and by the shoulder-blade with its muscles, and in front by the two pectoral muscles which pass from the ribs to the upper arm. Further, there is a more or less plentiful layer of fat beneath the skin, and in this fat lie the breasts, extending in the female from the second rib down to the seventh.

Contents.—The chest contains the lungs, one at each side, with the end of the wind'pipe, which divides into right and left bronchial tubes, to the two lungs; the heart in the middle and projecting on the left almost to the nipple, with the great vessels which carry blood from and to it; the gullet, which passes down on the left side of the spinal column to enter the abdomen through an opening in the diaphragm; the thoracic duct of the absorbent system, which runs up to enter a vein in the neck; and various important nerves which control the contained organs. Each lung is enclosed in a smooth, double membrane, the pleura (*see* LUNGS), and the heart in a similar membrane, the pericardium.

CHEST, DEFORMITIES OF.—The healthy chest is gently rounded all over, its contour being still more rounded in women by the breasts, and in transverse outline it should present an oval shape slightly flattened behind and having a proportion of about 10 to 7·5 between its side-to-side and front-to-back measurements. The angle at the lower end of the breast-bone formed between the edges of the rib cartilages of the two sides should be about four-fifths of a right angle. An interval of about two inches should exist between the twelfth rib and the haunch-bone. The circumference varies from 33 inches for a man of 5 feet in height to about 40 inches for a man of 6 feet.

Long chest is one in which the shoulders slope downwards, the ribs incline downwards as they come forwards more than they should do, the lower ribs touch or almost touch the haunch-bones, and the circumference is small. Further, the neck is long, the throat prominent, and the shoulder-blades stand out behind, the chest for this reason being also called the winged or 'alar' chest. This form predisposes to consumption and other lung diseases, probably because the lungs are never properly expanded, but this long chest

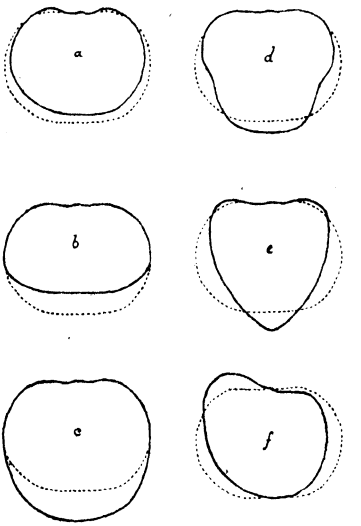


FIG. 103.—Outline of various forms of chest in transverse section, the dotted line in each case showing the normal shape. *a*, Long chest; *b*, flat chest; *c*, barrel-shaped; *d*, rickety chest; *e*, pigeon breast; *f*, bulged chest in curvature of the spine.

can be much improved and the circumference rapidly increased by proper exercises.

Flat chest is often a consequence of lung diseases, and flatness is sometimes found along with too great length. In this form, the ribs and their cartilages grow too straight in front, so that the chest loses in fullness. This form is partly curable in youth by exercises.

Barrel chest is one in which the ribs are too horizontal, the shoulders raised, and the chest short. It is the opposite in every respect of the 'long chest'. The curves of the chest resemble those of a barrel and the ribs the hoops. This form is due to too great expansion of the lungs, especially in the disease

called emphysema. The chest being blown out almost to its full capacity at expiration, inspiration is made very laborious.

Rickety chest is due to rickets in early life, and usually the head and other bones are also affected. (*See* RICKETS.) There is a hollow down each side owing to the yielding of the soft growing ribs in early life under the pressure of the atmosphere. There is, however, a protrusion of the front of the chest, so that the lungs are not pressed on, nor specially liable to disease. Frequently the chest shows, down each side, a row of nodules placed at the junction of the ribs with their cartilages, and known as the 'rickety rosary'. Sometimes the lower part of the chest is much bulged out from moulding over the liver and other abdominal organs.

Pigeon breast is one in which the cross-section of the chest becomes triangular, the breast-bone forming a sort of keel in front, like that in the pigeon's breast. It is due to the ribs becoming straightened so as to push the breast-bone straight forwards, and is caused by some obstacle to the entrance of air in early life, such as enlarged tonsils and adenoids in the throat.

Bulging of the chest may be due to curvature of the spine, which makes a projection behind, and consequently, the chest being shortened, causes the breast-bone to bend on itself and project in front. When the spine twists to one side, that side becomes flattened, the other side bulging and the contained organs being pushed into it.

Hollowing of the chest is found in many conditions. In consumption, when the lung becomes chronically solidified in its upper part, and later probably develops a cavity, it shrinks, and the chest wall to some extent falls in beneath the collar-bone. In pleurisy of long standing the lung is apt to collapse, *i.e.* undergo a shrinking process and lose its air spaces, so that the whole chest wall of that side sinks inwards under atmospheric pressure. In shoemakers and others who, in the course of employment, press constantly against a tool, this produces a hollow, and the deep depression at the lower end of the chest is a well-known result of using the shoemaker's last.

CHEST DEVELOPMENT is of great practical importance in view of the fact that persons with 'long' and 'flat' chests undoubtedly suffer more often from serious lung disease than those who have good chest capacity. The art of full breathing also confers a feeling of exhilaration upon those who practise it, and adds ease to the carriage of the body. Many persons, debarred from entering one of the public services through having too small a chest circumference, owe this largely to a faulty manner of carrying the chest, the ribs being allowed to droop and the shoulders to slope downwards and forwards, although one or two inches might be added to the girth in a few days or weeks by proper exercises. (*See* CHEST, DEFORMITIES OF.) The muscles which come into action in taking a breath fall into two classes: (1) the muscles of ordinary inspiration, including the diaphragm, and the intercostal muscles, which suspend one rib from that next above it; and (2) the muscles of forced inspiration, including most of the muscles of the neck, the shoulder, and the abdomen, which come into play in taking an extra deep breath.

Now the lungs rise a distance of half an inch to one and a half inches above the collar-bone into the root of the neck, and this portion is little expanded except in forced breathing. It is just here that consumption is liable to make its first appearance, and though cause and effect are not quite clear in this matter, it is beyond doubt that the deficient expansion, and consequently sluggish circulation, play an important part.

Although violent exercise like football has an indirect influence in expanding the chest by necessitating deep breathing, other forms of athletics add mainly to the size and strength of the muscles on the chest without increasing its capacity. Probably the only exercise which attains the latter thoroughly is forced breathing.

Every one, whether of athletic build or not, may practise this by the following three movements, recommended by Checkley. These should be carried out night and morning, with the upper part of the body bare, or covered only by a loose or elastic undervest:

(*a*) The person standing erect holds

the hands in front of him, backs upwards, on a level with his hips. As he begins to breathe he raises them till,

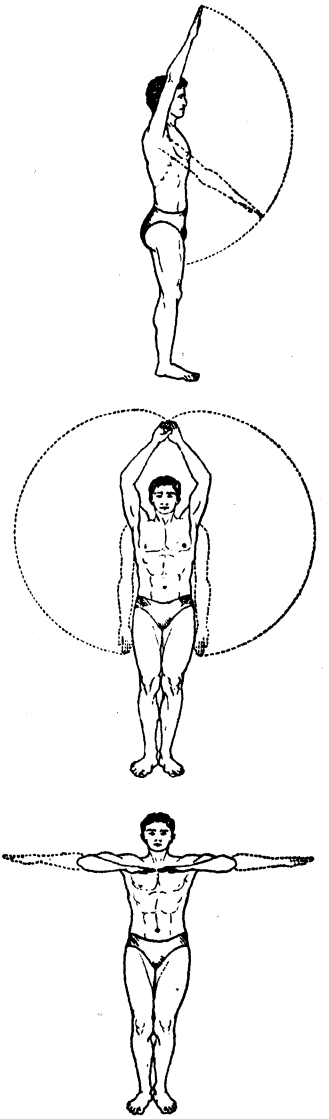


FIG. 104.—Movements for expansion of the chest. (After Checkley.)

at the end of an inspiration, they are straight above his head. As he breathes out he lets them slowly fall to their former position. This he repeats with each breath, making the breaths as deep as possible.

(*b*) Standing with the hands by the sides, palms forwards, he raises them away from the sides as he breathes in, to the same position as in the first movement, and lets them descend slowly outwards as he breathes out.

(*c*) Standing with elbows bent, the thumbs pressed against the upper part of the chest, and the finger-tips of opposite hands touching, he carries the arms outwards and as far backwards as possible, keeping them always on a level with the shoulders, as he draws a deep breath, and brings them forwards again as he breathes out.

In performing these movements a light pair of dumb-bells (not exceeding 2 pounds each) may, if desired, be used, and the movements will then be a better exercise for the arm muscles.

It is of the utmost importance that the movements should be slow. Not quicker than six to the minute, and preferably about three per minute, and each movement should be a conscious effort, not made automatically. If each movement be performed twenty times a fair amount of exercise will be got in about a quarter of an hour.

Further, the person should cultivate the habit of breathing deeply at all times, and of standing, sitting, or walking with the shoulders well braced back, so as to take the weight of the shoulder blade and upper limb off the expansile part of the chest.

CHEST DISEASES (*see* LUNGS, DISEASES OF; HEART DISEASES, ANEURYSM, ANGINA PECTORIS, PLEURISY, PNEUMONIA, BRONCHITIS, CONSUMPTION).

Chest diseases are of special importance, because the lungs and heart are perhaps the most important organs in the body, and are especially difficult to treat, as these are the only organs which cannot rest for a few minutes without death becoming imminent. Further, they are so closely placed and so intimately associated by the circulation of the blood, that when one suffers from disease, either acute or chronic, the other is rarely unaffected.

Symptoms.—Owing to the rigid

nature of the chest wall, changes in the enclosed organs rarely become visible to the eye. *Pain* is a very important symptom. Very severe pain may, it is true, be caused by muscular rheumatism in the chest wall (the condition called pleurodynia) or by neuralgia, but when of a stabbing character and felt at the end of every breath it suggests pleurisy as a cause. Pain about the heart may be caused by indigestion, but if severe, and especially if brought on by exertion, seldom is found without some slight or serious heart disease. An agonising spasm of the heart, often coupled with a feeling of impending death, is known as angina pectoris. (*See* ANGINA PECTORIS.) Severe pain, especially when it extends down the left arm, may be caused by an aneurysm. (*See* ANEURYSM.) *Expectoration* of blood may occur both in heart and in lung disease, and various other characters are noteworthy in the sputum. (*See* EXPECTORATION.) *Breathlessness* is an important sign of lung and heart diseases. (*See* BREATHLESSNESS.) *Other organs* are prone to be affected by disease of either heart or lungs; thus in consumption the digestive system sometimes gives the first sign of ill-health, and in heart disease congestion of the liver, or swelling of the feet, may be for long the only trouble. *Cough* is one of the best-known symptoms of lung mischief, either of consumption or of bronchitis, but it may be due to irritation of other parts of the respiratory system, or even of the stomach.

Treatment.—Rest is the most important factor in the treatment of all chest conditions, because, when the body is quiet, the circulation of the blood becomes slower, the rate of pulse and respiration slackens, and so the heart and lungs have a partial rest. Pain is soothed by the application of fomentations, poultices, ice-bags, or counter-irritants to the chest. Fresh air is specially necessary in lung disease. (*See* CONSUMPTION.) Various drugs called expectorants, which are excreted in the breath, are given to act upon the lungs, or similar drugs are inhaled. (*See* EXPECTORANTS *and* INHALATIONS.) Oxygen is much used both in affections of the heart and of the lungs. In the case of the heart, there are several drugs by which the action of this organ can be slowed, or quickened, or made more regular, for example, digitalis, strophanthus, atropine, strychnine.

CHEST INJURIES.—Injuries due to moderate violence are not usually serious, resulting generally in muscular bruises or in fractured ribs. (*See* FRACTURES.) If the ribs do not penetrate the lung, union and recovery are rapid, but, if the lung be injured, various complications, such as emphysema, effusion of blood and entrance of air into the pleural cavity, abscess in the lung, traumatic pneumonia, etc., may ensue. Penetrating wounds of the lungs, as by a bullet or stab, are apt to lead to similar complications, but do not necessarily produce serious effects unless a large vessel be severed. Simple fractures of ribs may be serious in old people, and bronchitis often follows their occurrence. Wounds of the heart are generally at once fatal from hæmorrhage, but this organ has been so seriously injured as even to require stitching, and yet in several cases recovery has ensued.

CHEYNE-STOKES' BREATHING is a type of breathing seen in some serious nervous affections and also in the case of persons very much weakened by other diseases. When well marked it is a sign that death is impending. The breathing gets very faint for a short time, then gradually deepens till full expirations are taken for a few seconds, and then gradually dies away to another quiet period, again increasing in depth after a few seconds and so on in cycles.

CHICKEN-POX, or VARICELLA, is an acute contagious disease of children, characterised by feverishness and an eruption on the skin.

Causes.—The disease occurs in epidemics affecting especially children under the age of ten years. It has no connection with smallpox, to which it bears a superficial resemblance. Although one person seldom suffers twice from chicken-pox, yet chicken-pox gives no protection from smallpox or *vice versa*. Vaccination also gives no protection against chicken-pox. No special microbe of the disease has been dis-

covered, but the condition is an extremely infectious one from child to child.

Symptoms.—There is an incubation period of twelve to twenty days after infection, and then the child becomes feverish or has a slight shivering, or may feel more severely ill with vomiting and pains in the back and legs. Almost at the same time, and at all events within twenty-four hours, an eruption consisting of red pimples which quickly change into vesicles filled with clear fluid appears on the back and chest, sometimes about the forehead, and less frequently on the limbs. These vesicles during the second day may show a change of their contents to turbid, purulent fluid and within a day or two they burst, or, at all events, shrivel up and become covered with brownish crusts. An important point of difference between this irritation and that of smallpox is that these vesicles keep on appearing for several days, so that vesicles are seen at all stages of development, whilst in those of smallpox all parts of the rash are at the same stage at one time. In a slight case there may be only eight or ten of these vesicles, or there may be several hundreds. The small crusts have all dried up and fallen off in little more than a week and recovery is almost always complete.

Treatment.—The child must be isolated from other children until the last crust has disappeared, and may then be washed and go about as usual. A patient need not be confined to bed unless the temperature is raised, but he should be kept in one room. If the rash appear on the face, care must be taken to prevent scratching or pock marks may remain. A lotion of calamine or of carbolic acid, or a simple dusting powder, relieves the itchiness. No other treatment beyond isolation is required. If children have been exposed to the risk of infection, it is usual to isolate them for a period of twenty days before allowing them to return to school.

CHICORY (*see* ADULTERATION OF FOOD).

CHIGOE (*see* PARASITES).

CHILBLAIN, or ERYTHEMA PERNIO, is an inflamed condition of the skin of hands or feet, or even of the ears, occurring in persons of defective circulation and in those of poor health.

Causes.—Chilblains are found especially in weakly children in winter time. Under-feeding, poor clothing, and a defective circulation favour their appearance. Persons who suffer from them have habitually cold and numb hands and feet, and are subject to chills and colds in the head. In these persons, tight boots often are sufficient to bring on chilblains of the feet, and warming the hands at the fire when they are cold produces chilblains on the fingers, the skin becoming engorged with blood in consequence of the irritation or warmth, and later losing its vitality.

Symptoms.—The state of the general health is usually feeble in affected persons. There are three stages in the development of a chilblain :

(1) The skin, usually of the little toe, the outer side of the foot, or the inner side of the hand, becomes purple and very itchy.

(2) Blebs, containing a thin yellow fluid, form on this discoloured area, which becomes very painful.

(3) These blebs break and leave behind an ulcerated surface very difficult to heal.

True chilblains should not be confounded with a cracked or 'chapped' condition of the hands, feet, lips, or ears brought on by cold wind, or washing with hot water during cold weather in persons of robust constitution but delicate skin.

Treatment. — Preventive treatment is the best. Good food, tonics, and warm clothing improve the general condition upon which chilblains depend. Regular exercise, and a cold or modified cold bath every day (*see* BATHS) improve the circulation. The person liable to chilblains should wear wide boots and thick woollen socks in winter, and, before going into the open air, should always pull on a pair of woollen gloves. Garters and constrictions round the wrist or ankle, which interfere with the circulation, should be abolished, and india-rubber shoes should not be worn. If the hands and feet are cold they should be rubbed for warmth, not held before the fire. In the first stage the chilblain may be rubbed with hazeline

snow or cream, or painted with tincture of iodine. Voyagers to the Arctic regions rub the part with a mixture of whisky and soap, which is very effective. In the second and third stages some simple ointment like boracic, and a dressing of wool are best, or the part may be painted with compound tincture of benzoin. Lactate of calcium, taken internally, is also useful.

CHILD-BED (*see* LABOUR).

CHILD-CROWING is another name for laryngismus. (*See* LARYNGISMUS.)

CHILDREN, FEEDING OF (*see* INFANT FEEDING).

CHILDREN, PECULIARITIES OF.—The fact that children cannot put into words, or cannot correctly estimate the nature of troubles and pains from which they suffer, coupled with the great importance of remedying as early in life as possible any physical or mental defect, or any bad habit, makes the observation of their peculiarities of great importance.

Activity.—For some weeks after an infant is born the only signs of intelligence, apart from the performance of the merely animal functions, consist in *constant movements* of the lips, head, and limbs. The fingers are constantly opened and shut, the legs drawn up and down, and the lips pouted, while the child is awake; and the vigour of these movements gives a good idea of the vitality of the child. At about the third or fourth month the child should begin to develop the power of attention, as shown by its staring fixedly at any bright or moving object presented to it and ceasing other movements while its attention is so engaged. During the sixth month teething, with the various disorders of the alimentary canal, skin, etc., incidental to it, begins. A delay in teething is one of the signs of rickets. (*See* TEETH.) About the end of the first year of life the child should be gaining the power to stand and walk. (*See* GAIT.)

Crying in early childhood is a manifestation of either pain, or hunger, or discomfort. The most common pain is that known as 'gripes' and associated with indigestion, in which the cry is of a wailing character, with a note of ill-temper. (*See* COLIC.) In head pain the cry is of a sharp, piercing nature. In older children frowning is a common symptom of headache, especially when it is due to eye-strain. (*See* VISION, DISORDERS OF.)

Temperature is not much of a guide to disease in children, because the temperature-regulating mechanism is easily thrown out of gear.

Fullness under the eyes may be a symptom of Bright's disease.

An open mouth in breathing, especially when deafness and shortness of breath accompany it, is usually due to enlargement of the tonsils and adenoids in the throat. A child so affected is generally found to snore when asleep. (*See* NOSE, DISEASES OF.)

Accompanying these symptoms in older children we find broadening of the bridge of the nose, narrow nostrils, and often narrowing of the roof of the mouth with projecting front teeth.

The expression of the face is often of great importance. Brain disease causes contractions of the facial muscles producing the appearance of emotions quite foreign to childhood, and causing the deep lines which, in middle-aged persons, are supposed to denote character. The head, too, is often drawn back in such a case, and the back arched. Deep hollowing of the eyes during an attack of summer diarrhœa and vomiting is a grave sign, indicating great exhaustion. The size of the cranium is large in children compared with that of the face. At birth the proportion is about eight to one, though the face rapidly grows in size. On the top of the head is the 'fontanelle' or soft spot, which is at birth about a square inch in size, and gradually closes as the bones grow till, at the end of the second year, it should have disappeared. Premature closure, with narrowing of the forehead, is often, though not necessarily, associated with mental deficiency. Late closure, with the development of a lofty, 'intellectual'-looking forehead, is one of the signs of rickets.

Bad postures in children, such as standing on one leg, stooping at the shoulders, and leaning the left elbow on the table at lessons, should be

discouraged as tending to produce deformities. The latter habit may produce considerable curvature of the spine and defective development of one side of the chest in a few months.

Nervousness may show itself by twitching movements of hands and feet, and a shy, nervous child is apt to be unintentionally clumsy. Twitchings and grimaces very often show the beginning of St. Vitus's dance, and children are apt to be punished for these quite involuntary peculiarities, such punishment only aggravating the condition. Grinning on every occasion, however, shows a want of control over the muscles of expression, and indicates a low-class brain and necessity for careful upbringing. Convulsions in young children are due to many causes (*see* CONVULSIONS), and when some nervous disease is the cause they form a serious symptom. Although much more common in children, they are not by any means so grave as fits of similar severity in adults. Incontinence of urine, showing itself generally by wetting of the bed, may be a bad habit in a nervous child and capable of correction by careful psychological treatment, but it is occasionally due to physical conditions which need correction.

Bad habits in children include such actions as persistent sucking of the thumb or tongue, biting the nails, rolling or nodding the head in a rhythmic manner, knocking the head violently on the pillow, rhythmic swaying of the body, eating of dirt, etc. These habits all consist in a morbid exaggeration of some normal action which has an extraordinary fascination for the children who practise it. All these habits are the counterpart of hysteria in older people, and children who practise them frequently develop hysterical symptoms later. It is very important, therefore, that these should be corrected at an early stage by checking the child and making him carry out some other activity on each occasion when the habit is noticed. Advice may be sought at a child-guidance clinic.

Left-handedness is often taken for a sign of stupidity, and children are punished when they do not use the right. This is a great mistake, because the condition is due to the fact that the side of the brain governing the left hand has developed in advance of the other. The child may, however, be taught to do certain things with the right, and so attain a condition of ambidexterity.

The teaching of children should not be forced before the age of seven, and up to this age should be directed rather to teaching habits of study, orderliness, and regularity. The teaching of good habits should begin at birth. This may be done, for example, in the matter of feeding. The periods at which the child is to be fed having been determined upon, these should be rigidly adhered to, despite the child's crying. It is astonishing how soon the child accepts this discipline and ceases to cry for food at irregular times. Present-day teaching in the kindergartens and primary schools is directed towards instructing children how to observe and study rather than towards cramming them with facts. After the age of seven is reached, the child's brain is quite capable of enduring some fatigue, and regular lessons should be begun, or the child will learn idle, loafing habits.

Sleep should be longer the younger the child, and nervous children should have a specially good allowance. The following table gives approximately the minimum periods of sleep at different ages:

	Hours a Day.
During first year	20
During second year	14-16
From second to fourth year	12-14
From fourth to sixth year	10-12
From sixth to twelfth year	10
From twelfth to sixteenth year	9

CHILLS and COLDS form a subject of some importance because, although, in general, trivial ailments, they are often the prelude to serious diseases.

Causes.—A cold follows generally some chill to the surface, such as exposure to a draught of cold air, breathing in a foggy atmosphere, wetting of the feet on a cold day, sudden immersion in water, etc., some persons being specially liable after one of these to develop a catarrh of the respiratory passages and feverish state. In other cases errors in diet seem either to bring on the same condition or to assist the effect of cold. Often a 'cold in the head' runs through all the members of

a family or school or a group of persons employed together, and such an 'infectious cold' is due to bacteria or a filter-passer passed from one person to another by sneezing or coughing.

Varieties and symptoms.—A cold in the head with catarrh of the nose is known to every one; the catarrh sometimes extending up into the frontal sinuses and causing a severe browache, or involving the maxillary sinuses (*see* ANTRUM) and causing faceache, or even spreading up the Eustachian tubes and causing inflammation of the middle ear with painful earache. Generally, these secondary affections disappear as the cold gets well, but suppuration may result in these various cavities, most commonly in the middle ear, though seldom in the frontal sinus. When the throat is the part affected, inflammation of the tonsils or 'quinsy' is liable to result, especially in rheumatic persons. In persons who use the voice much, or in those who indulge overmuch in alcohol, the larynx is a weak point, and laryngitis, with huskiness or even temporary loss of voice, is the common result of a chill. The cold may affect the respiratory passages farther down and bronchitis then results, or if the surfaces of the air spaces in the lungs be inflamed, pneumonia is the condition produced. When the air passages from the larynx downwards contain mucus, coughing results, this being a series of involuntary explosive expirations designed to force the irritating substance up into the mouth, from which it is spat out. Some persons have a liability, as the result of a chill, to catarrh not of the respiratory, but of the alimentary system, as shown by ensuing dyspepsia or diarrhœa. It should be remembered that a so-called 'cold' is the commencement of several infectious and serious diseases, such as measles, whooping-cough, influenza, consumption, and, with regard to the latter especially, one should seek medical advice and examination whenever this apparently trivial malady lasts more than a few weeks. Finally a chilly sensation is a frequent accompaniment of some nervous shock either of a severe nature or even of some minor type.

Treatment.—There is very little one can do in the treatment of a cold. Most people have their pet remedies, and most of these are harmless. On catching a cold, with a temperature above normal, the best thing to do is to go to bed and stay there at least 24 hours, if not two days. In this way the course of the cold will be cut short, and at the same time the sufferer will not be exposing other people to his infection. The best way to prevent colds is to isolate the infected by keeping them in bed. Vaccines seem to be quite ineffectual in the prevention of colds.

It has yet to be seen whether patulin (proprietary term—'tercinin'), a substance isolated from *Penicillium patulinum*, proves to be as astonishingly efficacious as the first reports indicated.

CHINASOL is a yellowish powder, oxyquinolin sulphate, which has an antiseptic, antipyretic, and astringent action. It is used both externally in solutions of 1 in 5000 or stronger and internally in doses of 1 to 5 grains.

CHINCOUGH (Dutch, *kind*, a child; *kuch*, cough) is another name for whooping-cough. (*See* WHOOPING-COUGH.)

CHIRAGRA (χειράγρα) is an ancient term applied to gout affecting the hand.

CHIRETTA, or CHIRATA, is a favourite bitter, very much resembling gentian, (*See* BITTERS.)

CHIROPODIST (χείρ, hand; πούς, foot) is the name applied to one who treats corns, bunions, and other minor affections of the hands and feet.

CHIROPRACTOR (χείρ, the hand; πράσσω, I practise) is a term applied to a person who practises chiropractic, which is a system of adjustment by hand of supposed minor displacements of the spinal column in order to relieve pressure upon the nerves issuing at the intervertebral foramina. The essential fallacy of this system lies in the fact that the foramina for the exit of the spinal nerves are so large that pressure upon these nerves is only possible in gross displacements caused by very severe injury or disease.

CHIRURGEON (χειρουργός) is an obsolete method of spelling surgeon.

CHITTENDEN'S DIET is the name applied to a diet containing about half the amount of protein which the ordinary diet of healthy persons includes. Chittenden found by experiment that, instead of the 100 grams of protein which most people take in the daily diet, it was quite possible to maintain the wear and tear of the body tissues and to maintain the balance between the nitrogenous materials taken in and those excreted on a diet containing from 47 to 55 grams of protein only. Such a diet is advantageous for persons subject to diseases in which an accumulation of waste products takes place (*e.g.* chronic nephritis). This diet is, however, not sufficiently stimulating for the average person doing hard work.

CHLOASMA (χλόα, a green plant) is a condition in which brown blotches appear, especially on the face. It occurs chiefly in pregnant women, in whom the spots fade after delivery, and also in those who suffer from various abdominal complaints.

CHLORALAMID is crystalline powder with faintly bitter taste which is generally regarded as a very safe hypnotic, and is used for producing sleep in cases of neuralgia, hysteria, and cardiac disease. It is given in doses of 15 to 45 grains.

CHLORAL HYDRATE, generally known as CHLORAL, is a substance prepared by prolonged action upon alcohol with chlorine gas. It is a clear, crystalline substance, with sweetish taste, which dissolves rapidly in water. When taken internally in moderate doses it produces sound, dreamless, refreshing sleep, like natural sleep. It is, however, dangerous in large doses, and persons taking it frequently are very liable to contract a habit for it. In safe doses it does not lessen pain appreciably, as opium does, and so will not cure sleeplessness due to this cause. In dangerous doses it paralyses and slows the heart, slows respiration, and reduces body temperature.

Uses.—Chloral is chiefly used to produce sleep in those suffering from worry, overwork, or delirium tremens. It is given in doses of 5 to 20 grains, or in the form of syrup of chloral, a teaspoonful, but for the reasons mentioned above, should never be taken but under medical observation. It is also used in smaller doses for relief from convulsions, asthma, sea-sickness, etc. *Externally* chloral is a powerful antiseptic, and a lotion of strength 8 grains of chloral to each ounce of water is good for cleansing unhealthy ulcers, and some forms of eczema. Chloral and camphor, rubbed together in equal parts, form a clear fluid, so do chloral and menthol, and either of these is very useful for painting on to the skin in cases of neuralgia or of gouty pain.

CHLORAL POISONING is by no means infrequent, because, the sleep-producing effect of the drug passing off after repeated administrations, the sleepless person is apt to increase the dose too far.

Symptoms. — Occasionally, though seldom, there is gastric pain and sickness after a large dose. Usually the result is a speedy and deep sleep, passing gradually into coma, the pulse growing feebler, and the respirations embarrassed till death peacefully ensues.

Treatment.—The patient must be persistently irritated and roused as in opium poisoning. The stomach should be at once emptied by stomach-tube or emetic. The extremities of the body must be kept warm, and stimulants given. Metrazol and ephedrine are said to be useful. Artificial respiration may be needed.

CHLORALUM, or CHLORIDE OF ALUMINIUM, is used as a disinfectant for drains and excreta, in strength of 1 lb. to a gallon of water.

CHLORAMINE is a white powder with powerful antiseptic action, which is non-irritant and non-poisonous.

CHLORETONE, or CHLORBUTOL, is a white powder with an odour like camphor. Applied to the surface of the skin or mucous membrane it has a soothing and antiseptic effect, and internally it acts as a hypnotic.

CHLORIC ETHER is an old name for spirit of chloroform.

CHLORIDE OF SODIUM is the chemical name for common salt.

CHLORIDE OF ZINC is the main constituent of Burnett's disinfectant.

CHLORINATED LIME, generally known as CHLORIDE OF LIME, is a white powder made by passing chlorine gas over slaked lime. Chlorine is a greenish gas, heavier than air, with a pungent, choking smell, and highly poisonous to all forms of bacterial life. By virtue of its power to give off chlorine, chlorinated lime is a powerful bleaching agent and disinfectant, especially when mixed with an acid.

To disinfect rooms, chlorinated lime may be mixed with an equal bulk of water acidulated with sulphuric acid, and exposed on flat dishes for some hours.

To disinfect water-closets and drains, 1 lb. of the chlorinated lime may be mixed with a gallon of water and poured down the drain.

CHLORINE WATER is a solution of chlorine gas in water. It is used as a gargle in suppurating sore throat, as an inhalation when the expectoration is very offensive, and for an antiseptic application to foul-smelling ulcers.

Preparation.—Ten grains of chlorate of potash and thirty drops of strong hydrochloric acid are mixed in the bottom of a pint bottle. Chlorine gas is produced, and replaces the air in the bottle. When this yellow gas begins to issue from the bottle the latter is corked, allowed to stand for two minutes to cool, and then the bottle filled little by little with water, being corked and well shaken after each addition, so that the gas may be absorbed by the water.

CHLORODYNE is a proprietary soothing remedy said to contain chloroform, hydrocyanic acid, morphine, capsicum, and Indian hemp. It is similar to the pharmacopœial preparation of compound tincture of chloroform and morphia, which is used in doses of five to fifteen minims.

CHLOROFORM is a colourless, mobile liquid, half as heavy again as water, and, unlike ether, non-inflammable. It was discovered by Liebig in 1831, and is manufactured by distilling alcohol with a mixture of slaked lime and chloride of lime, being a compound of carbon, hydrogen, and chlorine. It does not dissolve to a large amount in water, but mixes readily with alcohol or ether. It dissolves sulphur, phosphorus, fats, resins, and most substances which contain a large proportion of carbon; it is therefore very useful as a cleansing agent. It was introduced into medicine in 1847 by Sir J. Y. Simpson, who was then in search of a substance which could produce unconsciousness for operative purposes more conveniently than ether, introduced a short time previously by Morton in America. (*See* ANÆSTHETICS.)

Uses.—Chloroform is used as a solvent of fats, resins, etc., in many chemical processes. *Externally* it may be used to produce blisters (*see* BLISTERS), and the liniment of chloroform is a very useful application for rheumatic and similar pains, having both a soothing and a mildly counter-irritant action. *Internally* its chief use is by inhalation to produce insensibility to pain during surgical operations, in painful and convulsive diseases such as gall-stone colic, and during child-birth. By the mouth, small doses have also the effect of relieving pain and producing sleep, so that it is useful for soothing headache and relieving vomiting, especially in seasickness. For this purpose 1 to 5 drops may be taken on a lump of sugar, but care is needful, for, in large doses, chloroform is a violent irritant and narcotic poison. Spirit of chloroform is a very frequent component of cough and digestive mixtures, for its stimulating and soothing effects upon the interior of the stomach and bronchial tubes.

CHLOROMA, or GREEN CANCER, is the name of a disease in which greenish growths appear under the skin, and in which a change takes place in the blood resembling that in leukemia.

CHLOROPHYL (χλωρός, green; φύλλον, leaf) is the name of the green colouring matter of plants. It is sometimes used as a remedy in cases of anæmia.

CHLOROSIS (χλωρός, greenish-yellow) is a form of simple anæmia which occurs in persons of a particular constitution, and receives its name from the yellow or faintly greenish-grey complexion of those suffering from it. (*See* ANÆMIA.)

CHOCOLATE is a solid substance made by grinding cocoa nibs to powder.

and mixing with a large amount of sugar and some flavouring substance, such as vanilla. It consists, roughly, half of sugar, starch, and protein, and half of a fat known as cocoa-butter, with small quantities of water and salts, and about 1 per cent of theobromine, an alkaloid of stimulating properties similar to those of tea and coffee.

Chocolate has been used in England since the time of Charles II., when it was very popular. It forms a compact and easily carried food, suitable for sustaining hard labour and for protecting against cold. The energy value of chocolate is about 600 calories per 100 grams.

CHOKE-DAMP (*see* DAMP).

CHOKING is the process which results from an obstruction to breathing situated in the larynx. (*See* AIR PASSAGES.) It may occur as the result of disease causing swelling round the 'glottis' (the entrance to the larynx), or of some nervous disorders that interfere with the regulation of the muscles which open and shut the larynx, but generally it is due to the irritation of a piece of food or other substance introduced by the mouth, which provokes coughing but only partly interferes with breathing. In the act of swallowing, all food passes over the top of the larynx, and, as a preliminary to swallowing, the glottis is automatically closed by approximation of the sides of the larynx at their upper edge, over which the bolus of food is shot into the gullet. When, as the result of some nervous disease, such as a form of paralysis of the mouth and throat muscles, or simply of an attempt to speak or laugh during eating, this preliminary closure is not complete, a piece of food is apt to lodge in, or some fluid to trickle down into, the larynx. The mucous membrane lining the upper part of the latter being specially sensitive, coughing results in order to expel the cause of irritation. At the same time, if the foreign body be of any size, lividity of the face appears, due to partial suffocation. (*See* ASPHYXIA.)

Treatment.—If coughing be vigorous the choking person should be let alone, a glass of water being put within his reach, because a gulp of cold water often dislodges the particle, and, at all events, stimulates more vigorous coughing. The choking person should take slow, deep inspirations, which do not force the particle farther in (as sudden catchings of the breath between the coughs do), and which produce more powerful coughs. If the coughing be weak, one or two strong blows with the palm of the hand over either shoulder blade, timed to coincide with coughs, aid the effect of the coughing. In the case of a child the patient may be held up by the legs, when the substance causing the obstruction is more readily dislodged. Finally, if the coughing be getting weak, lividity of the face and finger-nails coming on, and especially if unconsciousness have supervened, death is imminent within a few minutes unless the obstruction be removed. For this purpose the bystander should pass his right forefinger along the side of the patient's tongue, forcing the teeth apart first, if necessary, with a knife handle, and keeping them apart by the fingers of the other hand with a napkin rolled round them. The forefinger should be passed as far down the throat as possible, its point then

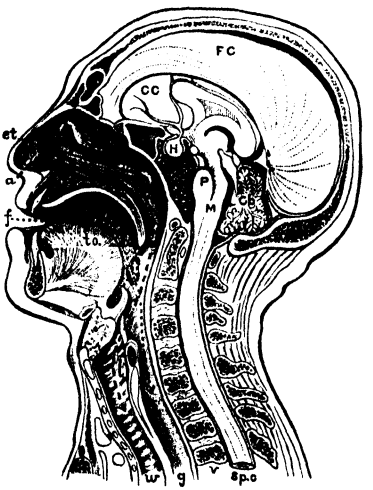


FIG. 105.—Vertical section through the middle of the head and neck, showing the upper air passages. The passages for air *a*, are indicated by a heavy dotted line, those for the food *f*, by a fainter line; *et*, Eustachian tube; *l*, larynx; *w*, windpipe; *t*, tonsil; *to*, tongue; *g*, gullet. For other letters see BRAIN. (After Braune.)

turned towards the middle line and hooked forwards towards the root of the tongue. After a few attempts the foreign body will very likely be dislodged and pulled up into the mouth. Sometimes, however, the foreign body may be too small to catch; for example, death has been recorded in consequence of a fragment of cabbage leaf which lay over the opening of the larynx like a valve, completely preventing the entrance of air, and, the opening being only a slit about a quarter of an inch from side to side and less than an inch from before backwards, such an accident may readily happen. In this case, if the sufferer be livid and unconscious, and if no medical man be obtainable within five minutes, some one at hand may undertake to open the larynx below the obstruction, and so admit air to the lungs, but, on account of its dangers, this is suitable only in extremest cases. For this purpose a sharp-pointed knife, such as a penknife, should be taken, the prominent Adam's apple in front of the neck felt for, and the knife pushed boldly into the throat at a point half an inch below the prominence (in a full-grown person). The knife must be pushed in exactly in the middle line, straight backwards to the depth of half an inch, and the cut extended half an inch downwards. After this, artificial respiration (*see* DROWNING) may be necessary, and, if there be any bleeding from the wound in the neck, a bystander should press gently with his finger on the edge from which it comes, at the same time pressing the edges of the wound apart so as to allow the air to enter. By this procedure, lives have been saved when the obstruction could not be dislodged through the mouth.

CHOLÆMIA (χολή, bile; αἷμα, blood) is a vague term applied to conditions in which the bile is not excreted from the body to its usual extent, but circulates in the blood. (*See* JAUNDICE.)

CHOLAGOGUES (χολή, bile; ἄγω, I move) are substances which increase the flow of bile. The great majority of these act only by increasing the activity of the digestive organs, and so producing a flow of bile already stored up in the gall-bladder, but a few actually stimulate the liver to secrete more bile, and so have the effect of clearing the system of various injurious substances circulating in the blood.

Varieties and Uses.—Among the former class are blue pill, calomel, various resins like iridin, also aloes, ipecacuanha, rhubarb, and phosphate of soda, while, of those which produce new bile, perchloride of mercury, salicylate of soda, and Epsom salts are the chief. All are used combined with purgatives to clear the blood in various lethargic states, in the vague condition known as biliousness, and in gout and other conditions due to over-eating.

CHOLANGITIS (χολή, bile; ἀγγεῖον, vessel) is the term applied to inflammation of the bile ducts.

CHOLECYSTECTOMY means the removal of the gall-bladder by operation.

CHOLECYSTITIS (χολή, bile; κύστις, a bladder) means inflammation of the gall-bladder.

CHOLELITHIASIS (χολή, bile; λίθος, a stone) means the presence of gall-stones in the bile-ducts and/or in the gall-bladder.

CHOLERA (from χολή, bile; and ῥέω, I flow).—Two distinct forms of disease are included under this general term, namely, simple cholera and malignant cholera. Although essentially different both as to their causation and their pathological relationships, these two diseases may in individual cases present many symptoms of mutual resemblance.

SIMPLE CHOLERA, or EPIDEMIC GASTRO-ENTERITIS (synonyms, *Cholera Europœa*, *British Cholera*, *Summer* or *Autumnal Cholera*, *Cholera Nostras*, *Cholerine*, *Choleraic Diarrhœa*) is the cholera of ancient medical writers, as is apparent from the accurate description of the disease given by Hippocrates, Celsus, and Aretæus. Its occurrence in an epidemic form was noticed by various physicians in the sixteenth century, and an admirable account of the disease was subsequently given by Sydenham in describing an epidemic of cholera in London in 1669–72. Attacks of this kind are of frequent occurrence in summer and autumn in almost all countries. They appear specially liable to occur when cold and damp

alternate with great heat. Occasionally the disorder prevails so extensively as to constitute an epidemic. The exciting causes of an attack are in many cases errors in diet, particularly the use of unripe fruit and new vegetables, or of tainted meat. The condition is largely dependent upon the excessive development of bacteria, resembling those of dysentery (*e.g.* Gaertner's bacillus, Morgan's bacillus, etc.) under the above-named favourable conditions, in the intestine.

Symptoms.—The chief symptoms in well-marked cases are vomiting and purging, occurring either together or alternately. The seizure is usually sudden and violent. The contents of the stomach are first ejected, and this is followed by severe retching and vomiting of thin fluid of bilious appearance and bitter taste. The diarrhœa which accompanies or succeeds the vomiting, and is likewise of bilious character, is attended with severe griping abdominal pain, while cramps affecting the legs or arms greatly intensify the suffering. The effect upon the system is rapid and alarming, a few hours of such an attack sufficing to reduce the strongest person to a state of extreme prostration. The surface of the body becomes cold, the pulse weak, the voice husky, and the whole symptoms may resemble in a striking manner those of malignant cholera, to be subsequently described. In unfavourable cases, particularly where the disorder is epidemic, death may result within forty-eight hours. Generally, however, the attack is arrested and recovery follows, although there may remain for a considerable time a degree of irritability of the alimentary canal, rendering necessary the utmost care in regard to diet.

Treatment. (*See* DIARRHŒA.)

ASIATIC CHOLERA (synonyms, MALIGNANT CHOLERA, INDIAN CHOLERA, EPIDEMIC CHOLERA, ALGIDE CHOLERA) is one of the most severe and fatal of all diseases. This form of cholera belongs originally to Asia, more particularly to India, where, as well as in the Indian Archipelago, epidemics are known to have occurred at various times for several centuries. It was not, however, till 1817 that the attention of European physicians was specially directed to the disease by the outbreak of a violent epidemic of cholera at Jessore in Bengal. This was followed by its rapid spread over a large portion of British India, where it caused immense destruction of life among both natives and Europeans. By 1823 it had extended into Asia Minor and Russia in Asia, and it continued to advance steadily though slowly westwards, and spread onwards to England, appearing in Sunderland in October 1831, and in London in January 1832. The disease subsequently spread through North and Central America, reaching even to the military posts on the upper Mississippi. In 1835 it was general throughout North Africa, after which this epidemic disappeared.

About the year 1841 another great epidemic of cholera appeared in India and China, and soon began to extend in the direction traversed by the former, but involving a still wider area. This epidemic appears to have been even more deadly than the former, especially as regards Great Britain and France.

A third great outbreak of cholera took place in the East in 1850, entering Europe in 1853. It was specially severe throughout both North and South America.

A fourth epidemic visited Europe again in 1865–66, but was on the whole less extensive and destructive than its predecessors. In 1884, and again in 1892 and 1893, there were outbreaks in the middle of Europe, the last one being specially severe in Hamburg and some other cities, but, apart from occasional cases brought by ship, there has been no epidemic in Britain or in the United States for the past thirty years.

Causes.—The direct cause of the disease is now generally admitted to be the *Spirillum choleræ* or 'comma-bacillus' discovered by Koch. This organism is constantly found in the discharges from the bowels of those suffering from the disease, and, though animals are not subject to the disease, and it is therefore difficult to show that the organisms, if swallowed, are capable of producing cholera, nevertheless several instances have occurred of persons, working with cultures of the bacteria and accidentally poisoned by them (as, for example, a student of

Koch's class in 1884), who have developed an attack of cholera. These accidents have proved that the organism, or some poison produced by it, is the direct cause of cholera.

But even when this is proved, it is insufficient to explain the intense tendency of cholera to spread widely at some times, more than at others. It is stated that a high temperature favours the development of the bacillus, and consequently the spread of cholera. The relation of the character of the soil to the propagation of cholera was elaborately investigated by Pettenkofer in Munich, who ascribed a powerful influence to the ground-water—shallow, porous soils affording special facilities for the reception, increase, and distribution of the cholera germs.

Again, in this, as in other infectious diseases, a special liability of individuals must be admitted, as is proved by the fact that among persons living under precisely the same conditions, some will suffer while others escape, and also that persons living in cholera districts may come to enjoy an immunity from attacks of the disease. (*See* IMMUNITY.) Among predisposing causes the incautious use of purgative medicines, eating of unripe fruit, bad and insufficient food, intemperance, dirt, overcrowding, and all kinds of unfavourable hygienic surroundings play an important part during the course of a cholera epidemic.

Symptoms.—The *first stage* consists in the occurrence of diarrhœa, which is frequently of mild and painless character, and coming on after some error in diet, is apt to be disregarded. The discharges from the bowels are similar to those of ordinary summer cholera, which the attack closely resembles.

The *second stage* is termed the stage of collapse or algid stage. It is often preceded by the premonitory diarrhœa, but not infrequently it appears without earlier sign. It comes on, often suddenly, in the night, with diarrhœa of the most violent character, the material discharged being of whey-like appearance, and commonly termed 'rice-water' evacuations. They contain large quantities of disintegrated epithelium from the mucous membrane of the intestine. The discharge, which is at first unattended with pain, is soon succeeded by copious vomiting of matter similar to that passed by the bowel, accompanied by severe pain at the pit of the stomach and by intense thirst. The symptoms now advance with rapidity. Cramps of the legs, feet, and muscles of the abdomen come on and occasion great agony, while the signs of collapse make their appearance. The surface of the body becomes cold and assumes a blue or purple hue, the skin is dry and wrinkled, indicating the intense draining away, in the evacuations, of the fluids of the body. The features are pinched and the eyes deeply sunken, the pulse at the wrist is imperceptible, and the voice is reduced to a hoarse whisper (the 'vox cholerica'). There is complete suppression of the urine.

In this condition, death often takes place in less than one day, but, in epidemics, cases are sometimes observed where the collapse is so sudden and complete as to prove fatal in one or two hours without any great amount of previous purging or vomiting. In most instances the mental faculties are comparatively unaffected, although in the later stages there is generally more or less apathy.

Reaction may, however, take place, and this constitutes the *third stage*. It consists in the arrest of the alarming symptoms of the second stage, and the gradual but evident improvement in the patient's condition. The pulse returns, the surface assumes a natural hue, and the bodily heat is restored. Before long, the vomiting ceases, and, though diarrhœa may continue for a time, it is not of a severe character and soon subsides, as do also the cramps. The urine may remain suppressed for some time, and on returning is often found to be albuminous.

Even in this stage, however, the danger is not past, for relapses sometimes occur which speedily prove fatal; while, again, the reaction may be of imperfect character, and there may succeed an exhausting fever (the so-called *typhoid stage* of cholera), which may greatly retard recovery, and under which the patient may sink at a period even as late as two or three weeks from the commencement of the illness.

The bodies of persons dying of cholera

are found to remain long warm, and the temperature may even rise after death. Peculiar muscular contractions have been observed to take place after death, so that the position of the limbs may become altered. The soft textures of the body are found to be dry and hard, and the muscles of a dark-brown appearance. The blood is of dark colour and tarry consistence. The upper portion of the small intestines is generally found distended with the rice-water discharges, the mucous membrane is swollen, and there is a remarkable loss of its natural epithelium. The kidneys are usually in a state of acute congestion.

Treatment. — PREVENTIVE TREATMENT.—When cholera threatens to invade any place, however favourably circumstanced as to its hygienic condition, increased vigilance will be requisite on the part of those entrusted with the care of the public health. Cholera may be introduced into a community by one or more individuals who have themselves only suffered from the first or milder stage of the disease (cholera diarrhœa), since the discharges from the bowels abound in the infective organisms, and, where sanitary arrangements are deficient, may readily contaminate the water of a locality.

Where suspicion attaches to the water, it should be boiled before being used, and the same holds true of the milk. The cholera organism is readily destroyed and even aeration of water is said to get rid of it. Instructions should be issued by the authorities warning all persons against the use of unwholesome food, unripe fruit, and excesses of every kind, and recommending early application for medical advice where there is any tendency to diarrhœa. The discharges from cholera patients should be treated, as soon as passed, with strong disinfectants (*see* DISINFECTION), and special care should be taken that they are not disposed of in places where they can contaminate drinking-water. In 1893 Haffkine introduced a vaccine for preventive inoculation against cholera, and this seems to afford a certain amount of protection over a period of some months.

CURATIVE TREATMENT. — In the earlier period of the attack, for the cholera diarrhœa the use of opium is of undoubted value. Given alone in small doses, or in combination with other astringents, such as catechu, tannin, bismuth, nitrate of silver, or acetate of lead, it frequently succeeds in quelling this symptom, and thus arresting the disease at the outset. Strict maintenance of the recumbent position in bed is very important. The violent vomiting and purging and the intense thirst may be relieved by iced effervescing drinks; while, at the same time, endeavours should be made to maintain the heat of the body by rubbing with stimulating liniments or mustard to the surface, and by enveloping the body in flannel and surrounding it with hot bottles. The administration of kaolin has also been highly recommended.

The chief modern advance, however, in the treatment of this disease, which indeed has reduced the mortality in some places to one-half its previous figures, is the method of injecting 'hypertonic' salt solution into the veins. This method, introduced by Rogers, consists in taking the specific gravity of drops of blood extracted from time to time from the finger; and, if the specific gravity rises above 1063, of injecting a solution of salt, double the normal concentration of the blood, into a vein. As a result, fluid transudes back from the bowel into the tissues and thence into the blood, and the diarrhœa comes to an end. Several pints of this highly concentrated saline fluid are thus injected. In some epidemics in China the success of this form of treatment, in reviving persons desperately ill and apparently moribund, has been surprising.

For the relief of the cramps the inhalation of chloroform is recommended, and morphia given hypodermically is also of value. Stimulants, such as champagne and brandy, must be had recourse to, when these measures fail to establish reaction and the patient threatens to sink. When reaction occurs and the vomiting ceases, liquid food in small quantities should be cautiously administered.

CHOLERINE is the name given to cases which occur during an epidemic of cholera with very slight symptoms of

the latter, and which are either mild cases of cholera or are due to fright.

CHOLESTERIN, or CHOLESTEROL (χολή, bile; στερεός, solid), is a substance derivable from many tissues of the body, from fat, blood, tumors, and several secretions such as the bile. It can be obtained pure by extraction with alcohol or ether, and is then found to be chemically a complex alcohol, which crystallises in colourless rhombic plates. Its practical interest lies in the fact that gall-stones consist mainly of masses of cholesterin mixed with more or less bile pigment, and are produced either by its sedimentation from the bile, or by degeneration in the mucous membrane of the bile ducts.

CHONDROMA (χόνδρος, cartilage) is a tumor composed in part of cartilage. (*See* TUMORS.)

CHORDOTOMY is the term applied to the operation of cutting the nerves in the spinal cord which convey the sensation of pain to the brain. This operation is done for the relief of severe and intractable pain.

CHOREA (χορεία, a dance). The medical name for St. Vitus's dance. (*See* ST. VITUS'S DANCE.)

CHORION (χορίον) is the name applied to the more external of the two fœtal membranes.

CHOROID, or CHORIOID (χορίον, a membrane; εἶδος, form), is the middle of the three coats of the eye, and consists chiefly of blood-vessels, which effect the nourishment of this organ. (*See* EYE.)

CHOROIDITIS, or CHORIOIDITIS, means inflammation of the choroid coat of the eye, and is sometimes associated with inflammation of the iris. (*See* EYE, DISEASES OF; IRITIS; *and* VISION.) It is a very frequent result of syphilis, or occasionally of tuberculous disease. In its early stages it may produce no symptoms. When well advanced, it produces inflammation in the retina and then causes interference with sight in various ways, such as dark spots in the field of vision, loss of vision for particular colours, etc. Its effects vary greatly, according to the position of the inflamed patches, for wide stretches of inflammation may occur situated towards the front of the eye without causing much interference with vision, while a very small patch, occurring on or near the macula or spot of clearest vision in the centre of the back of the eye (*see* EYE), may cause great visual defect. The condition is very easily made out by examination with the ophthalmoscope, even in early stages; but, though treatment retards, or completely stops the progress of the disease, very little improvement in vision is to be expected.

CHROMAFFIN is a term applied to certain cells and organs in the body, such as part of the adrenal glands, which have a peculiar affinity for chrome salts. These cells and tissues generally are supposed to secrete substances which have an important action in maintaining the tone and elasticity of the blood-vessels and muscles.

CHROMIC ACID, or CHROMIUM TRIOXIDE, in crimson crystals, is a caustic much used in small operations on the nose and throat. Two of its salts, chromate and bichromate of potassium, are used for paints and dyes of various shades of yellow and orange, and are poisonous. In the process of manufacture of these substances, workmen, who neglect to wash the skin carefully, are apt to suffer from ulcers. These are caused by a deposit of the chromic acid or its salts in cracks of the skin, which is thereby destroyed, leaving a callous ulcer with hard thick edges, very difficult to heal. (*See* ULCERS.)

Uses.—The chief medicinal use of chromic acid is as a caustic, also in weak solution it is used to harden the skin of the feet, so as to resist the friction of the shoes in long marches. (*See* CHAFING.)

CHRONIC DISEASES (χρόνος, time) are those which last a long time, or which progress very slowly. Many diseases are essentially chronic, such as leprosy, others have both acute and chronic forms, for example tuberculosis and gout.

CHRYSAROBIN, or GOA POWDER, is a substance got from Brazil, being a concretion, which forms on the stems of the *Araroba* plant, powdered and purified. It is used in various skin diseases,

especially psoriasis and ringworm, either in the form of an ointment, or plaster, or made into a paste with vinegar. It is very efficacious, but has the drawback that it stains the clothes a deep violet colour. These stains, however, may be removed with benzol or weak chlorinated lime in water.

CHYLE (χυλός) is the name given to the partly digested food as it passes down the small intestine, and also to that part of it which is absorbed by the lymphatic vessels of the intestine. The absorbed portion consists of fats in very fine emulsion, like milk, so that these vessels receive the name of lacteals (L. *lac*, milk). This absorbed chyle mixes with the lymph and is discharged into the thoracic duct, a vessel as large as a quill, which passes up through the chest to open into the jugular vein on the left side of the neck, where the chyle mixes with the blood.

CHYLOPOIETIC VISCERA (χυλός, chyle; ποιέω, I make) is a name used to include the stomach, intestine, pancreas, and liver, which act together in forming the chyle.

CHYME (χυμός, juice) is the name given to the partly digested food as it issues from the stomach into the intestine. It is very acid and grey in colour, containing salts and sugars in solution, and the animal food softened into a semi-liquid mass. It is next converted into chyle.

CICATRIX (*cicatrix*) is another word for scar.

CIDER is an alcoholic beverage made from apples. (*See* ALCOHOL.) As cider contains a considerable amount of fruit acids which are converted in the body into alkaline substances, it is much used as an antacid by persons with a rheumatic tendency. (*See also* COLIC.)

CILIA (*cilium*, eyelash) is a term applied to minute, lash-like processes which are seen with the aid of the microscope upon the cells covering certain mucous membranes and which maintain movement in the fluid passing over these membranes. They are also found upon certain bacteria which have the power of rapid movement.

CIMEX LECTULARIUS (*see* BED BUG *and* PARASITES).

CINCHONA is the general name for several trees in the bark of which quinine is found. This bark is also known as Jesuit's bark, having been brought first to notice by Spanish priests in South America and brought to Europe first by the Countess of Cinchon, wife of the Viceroy of Peru, in 1640. The red cinchona bark is that which contains most quinine, and from which it is usually prepared. (*See* QUININE.) Various extracts and tinctures are made direct from cinchona bark, and used in place of quinine.

CINCHOPHEN, also known as atophan, agotan, and phenoquin, is described chemically as phenyl-quinoline-carboxylic acid. It is used in neuralgia, sciatica, rheumatic diseases, and especially in gout by virtue of its power to promote the excretion of uric acid. One of its risks is that it is toxic to the liver.

CINNAMON is the bark of *Cinnamomum Zeylandicum*, a species of laurel grown in Ceylon. It has a stimulating action upon the stomach, and assists digestion, hence its use as a condiment. It is also an antispasmodic.

Uses.—In flatulent dyspepsia and in sea-sickness, cinnamon powder (10 grains) is very useful. For the same purposes, or for relieving griping, four drops of oil of cinnamon may be taken on sugar, or one tablespoonful of cinnamon water (distilled) may be similarly used.

CIRCULATION OF THE BLOOD.—This principle, demonstrated for the first time by William Harvey in a small book published in 1628, was the result of many years of careful reasoning and experimentation. He confesses that the subject, when he began it, seemed to him so overwhelmingly difficult that he fancied the motions of the heart could be 'understood only by God'. The proof of the facts of circulation was certainly one of the most important discoveries in medical science. Before Harvey's discovery the generally accepted view was that the arteries contained a mixture of air

and 'vital spirits', with only an accidental admixture of blood, and that the heart by its motions alternately sucked in more air through the pores of the skin and those of the lungs,

FIG. 106.—Capillaries with circulating blood. (Turner's *Anatomy*.)

and through the same channels expelled 'fuliginous vapours'. The 'vital spirits' were assumed to be manufactured by the heart and to be the origin of all activity, while the 'fuliginous vapours' were a form of smoke resulting from the bodily motions. The blood in the veins was supposed to be derived from the liver, which absorbed the 'juices of the food', and to ebb and flow in and out of the various organs for their nourishment. Harvey proved, first of all, mainly by the examination of living animals, that the arteries contain only blood. Secondly, he showed by three main propositions that this blood must go round from arteries to veins in a continuous circuit. (1) The quantity of blood passing from the veins into the heart in the course of a whole day is so great that it is quite impossible it could all be manufactured from the food. (2) The blood in the arteries passes in a constant stream to all the members of the body, and does not return by the same route. (3) The blood in the veins flows incessantly to the heart, and does not ebb and flow, as is shown by the valves in veins and in the heart, and by the fact that veins when pressed on do not fill from above. Having proved these points, he assumed

CIRCULATION OF THE BLOOD

there must be 'pores in the flesh' through which the blood 'percolated' from the ends of the arteries to the commencements of the veins. The last link in the evidence was supplied some thirty years later by Malpighi, an Italian scientist, who with the help of the microscope showed these 'pores' to be the minute vessels now called 'capillaries'.

The course of the circulation is as follows: The veins pour their blood coming from the head, trunk, limbs, and abdominal organs, into the right auricle of the heart. This contracts and drives the blood into the right ventricle, which then forces the blood

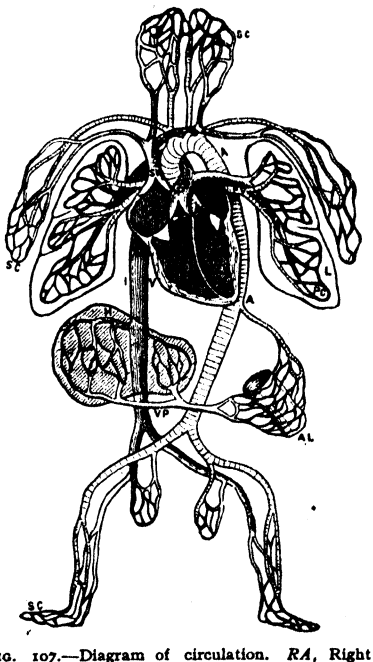


FIG. 107.—Diagram of circulation. *RA*, Right auricle; *RV*, right ventricle; *P*, pulmonary artery; *PC*, capillaries in lung; *PV*, pulmonary veins; *LA*, left auricle; *LV*, left ventricle; *A*, aorta; *SC*, capillaries of general system; *AL*, capillaries in bowels; *VP*, portal vein; *H*, circulation in liver; *IV*, *SV*, inferior and superior vena cava. (Turner's *Anatomy*.)

into the lungs by way of the pulmonary artery. Here it is contained in thin-walled capillaries, over which the air plays freely, and through which gases pass readily out and in. The blood

gives off CO_2 and takes up oxygen (*see* RESPIRATION), and passes on by the pulmonary veins to the left auricle of the heart. The left auricle expels it into the left ventricle, which forces it on into the aorta, or great artery, by which it is distributed all over the body. Passing through capillaries in the various tissues it enters the veins, which ultimately unite into two great veins, the superior and the inferior vena cava, these emptying into the right auricle.

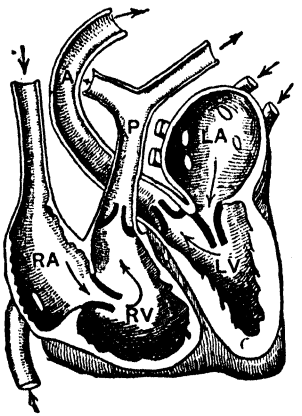


FIG. 108.—Diagram of the heart opened from in front to show the action of the valves. *RA*, Right auricle; *RV*, right ventricle; *P*, pulmonary artery; *LA*, left auricle; *LV*, left ventricle; *A*, aorta.

This complete circle is accomplished by any particular drop of blood in about half a minute.

In one part of the body there is a further complication. The veins coming from the bowels, charged with food material and other products, split up, and their blood undergoes a second capillary circulation through the liver. Here it is relieved of some food material and purified, and then passes into the inferior vena cava, and so to the right auricle. This is known as the 'portal circulation'.

The circle is maintained always in one direction by four valves, situated one at the outlet from each cavity of the heart. (*See* HEART.)

The blood in the arteries going to the body generally is bright red, that in the veins dull red in colour, owing to the former being charged with oxygen, the latter with carbonic acid. (*See* RESPIRATION.) For the same reason the blood in the pulmonary artery is dark, that in the pulmonary veins bright.

It must be remembered that there is no direct communication between the right and left sides of the heart, the blood passing from the right ventricle to the left auricle through the lungs.

In the embryo, before birth, the course of circulation is somewhat different, owing to the fact that no nourishment comes from the bowels nor air into the lungs. Accordingly, two large arteries pass out of the navel, and convey blood to be changed by contact with maternal blood (*see* AFTER-BIRTH), while a large vein brings this blood back again. There are also communications between the right and left auricle, and between pulmonary artery and aorta. At birth all these extra vessels and connections close and rapidly shrivel up.

CIRCULATION OF SECRETIONS.—There are many subsidiary circulations in the body depending, in part of their course, upon the circulation of the blood. The *lymph*, which percolates out from the minute blood-vessels to bathe the tissues with nutritive material, does not return directly, but is collected by a multitude of small lymphatic vessels which, passing through glands as through filters, unite ultimately into two vessels, the thoracic duct and right lymphatic duct, and these open into the veins of the neck on the left and right sides respectively. The *saliva*, when swallowed, acts upon the food in the stomach during the first twenty minutes of digestion, but is gradually reabsorbed and carried round to the salivary glands again. This is proved by swallowing certain drugs in capsules, for example, iodide of potash, which are also absorbed from the stomach, and may, after fifteen minutes or thereabout, be found, by chemical tests, in the saliva. The *gastric juice* is secreted in much larger quantities than is generally supposed, about fourteen pints or more being mixed weekly with the food. Of this, the greater part is reabsorbed in the bowels, and probably used over again by the stomach. The *bile* secreted by the liver and poured into the small intestine, to the amount of

about two pints daily, circulates back to the liver by way of the lymphatics and then the blood stream, only about one-eighth of the whole amount being daily lost in the stools. Other glands produce secretions which similarly circulate and produce some important effects in the blood, in addition to their more obvious functions. These glands which secrete substances that are absorbed into the blood and influence the action of organs at a distance are known as ' glands of internal secretion ' or ' endocrine glands '. (*See* ENDOCRINE GLANDS.) There is thus some scientific justification for the old theory of the ' humours ' in the causation of disease.

CIRCULATION, DISORDERS OF. —The steady maintenance of the circulation depends upon two factors : (1) the power and regularity of the heart ; and (2) the condition of the walls of the vessels, especially of the small arteries. The arteries are not rigid tubes, nor are they merely elastic tubes of a definite size, for each vessel has the power of dilating and contracting within wide limits, so as to let a larger or smaller stream of blood pass through. These motions are controlled by constricting and dilating nerves governed by the nervous system, and upon the action of these, more than upon the heart, depends the state of circulation in various parts. For example, when cold strikes the skin the constrictor nerves are stimulated, the vessels contract, and the blood is driven from the skin, which becomes pallid. On the other hand, ' blushing ' is due to loss of control by these nerves over the vessels, or, when the redness is extreme, to stimulation of the dilating nerves by some emotion powerfully affecting the nervous system. Similar changes occur, under other conditions, in all the organs.

Causes and Symptoms.— *Inflammation* in its early stages is associated with great redness and swelling, due to excessive inflow of blood to the inflamed part through widely dilated arteries. *Congestion* is a condition sometimes due to inflammation, sometimes to an obstruction to the veins which should carry off the blood, or very often to the feebleness of the heart, which cannot drive the blood upwards from dependent parts like the feet, or like the back portions of the lungs in bed-ridden persons. In old persons with diseased vessels, in which blood-clots are liable to form, congestions of the brain readily take place from such obstructions. In weak persons, or those exhausted by illness, lying constantly on the back, congestion of the lungs is very apt to come on. Congestion of the lungs with bronchitis, and congestion of the liver and stomach with various disorders of digestion are common results of valvular disease of the heart. (*See* HEART DISEASES.) *Dropsy* and *varicose veins* are similar disorders often due to obstruction to veins. Dropsy is also a usual result of valvular heart disease, but still more commonly results from kidney disease. (*See* DROPSY *and* VEINS, DISEASES OF.) *Bloodlessness* of parts is a disorder in the opposite direction, due to spasm and extreme narrowing of arteries. It occurs in the form of ' dead fingers ', generally in women of a nervous temperament. (*See* RAYNAUD'S DISEASE.) A local blanching often precedes *chilblains*, which are due probably to a constriction in the veins, and which occur in persons of sluggish circulation. *Cold feet and hands*, especially at night, form a milder variety of the same condition. An internal condition of similar nature occurring in nervous persons and those subject to chilblains produces *catarrh of the small intestine*, with pain, coldness, and flatulence about the abdomen, and attacks of alternate constipation and diarrhœa. *Insomnia* in elderly persons is very frequently due to a disordered circulation, either because the vessels of the brain remain distended after the day's work is done, or, less commonly, because the vessels are extremely narrowed by disease, in either case that moderate fullness essential to sleep not being present.

Treatment.—Where any failure of the heart is present, the case is treated by various cardiac tonics, by rest, and by graduated exercises. Cases of disordered circulation depending on the vessels are much benefited by cold baths (*see* BATHS) and daily vigorous exercises, while good diet, warm clothing, and tonics are of the greatest importance for their cure. (*See also* CHILBLAINS.)

CIRCUMCISION (*circum*, around; *caedo*, I cut) means the cutting round and removal of the foreskin. It is performed as a religious rite among many tribes, notably by the Jews, and is advisable when the foreskin is so narrow at the opening, or so adherent, as to render its drawing back, for washing, impossible. If done in infancy, it is a trivial operation.

CIRRHOSIS, or FIBROSIS (κιρρός, yellow), is a diseased condition of various internal organs, in which the proper tissue is replaced by fibrous tissue similar to scar-tissue. The name 'Cirrhosis' was originally given by Laennec to the disease as occurring in the liver, because of its yellow colour, but it is now applied to a similar condition in the lung, kidney, stomach, etc.

Causes.—Cirrhosis of the liver is the result of an inflammatory condition produced frequently by the abuse of alcoholic liquors, more particularly of ardent spirits; it also follows the use of other irritating articles of diet, and is frequently produced by malaria and by syphilis. In many cases, however, the cause is obscure. Cirrhosis of the kidney is associated also with abuse of alcohol, with disease of the blood-vessels, and with gout. (*See* BRIGHT'S DISEASE.)

Symptoms.—In one form of cirrhosis the liver is much contracted (atrophic or coarse cirrhosis), its blood-vessels are pressed upon and dropsy results. In another form there is great enlargement of the organ (hypertrophic or biliary cirrhosis) and jaundice appears. Cirrhosis of the kidney is the most serious form of Bright's disease.

Treatment.—Nothing can be done to repair a cirrhosed organ, but the cause, if known, must be removed and further advance of the process thus prevented. In the case of the liver an occasional dose of blue-pill or calomel, followed by a saline purge, relieves the tendency to dropsy or jaundice. In cirrhosis of the kidney farinaceous diet, warm clothing, and careful hygiene of the skin and bowels are the essentials.

CIRSOID ANEURYSM is the term applied to the condition in which a group of arteries become abnormally dilated and tortuous.

CITRATE OF IRON AND QUININE and CITRATE OF IRON AND AMMONIA are much used and very valuable for tonics, especially after attacks of rheumatism and fevers. The dose is 5 to 15 grains of either dissolved in water.

CITRIC ACID is the acid which gives their sharp taste to lemons, limes, unripe oranges, currants, and raspberries. It is practically identical in action and appearance with tartaric acid, which is obtained from grapes and other fruits, though the two differ in chemical composition. They are similar also to malic acid, found in apples, pears, and the berries of the mountain ash.

Uses.—These vegetable acids and their salts (citrates and tartrates) are changed, on absorption into the blood, into alkaline substances, and act, therefore, to correct acidity. (*See* ACIDITY.) The acids themselves have the power of allaying thirst by stimulating the flow of saliva, and also of creating a feeling of coolness. For both these reasons they are much used for cooling drinks in fever. When, in addition, the stomach is irritable, they are best taken in the form of effervescing drinks, which soothe this organ.

For feverish conditions a few slices of lemon may be put in a tumbler of drinking water, or 'Imperial Drink' made as follows: To one pint of cold water add a teaspoonful of cream of tartar, a squeeze of lemon, and two lumps of sugar.

For an effervescing draught 20 grains of citric acid or the juice of one fresh lemon may be mixed with a large wine-glassful of water; 30 grains of bicarbonate of potash or 24 grains of bicarbonate of soda (*i.e.* about as much baking soda as will lie heaped up on a shilling-piece) are dissolved in another wineglassful of water; a third wineglassful of water is sweetened with sugar; the contents of the three wineglasses are mixed just before drinking.

CITRIN (*see* HESPERIDIN).

CITRINE OINTMENT, or NITRATE OF MERCURY OINTMENT, is used for

stimulating sluggish ulcers, and also diluted with olive oil, to smear over boils and prevent these from spreading, and in cases of eczema.

CLARET (*see* ALCOHOL).

CLAUSTROPHOBIA means the fear of being in a confined space, or the fear experienced while in it. It is a neurotic trait.

CLAVICLE (*clavicula*, a twig) is another name for the collar-bone.

CLAVUS (*clavus*, a nail) is a form of neuralgia about the head, often found in hysterical persons and others, compared by them to the pain of driving in a nail. (*See* NEURALGIA.) The term is also applied to a corn, or thickening of the horny epithelium upon the foot. (*See* CORNS.)

CLAW-HAND is a condition of bending and wasting of the hand and fingers, especially of the ring and little fingers. The condition is generally due to paralysis of the ulnar nerve. A somewhat similar condition is produced by contraction of the fibrous tissues in the palm of the hand, partly due to rheumatic changes and partly to injury caused by the constant pressure of a tool against the palm of the hand (*See* DUPUYTREN'S CONTRACTION.)

CLEANLINESS (*see* ASEPSIS, ANTISEPTICS, BATHS, DISINFECTION).

CLEFT PALATE is the term applied to a fissure of the roof of the mouth sometimes present at birth and very often combined with hare-lip. (*See* PALATE MALFORMATIONS.)

CLERGYMAN'S SORE THROAT is the name given to a complication of throat ailments, which gradually comes on in those who do much public speaking, and who possess weak vocal organs. Persons who suffer from it, as a rule, produce the voice badly, using the throat as a resonating chamber instead of gaining the full volume of the voice by keeping the lungs expanded. Speaking, accordingly, is performed with great effort, the more so as the muscles of larynx and throat become soon tired. These muscles increase in size, the mucous membrane of the throat and even of the nose becomes congested, and catarrh follows on every slight chill, chronic laryngitis and pharyngitis being set up. Still greater vocal efforts of an incorrect kind being made to overcome the consequent huskiness and feebleness, the condition gets inevitably worse and worse, till public speaking may become an utter impossibility.

Treatment.—The first essential is to obtain a correct voice-production, by expansion of the chest (*see* CHEST, DEVELOPMENT OF), for the chest is often badly formed or undersized, and by a course of lessons on elocution from a good teacher. (*See* VOICE AND SPEECH.) The affected person must also get out of the bad habit of straining the throat in speaking. Secondly, the mucous membrane of the throat must be got back to its original state by such measures as inhalations of ammonium chloride; gargles of potassium chlorate, or of common salt and baking soda (one teaspoonful of each in a tumblerful of cold water), or of aromatic substances, painting the throat with tincture of iodine or glycerin of tannin, and similar procedures. When the chronic inflammatory condition has proceeded further, and has set up considerable laryngitis and pharyngitis, the case should be under the care of a throat specialist, for local astringent applications to the larynx, throat, and nose are necessary, or even the reduction of swollen mucous membrane by the cautery. In advanced stages, complete rest of the voice for six months or a year may be essential, and a change to some climate where the air is warm, moderately moist, and quite free from dust, may be advisable. Such a climate is found along the south coast of England, on the Mediterranean shores, or in Florida.

CLIMACTERIC (κλιμακτήρ, the step of a ladder) was a word originally applied to the end of certain epochs or stages in the life of an individual, at which some great change was supposed to take place. Thus the Greeks supposed the whole body was renewed every seven years, and looked upon certain of these periods as of special importance. There is considerable justification for such a view, since fourteen is the age about which puberty, *i.e.* the commencement of sexual activity, appears; at twenty-one a subtle change

takes place, which renders this the most approved age for marriage, and the age at which legal majority is fixed in most countries; at or after forty-two takes place in women the 'grand climacteric', when menstruation and the power of bearing children cease; about sixty-three there appears in men a transitory enfeeblement so frequently as to receive also the name of 'climacteric', while a Hebrew writer has fixed the utmost span of robust life at 'threescore years and ten'. In women at the grand climacteric there is a special liability to bodily and mental weakness, although in those of a previously robust constitution any such change is generally merely temporary. Both at this time in women, and about the age of sixty-one to sixty-three in men, melancholy and a general sluggishness of mind and body may appear, but are in general completely recovered from.

CLIMATE IN RELATION TO DISEASE. Climate is of great medical importance, both because various diseases are found in one part of the world and not in others, so that it becomes necessary to know the reasons for this difference, and because removal of a diseased person to new conditions of air, warmth, moisture, etc., is often a most valuable means of cure.

The broad division of climates is into hot, temperate, and cold climates.

(*a*) **Hot climates** are generally considered as extending to about 35° from the equator, and possessing an average temperature throughout the year of about 84° Fahr. In the Southern Hemisphere, Monte Video, Cape Town, and Sydney lie just at the edge of this band, while north of the equator the limit divides the Northern from the Southern States of North America, skirts the south of Algeria, the north of India, and excludes Japan from the hot region. Generally speaking, there are, in this region, a wet and a dry season, but near the equator, two wet and two dry seasons. It is a generally held, but mistaken idea that the equator is the place of greatest heat on the earth's surface. At the tropics, some 1500 miles north and south of the equator, it is both much hotter and much drier than at the line itself. This corresponds north of the equator with Central Mexico, the centre of the Red Sea, Central India, and Hong Kong; while south of the line it passes through Rio de Janeiro, Damaraland, and Central Australia. These places are the hottest on the earth's surface, but far less unhealthy than the damp and steamy climate of the Amazon Valley, the Gold Coast, the Congo Valley, and Borneo, which lie on or near the line. The general character of the natives of these hot climates is lethargic and indolent; the skin and digestive organs are particularly active and specially liable to disease; dysentery, yellow fever, malaria, degenerations of the liver and diseases due to parasites being specially common, while on the other hand lung diseases are comparatively rare.

(*b*) **Temperate climates** are those from about 35° to 55° of latitude, and have a mean temperature of about 38° F. in winter and 68° F. in summer. Including, as these regions do, the Northern American States, and south of Canada, Central and Southern Europe, and, in the East, Japan, they comprise the peoples who have been most distinguished for physical and mental superiority.

(*c*) **Cold climates** are those from 55° latitude to the poles. The cold is much modified, however, in some localities by ocean currents, so that Scotland, at the same latitude as Labrador, enjoys a temperate though moist climate, the surrounding seas and air being warmed by the Gulf Stream. The people of these northern latitudes are hardy and vigorous, and, though chest and kidney disorders are more common than in the temperate climes, they suffer from fewer diseases.

But, in estimating the effect of climate, far more than mere distance from the equator has to be considered. The degree of moisture in the air and presence of the sea near at hand, the rareness of the air in consequence of elevation, the difference between night and day temperatures, and the presence or absence of dust and bacteria are all of vital importance. For these reasons climates are classed into four sub-varieties: (1) sea-board and ocean climates; (2) inland low climates; (3) mountain climates; (4) dry climates.

(1) **SEA-BOARD AND OCEAN CLIMATES.**—The important features

of these climates are the large amount of moisture in the air, the density of the latter compared with that of mountain air, and the presence of more or less salt. The air of the high seas is also free from dust and bacteria, a point of great importance in lung diseases. The cases for which seaside air is most suitable are those convalescent from acute diseases, those worn out by business or social worries, and, above all, those of a scrofulous tendency (*i.e.* troubled with enlarged glands, etc.). The seaside air has a powerful action in increasing tissue change, by reason of its density, while its saltness stimulates the brain and muscles to greater activity during the day, and leads to healthy sleep at night. Holidays at the seaside, especially if the holidays be perforce short, as a rule benefit the jaded dweller in towns more than any other form of 'change of air', although, for the youthful and vigorous, mountain air is often better.

Perhaps the mildest climate in existence is that of the Mediterranean shores from Spain to Greece on the north, and in Algeria on the south. The proper time to seek this part is from October to May, so as to avoid the colder northern winter.

Ocean voyages are specially valuable for cases of early consumption, which have shown themselves by slight hæmorrhage, or for persons who are simply delicate and who have a hereditary tendency to consumption. Cases in which there is fever and sweating at night, or in which the disease has advanced to any extent, should never embark on a long sea-voyage. Various other chronic lung diseases benefit immensely from a long voyage, and so do those persons broken down by overwork. One of the best voyages for English people is that to Australia or New Zealand, which takes over one month, and on which the patient experiences a variety of climates with corresponding stimulation to the system. By leaving England in the late autumn and returning in the late spring, the patient escapes the winter altogether, and has two or three months at the Antipodes, which should be spent in the mountains of Australia or New Zealand. In going to Australia, one should choose a cabin on the port side, and, in returning, one to starboard, for, by this means, the cool breeze is secured both ways. From the States perhaps the usual voyage is to the West Indies and thence across to Europe, and back. Another good variety of climate is got by the voyage in which call is made at Lisbon, Teneriffe, Rio de Janeiro, Monte Video, and often a North American port.

(2) INLAND LOW CLIMATES include most of the health resorts to which people go in order to drink mineral waters. The general character of inland climates is the great variation between the summer and winter temperature, but, as most of these places are resorted to only in the open part of the year, the climate goes often by the vague name of 'relaxing', in contradistinction to the 'bracing' climate of mountains. In such a climate, the moistness and density of the air, the warmth, and the absence of stimulating sea breezes combine to reduce the pressure at which life is carried on, to diminish the appetite, and to give the organs which discharge waste products from the body a better chance to carry out their functions. This is aided by the various waters peculiar to these spas. The diseases for which this type of climate is most suitable are rheumatism, gout, skin diseases, and other chronic constitutional troubles. Examples of this climate are given by Harrogate, Bath, and the watering-places of the Rhine basin. Diseases of the heart and other parts of the circulatory system are treated at some of the less depressing of these resorts, such as Nauheim, Schwalbach, etc., where tonic treatment and graduated exercises aid the restful action of the climate.

(3) MOUNTAIN CLIMATES have, as their chief character, the rarity of the air, by reason of which the breathing and heart-beats are increased in rate, and a feeling of buoyancy and increased strength given to the whole system. Further, the air is drier and less laden with dust and bacteria, and there is greater difference between the day and night and between the sun and shade temperatures than at lower levels. Accordingly the mountains are suitable for persons who, though overworked and broken-down, are young and of good physique; for those who are young

but delicate, disposed by heredity to consumption, and who have outgrown their strength; for those also who suffer from chronic lung diseases with a certain amount of fever, and for whom sea-voyages are unsuitable. But for the weak and aged, for those with heart diseases, and for those with kidney diseases, mountain climates are unsuitable.

(4) **DRY CLIMATES OR DESERT CLIMATES** combine warmth and dryness. In addition, the air is very pure from bacteria, though apt to be dusty, and the nights are very cold. Such climates are found in Egypt, Australia, some of the Western States of the Union, and, in a milder degree, on the Pampas of South America and the tablelands of Cape Colony. These are suited especially for kidney diseases and chronic rheumatism, in both of which a maximum of perspiration is desirable, and *par excellence* for consumptive cases, in which a cavity in the lung is present, that the dry, mummifying air greatly helps to heal. All these cases must avoid the chill night air, and consumptive cases must, so far as possible, exclude the dust of the desert from their lungs.

CLINICAL (κλίνη, a bed) means literally 'belonging to a bed', but the word is used to denote anything associated with the practical study or observation of sick persons, as clinical medicine, clinical thermometers.

CLINICS (*see* MATERNITY AND CHILD WELFARE).

CLONIC (κλόνος, a tumult) is a word applied to short spasmodic movements.

CLOT is the term applied to any semi-solid mass of blood, lymph, or other body fluid. Clotting in the blood is due to the formation of strings of fibrin produced by the action of a ferment. Milk clots in a similar manner in the stomach when exposed to the action of the ferment rennin. Clotting occurs naturally when blood is shed and comes in contact with tissues outside the blood-vessels. It occurs also at times in diseased vessels (*thrombosis*) producing serious effects upon the organs supplied by these vessels. Clots also form sometimes in the heart when the circulation is feeble and the blood passes slowly through this organ, especially when some form of blood poisoning is present. (*See* EMBOLISM.)

CLOTHING has certain medical aspects in its relation to the preservation of health.

Five chief substances are used in manufacturing clothes, viz.: *sheep's wool*, from which worsted, flannel, and alpaca are made; *silk*, from which also velvet, satin, and crepe are produced; *flax*, from which linen, and the finer cambric and lawn originate; *cotton*, giving us, by various forms of weaving, calico, jean, flannelette, fustian, and muslin; and *cellulose*, producing artificial silk.

However these are manufactured, each of the five has certain properties which render it more or less suitable for clothing purposes in different circumstances.

(*a*) **Warmth.**—Those materials which conduct heat badly, retain the animal heat of the body, and so preserve its warmth best. The worst conductor is wool, and with it, furs and down; next come silk and cotton; while linen, conducting heat away most readily, is coolest. Wool, in fact, makes twice as warm a covering as linen of equal thickness. Colour, however, has a most important influence on the coolness of clothing, quite apart from material, and if the body be exposed to the sun's rays clad in black or dark blue, more than twice the amount of heat is absorbed that would be absorbed if the clothing were of the same material but white in colour. Thus white clothes are twice as cool as black or blue material in the heat of summer. Red stands about half-way between, while yellow is almost as cool as white. The texture has also much to do with warmth, quite apart from the actual weight of material employed. Thus material so made as to contain many spaces in the meshes of its threads, such as cotton-wool, knitted clothes, and 'cellular' underclothing, is much warmer than the same weight of closely woven calico, or flannel. The reason is that the intervening air is a still worse conductor of heat than the material. For the same reason, a single garment is not so warm as two

garments each of half its thickness, which have a layer of air between them. Another cause of the warmth of woollen underclothing lies in the scratching action of its rough hairs upon the skin. Persons with sensitive skin, who cannot bear this, may avoid it, and still wear wool, by having next the skin one of the net-work garments now much used for summer wear.

(*b*) **Absorptive power** is of immense importance, and varies greatly in the different materials. During perspiration, the garments absorb the moisture from the skin surface, and give it off into the surrounding air. Wool absorbs moisture twice as rapidly as cotton, and almost twice as rapidly as silk or linen. Accordingly, if a person be exerting himself vigorously in the sun, or in a hot room, he experiences a much more cooling effect at first if wearing linen or cotton next the skin, because these conduct away the heat more rapidly than wool, but, as he begins to perspire, woollen clothes, which carry off the perspiration better, render him both cooler and less clammy. If, in a state of free perspiration, he now goes out into the cold air, provided he be wearing cotton underclothing, this and the skin are reduced speedily to a dangerous condition of damp cold, whereas, if he be clothed in woollen material, the gradual cooling goes on much as before, and a dangerous reduction of heat is prevented by the poor conducting power of the wool. Waterproofs have absolutely no absorptive power, and prevent not only rain from passing inwards, but perspiration from getting out.' Accordingly, exertion in a waterproof produces much heat and soaking perspiration, but as the thin waterproof allows the heat to pass off quickly; it is a very undesirable costume for more than merely temporary use.

(*c*) **Non-inflammability** of clothing is a point which is of some importance, for while linen, cotton and the cloth called 'flannelette' blaze up when ignited, silk burns much more slowly, and wool smoulders slowly away without catching flame. Linen and muslin may, however, be made as non-inflammable as wool, by treating with a 'fire-proof starch' containing tungstate of soda.

General considerations.—From what has been stated, it will appear that, for outdoor clothes, sheep's wool is warmest in winter. For *summer wear* light-coloured clothes are coolest, and for much exercise with periods of rest, such as at cricket, tennis, etc., the clothes should be of white wool. For *underclothing*, one should wear wool next the skin both summer and winter, persons with irritable skin choosing fine merino wool or placing a network garment beneath the woollen one. Loose-fitting underwear is both more comfortable and warmer than tight-fitting. For *nightwear*, linen, cotton, or silk is better than flannel, because the warmth is maintained by the bedclothes and the sleeper does not, or should not, perspire. *Hats* are of importance to men, though of little necessity as a covering to women with thick hair. The silk hat is, perhaps, the worst form possible for summer wear. (*See* BALDNESS.) For winter a soft felt hat is, perhaps, the ideal wear, while in summer a straw or light-coloured felt is suitable, and, for the blazing suns of the tropics, a helmet of pith or wickerwork covered with white cotton. *Veils* are probably quite harmless, apart from the dye they contain possibly causing eruptions; nevertheless, they have been blamed as the cause of squinting and short-sight. *Corsets* are of very doubtful value. For young and healthy women they are quite unnecessary. The feeling of limpness, felt when they are discarded, is simply begotten of their constant use. For elderly women, who possess much fatty tissue, corsets, combined especially with an abdominal belt, give relief from many minor troubles and improve the figure. An abdominal binder or cholera belt of woollen material is very useful for persons subject to intestinal disorders. An abdominal belt is also helpful in the case of displacements of various organs such as the kidney and stomach. *Boots* form often a badly made article of clothing. (*See* CORNS AND BUNIONS.) Children, especially when growing rapidly, may show a tendency to 'weak ankles' or 'flat-foot'. They should wear shoes or sandals, because boots prevent the natural action of the ligaments and muscles at the ankle; the shoes should also have low heels.

CLOVES are the unexpanded flower-buds of a species of myrtle, *Caryophyllus aromaticus*, from the Indian Archipelago. Oil of cloves is a powerful antiseptic, checks griping, and covers bad breath. It may be taken in doses of 2 or 3 drops on a lump of sugar or one tablespoonful of infusion of cloves may be similarly used. Cotton-wool dipped in clove oil, and put in a hollow tooth, relieves toothache.

CLUB-FOOT, or TALIPES (*talus*, the ankle; *pes*, the foot), is a deformity

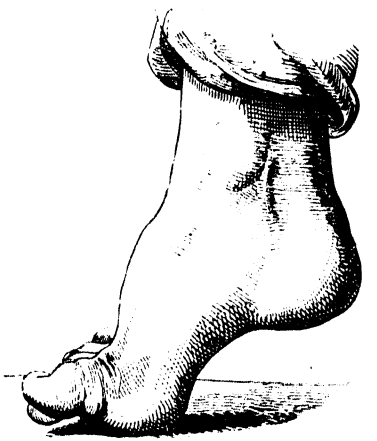


FIG. 109.—Talipes equinus. (Miller's *Surgery*.)

in which the foot is permanently twisted at the ankle-joint, so that the sole no longer rests on the ground in standing.

Varieties.—The foot can be twisted in four directions. The heel may be pulled up so that the person walks on his toes (*talipes equinus*), or the toes may be bent up so that he walks on his heel only (*talipes calcaneus*), or the sole may look inwards so that he walks on the outer edge of the foot (*talipes varus*), or outwards so that he walks on the inside of the foot (*talipes valgus*). These are usually combined, the heel being drawn up and the sole turned inwards (*equino-varus*), or the heel resting on the ground and the sole looking outwards (*calcaneo-valgus*). A more important division is into those cases in which the deformity exists at birth, which are generally at first fairly easily rectified; and into those cases which are acquired later in life as the result of some disease, which do not yield to such simple treatment.

Causes.—The cases found at birth are due to some arrest of development, or some faulty position of the fœtus in the womb. The popular idea, that a fright received by the mother may cause the deformity, is improbable. Those which are acquired later may be caused by some spasm in the muscles of one side of the leg, or especially by paralysis of the muscles on the side of the leg away from the deformity (infantile paralysis), or by rigidity due to the scar following a burn or inflammation.

Treatment.—For the cases acquired after birth, an elaborate treatment, including one or several operations, or the wearing of some special appliance to support the ankle in the correct position, is usually necessary. When the deformity is due to paralysis, the application of massage and electricity to the affected muscles is often requisite. When it is caused by scars or muscular spasms the muscles or their tendons must be divided before replacement in the correct position is possible. In all cases it must be remembered that, after the foot has been placed in good position by operation or otherwise, the cure

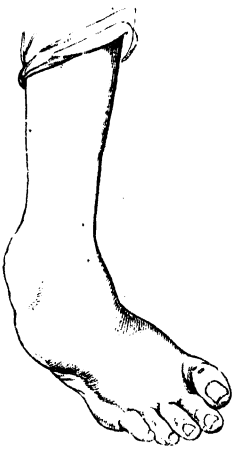


FIG. 110.—Talipes equino-varus. (Miller's *Surgery*.)

is not complete till after several years of care, because there is, for long, a great tendency to relapse.

The cases found deformed at birth have some distortion in shape of the bones about the ankle, but, as these bones are very soft in the young child, the condition is often quite remediable by attention on the part of the mother or nurse. The position of the foot must be corrected several times daily, the nurse grasping the fore part of the foot and pressing it gently, slowly, and firmly into position, after which she holds it in place for five or ten minutes. In addition to this, the muscles of the leg, especially those opposite the side to which the foot turns, should be repeatedly massaged every day. Generally it is also necessary to apply a splint which holds the foot in the correct position, so that, as growth goes on, the bones are moulded to the proper shape in a few months.

If the condition be not attended to at once after birth, and also in bad cases, an operation may become necessary, consisting, during the first few months of life, in the division of tendons, and if deferred till later, in the removal of parts of the deformed bones, so that the foot may be brought to its natural position.

CLYSTER (κλυστήρ) is another name for enema.

COAGULATION is another name for clotting. (*See* CLOT.)

COAGULUM is the Latin term for a clot.

COAL-GAS is a mixture of several gases, but owes its dangerous properties to carbonic oxide or carbon monoxide gas, which is present to the extent of 5 or 10 per cent. Water-gas, which is sometimes mixed with coal-gas, contains a still larger proportion of this dangerous substance. It has two dangers, that of explosion and that of poisoning. Explosion takes place when gas has escaped into a closed space to such extent as to make a mixture of 1 part of gas to 10 parts of air, and when a light is brought into the mixture. But a mixture of 1 part of gas to 100 of air is a dangerous poison to inhale. The burning of one cubic foot of wood is enough in the absence of a ventilating draft to poison a mine gallery one-quarter mile long. When a person enters such an atmosphere death may be almost instantaneous; but if only small traces of the gas are present the poisoning comes on very insidiously. Carbon monoxide has a special action upon the ganglia at the base of the brain, and large quantities cause destructive changes in this part of the nervous system.

A very slight but constant escape of gas, insufficient even to cause a smell throughout a room, is enough to cause headache, inflamed throat, and general ill-health in those living or sleeping in the room. Fatal cases often occur from accidental escape of gas during sleep, and a much smaller percentage of gas in the air than that necessary to explode, will cause death if inhaled for a few hours. A case is recorded, in which a whole family in Glasgow was poisoned during sleep by an escape of gas outside the house beneath the street, the surface of which was at the time frozen hard; and although an oil-lamp remained burning in the bedroom all night no explosion resulted.

Treatment of gas poisoning consists of artificial respiration and fresh air. (*See* DROWNING.) The inhalation of oxygen or air containing a small quantity of carbon dioxide (4 to 6 per cent) has been found especially valuable in mine-rescue work for freeing the blood quickly from carbon monoxide gas.

COAL-MINER'S LUNG is a condition in which, from the constant respiration over many years of air containing fine coal dust, this is deposited in the tissues of the lungs, which, in consequence, become black in colour and slightly hardened. The coal dust appears to have very little harmful effect.

COCAINE.—Coca leaves are got from two South American plants, *Erythroxylon coca* and *Erythroxylon bolivianum*, and contain an alkaloid, COCAINE, which has most marked effects as a stimulant, and, locally applied, as an anæsthetic by paralysing nerves of sensation. The dried leaves have been used from time immemorial by the South American Indians, who chew them mixed with a little lime. Their effect is to dull the mucous surfaces of mouth and stomach, with which the

saliva, produced by chewing them, comes into contact, thus blunting, for long, all feeling of hunger. The cocaine, being absorbed, produces on the central nervous system a stimulating effect, so that all sense of fatigue and breathlessness vanishes for the time. It was by the use of coca that the Indian post-runners of South America were able to achieve their extraordinary feats of endurance, using half an ounce or thereabout of the leaves daily. The continued use of the drug, however, results in emaciation, loss of memory, sleeplessness, and general breakdown.

Uses.—Before the serious effects that result from its habitual use were realised the drug was sometimes used by hunters, travellers, and others to relieve exhaustion and breathlessness in climbing mountains, to steady the nerves, and to dull hunger. Also it was taken by students to carry them over a short period of intense brain work, such as in passing an examination. But this practice is extremely dangerous as tending to result in a habit. (*See* DRUG HABITS.) The chief use in medicine is by local application to dull pain. Internally, it relieves the pain of cancer and other diseases of the stomach. Cocaine ointment is useful to relieve pain in cases where the skin surface is broken, for example, in eczema, shingles, piles, and itchiness. Discs of cocaine (in gelatin), or a 4 per cent watery solution is used to soothe pain in the eye caused by foreign bodies and the like, or to enable operations to be performed, painlessly, on this organ. Artificial chemical compounds closely allied to cocaine are injected hypodermically in order to render painless small operations, such as amputation of the fingers, and by injection into the spinal canal to enable formidable operations to be done on the lower limbs without pain. (*See* NOVOCAIN.)

COCCUS (κόκκος, a berry) is the name applied to a rounded form of bacterium. (*See* BACTERIOLOGY.)

COCCYDYNIA, or COCCYGODYNIA, means the sensation of severe pain in the coccyx.

COCCYX (κόκκυξ a cuckoo) is the lower end of the spinal column, resembling a bird's beak and consisting of four nodules of bone, which represent vertebræ, and correspond to the tail in lower animals. They are deeply buried in the muscles in man, but in occasional cases they project backwards, and are surrounded by a fold of skin, so as to form an actual tail.

COCHINEAL, or CARMINE, is a bright red powder derived from a dried American insect, *Coccus Cacti* It is used to colour various medicinal preparations.

COCILLANA is the bark of *Guarrea Swartzii*, a South American plant with properties similar to those of ipecacuanha. It is much used as a remedy in coughs and also as an aperient.

COCOA, or CACAO, is a West Indian plant, *Theobroma cacao*, first brought to Europe by Columbus. It bears a fruit containing pulp in which are embedded seeds, each as large as a bean. The seeds are fermented for some days, then roasted to loosen their husk, after which the two halves of each are pressed out as 'cocoa-nibs'. The nibs consist, half of a fat called cocoa-butter, and half of albuminous material, starch, tannin, gum, and water in varying proportions. There is an alkaloid named theobromine, very similar to the caffeine of tea and coffee, present to the amount of 1 per cent, which gives to cocoa and chocolate their stimulating properties. Of tannin, there is about half the amount that is present in tea leaves. The 'soluble-cocoa', sold for domestic use, has much of the fat removed, and consists about one-half of sugar and starchy material, one-quarter of fat, one-fifth of albuminous material, and of moisture, salts, etc., in small amounts. The cocoas of different makers are all very similar. As a food, cocoa is much overrated, although it contains a fair amount of fat, and, when made with milk and sugar, forms a valuable food. As it contains little tannin, it is sometimes tolerated by a weak stomach better than tea. (For uses see CHOCOLATE.)

CODEINE is one of the active principles of opium, much used to check severe coughing. (*See* OPIUM.)

COD-LIVER OIL is made in large quantities in Norway and Newfoundland by purification of the oil pressed

from the livers of cod-fish. Its value lies in the fact that it is a liquid and easily digested form of fat, the biliary substances, mixed with the oil in small amount, possibly aiding its absorption. It seems also to aid the absorption of other food in wasting diseases. The oil is made much more palatable by being mixed with gum or glycerin, so as to form an emulsion, which then consists in about half its bulk of oil. Cod-liver oil with extract of malt is very nutritious, and generally readily taken by children. Most of the value of cod-liver oil lies in the fact that it contains a large amount of fat-soluble vitamin D which renders it specially useful in the prevention and cure of rickets.

Uses.—It is in wasting diseases, such as chronic consumption, debility with glandular enlargement, and rickets, that it is of most value. In the bronchitis of old people, it soothes cough and relieves the disease. And in various nervous complaints, such as neuralgia, nervous breakdown, and rheumatic gout, as also in some chronic skin diseases, it is much used.

Administration. — An emulsion is taken more readily by children than the pure oil, and should be given in small amount at first. A teaspoonful after the evening meal for a day or two, increasing to a dessertspoonful, and later to a tablespoonful, always immediately after meals, is the best way to commence its administration. Lemon juice removes its taste from the mouth after swallowing. Sometimes a child cannot be made to tolerate the oil, and it may then be administered by inunction. A tablespoonful is rubbed well into the abdomen every night, and a broad flannel binder is constantly worn and changed only once a week.

COELIAC DISEASE is a wasting disease of childhood in which there is inability to absorb fat from the intestines; there is therefore an excess of fat in the stools.

COELIOSCOPY is the term applied to a method of viewing the interior of the abdomen without a serious operation, in cases where a tumor or some other condition requiring operation may be present but cannot with certainty be diagnosed. The examination is carried out by making a minute opening under local anæsthesia, inserting an instrument bearing an electric lamp and telescopic lenses like that for examining the bladder (cystoscope) and blowing up the abdominal cavity with air. Some of the various abdominal organs can then be directly inspected in turn.

COFFEE and TEA.—Tea was introduced into Europe in 1610, but for long was so expensive that its use did not become general till during the course of the last century. Coffee, introduced rather later, has become the general beverage among the Latin and Teuton races, while tea has become the favourite over the whole British stock.

Coffee is a bean, obtained from the seed of a plant, *Coffea arabica*, originally hailing from Arabia, and now cultivated in tropical climes all round the world. Tea is the leaf of a plant, *Camellia thea*, brought first from China and now cultivated in Japan, India, and Ceylon, in the latter two of which it flourishes even more vigorously than in China. They agree in containing the same active principle, caffeine or theine, and tannic acid (or tannin), in addition to vegetable fibre and albuminous matters, while both possess volatile oils, which give them their peculiar aroma and flavour. The same alkaloid gives their stimulating properties to maté, or Paraguay tea, derived from the leaves of *Ilex paraguayensis*, and to kola, derived from the seeds of *Cola acuminata*, a West African plant. As to caffeine, which has the action of stimulating the intellectual powers, and increasing the force of the heart's action and the functions of the kidneys, see CAFFEINE; tea-leaves contain from 2 to 4 per cent, while coffee-berries have about half that amount. As to tannic acid, tea-leaves have about 10 per cent, and coffee-berries half this amount. But as regards the liquids, since coffee is made about twice as strong as tea in general, a strong teacupful of either will contain nearly two grains of caffeine and over three grains of tannic acid. Coffee, is however, often extensively adulterated with chicory (*see* ADULTERATION OF FOOD), which has no virtue beyond

imparting a dark colour to the mixture and changing its flavour somewhat.

COLCHICUM, the bulb of *Colchicum autumnale*, or meadow-saffron, has long been used as a remedy for gout in all the forms of this disease. How it acts is not quite certain. It stimulates the activity of the whole alimentary system, and is supposed by some to produce its effect by its action on the liver. Its power to relieve the pain of acute gout is also attributed to the power which it possesses of dulling sensory nerves.

Uses.—Its main use is in gout, for which colchicum tincture in 5 to 15 drop doses is the form generally employed. Its action is more certain after a purgative has been given. Colchicum has, however, dangers in large doses, being an irritant poison, and depressing the heart's action. If too large a dose has been taken, an emetic should be administered and the heart's action helped by stimulants.

COLD, INJURIES FROM (*see* CHILBLAINS, FROST-BITE, *also* CHILLS AND COLDS).

COLD, USES OF.—The application of cold to the surface of the body is capable of influencing the progress of disease in deep-seated parts to a considerable extent by acting on the blood at the surface, or through the nerves which end in the skin. Cold is applied for five chief purposes:

(*a*) **To subdue pain.**—In headache, a wet cloth to the forehead, or sponging with an evaporating mixture of vinegar and water, or eau-de-Cologne and water, is a well-known remedy. Sprains, if treated by holding the injured joint at once under running water, are much relieved. Later on, however, cold applications do harm, rather than good, by preventing the absorption of the effused blood. Pleurisy is often speedily rendered painless by the application of an ice-bag to the side. Small operations may be done painlessly after freezing the skin of the part by spraying ethyl-chloride over it.

(*b*) **To lessen inflammation.**—Ice-bags are used in many inflammatory conditions, such as appendicitis, to prevent the formation of an abscess. In meningitis, or inflammation of the membranes of the brain, a coil of tubing, through which iced water runs, laid on the head, very often gives some relief.

(*c*) **To reduce high temperature.**—In any fever, sponging the arms and legs, one by one, with tepid water, is harmless and often very soothing. When the temperature runs very high, *e.g.* to 105° or 107°, death is often averted by wrapping the patient in a wet sheet and rubbing it with ice, or by putting him in a cold bath. (*See also under* TYPHOID FEVER *and* WET PACK.)

(*d*) **To stop hæmorrhage.**—In cases of increasing hæmorrhage under the skin, for example, a bruised and blackening eye or a sprain, the amount of bleeding, and consequent discoloration, is lessened by applying compresses containing ice or some cooling lotion. In cases of internal hæmorrhage, ice may, with great benefit, be sucked if the bleeding be from the lungs, or swallowed in small fragments if from the stomach. Ice-bags are also applied over the chest, or abdomen, as the case may be.

(*e*) **As a general stimulant.**—Some diseases are systematically treated in certain countries by cold bathing, for example, typhoid fever. Others are benefited by an alternation of hot and cold bathing, for example, chronic rheumatism. In general debility, one of the best curative agents is the daily cold bath. (*See* BATHS.)

COLDS (*see* CHILLS AND COLDS).

COLECTOMY is the operation for removing the colon.

COLEY'S FLUID was a remedy, consisting of a vaccine of several bacteria, introduced for the treatment of malignant growths. It has now fallen into disuse.

COLIC (from κόλον, the large intestine).—By this term is generally understood an attack of pain in the abdomen, usually seated in the neighbourhood of the navel, of spasmodic character, and attended for the most part with constipation.

Causes.—Various forms of this complaint are described by medical writers. The most important are *simple* or *flatulent colic* and *lead colic*.

SIMPLE COLIC commonly arises from the presence in the alimentary canal of some indigestible matter, which

excites spasmodic contraction of the muscular coats of the intestines. The pain of colic is relieved by pressure over the abdomen, and there is no attendant fever—points which are of importance in distinguishing it from inflammation.

Attacks of this form of colic may occur in connection with a variety of causes other than that above mentioned, *e.g.* from accumulations of feculent matter in the intestines in the case of those who suffer from habitual constipation; also as an accompaniment of nervous and hysterical ailments, and not infrequently as the result of exposure to cold and damp, particularly where the feet become chilled, as in walking through snow. Similar attacks of colic are apt to occur in infants, especially those who are fed artificially; and in such cases it will generally be found that a temporary change of diet will be necessary. The duration of an attack of simple colic is seldom long, and in general no ill consequences follow from it. It is, however, not free from risk, especially that of sudden obstruction of the bowel from twisting, or invagination of one part within another (intussusception) during the spasmodic seizure, giving rise to a very grave condition. Colic is also a serious symptom when due to obstruction of the bowel by a tumor or similar condition. (*See* INTESTINE, DISEASES OF; INTUSSUSCEPTION.)

LEAD COLIC is of greater importance and interest from a medical point of view (*Syn.* painters' colic, *colica Pictonum*, Devonshire colic, dry belly-ache), since it has been clearly ascertained to be due to the absorption of lead into the system. This disease had been observed and described long before its cause was discovered. Its occurrence in an epidemic form among the inhabitants of Poitou was recorded by Francis Citois, in 1617, and the disease was thereafter termed *colica Pictonum*. It was supposed to be due to the acidity of the native wines, but it was afterwards found to depend on lead contained in them. About the middle of the eighteenth century this disease, which had long been known to prevail in Devonshire, was carefully investigated by Sir George Baker, who traced it to the contamination of the native beverage, cider, with lead, either accidentally from the lead-work of the vats and other apparatus for preparing the liquor, or from its being sweetened with litharge. (*See* LEAD POISONING.)

The terms ***hepatic colic*** and ***renal colic*** are applied to that violent pain which is produced, in the one case where a biliary calculus or gall-stone passes down from the gall-bladder into the intestine, and in the other where a renal calculus descends from the kidney along the ureter into the bladder, These affections are, however, entirely different from true colic. (*See* GALL-STONES *and* KIDNEY, DISEASES OF.)

Treatment.—The treatment of colic consists in means to relieve the spasmodic pain, and in the removal, where possible, of the cause upon which it depends. The former of these indications is fulfilled by the administration of opiates (except in the case of children) and of belladonna and the application of warm fomentations to the abdomen. Where the attack appears to depend on accumulations of irritating matter in the alimentary canal, a brisk purgative, such as castor oil, will in addition, be called for. It must be borne in mind that abdominal pain may indicate the onset of acute appendicitis or be a sign of, say, perforation of a peptic ulcer: in such cases purgatives must on no account be given.

Pressure upon the abdomen may relieve the pain partially if not completely. It may be effected, in the case of a child, by laying it face downwards across the nurse's arm, and in the case of older people by laying a hot-water bottle upon the abdomen, or by lying face downward upon a folded-up pillow. The various substances known as carminatives or antispasmodics (*see* ANTISPASMODICS) also aid in giving relief. For the treatment of lead colic see LEAD POISONING.

COLITIS (κόλον, the largest intestine) means inflammation of the colon or first part of the large intestine. Chronic colitis is known by various names such as *mucous colitis, membranous enteritis, mucous colic*, etc., and occurs especially in women of a nervous or hysterical type. It has increased greatly in frequency of recent years, partly in all probability owing to the spread of luxury in eating and partly in conse-

quence of its having attracted greater attention in slight cases.

Causes.—Some cases of slight degree are set up by local irritation from an unsuitable course of diet, for example in children ; or by irritation of the bowel through disease in neighbouring organs, *e.g.* from ovaritis. In most cases there is an excessive secretion of mucus, gradual in onset, sometimes associated with life-long distension of the bowel, and almost always accompanied by symptoms of nervous debility. In many cases it is difficult to say which of these is cause and which the result. As the case progresses, putrefactive changes in the stools take place, leading to much aggravation of the bowel condition as well as to deterioration of the general health. Some cases are associated with the presence of defective teeth and suppuration in the mouth, to which the colitis is probably due.

Symptoms.—The most prominent symptom usually is the passage of large quantities of mucus along with the stools, which may be either slimy and gelatinous, or in strings and strips of membrane. This appearance of mucus alternates with periods of constipation, and is associated with diarrhœa and pain in the abdomen. Most of the patients are nervous, self-centred, and very often highly neurasthenic ; and even after the bowel condition is cured feebleness of strength, palpitation on exertion, and similar symptoms generally persist for a long time. The disease is not serious to life, but is usually very prolonged and difficult to treat.

Treatment.—In the first place the general symptoms of debility and nervousness require treatment by rest and tonics or by occasional change of air and scene. In many cases this, combined with a return to a dietary of simple food restricted to three meals daily, is sufficient to effect a cure. In more advanced cases, in which the discharge of mucus is considerable, or putrefactive changes in the stools are taking place, irrigation of the bowel with warm saline or alkaline fluid through a long soft rubber tube—known as the Plombières douche—is highly beneficial. Intestinal antiseptics such as salicylate of bismuth, salol, naphthol are also given, and sometimes vaccines. In very severe cases an operation to provide an opening for direct irrigation through the caecum or the appendix may prove helpful.

COLLAPSE is a condition of extreme weakness of all the bodily powers, and especially of the nervous system. It forms the termination of many severe diseases, such as cholera, typhoid fever, irritant poisoning, etc. It is closely allied to the condition of surgical shock, but, while in collapse from the conditions mentioned the chief feature is feebleness of the heart's action, in shock there are numerous other prominent symptoms. (*See* SHOCK.)

Symptoms.—The face is pale and drawn, the forehead sometimes covered with cold sweat, the eyes sunken and glassy. The voice is weak, the breathing shallow, and the pulse rapid and feeble or imperceptible. The temperature is usually reduced to 96° or 97° Fahr. Generally the patient lies on his back, paying no attention to what is proceeding around him.

Treatment.—The patient should be allowed to lie quietly on his back in a darkened room, well covered, and surrounded by hot bottles to maintain the body heat. Stimulants are also necessary.

COLLAPSE THERAPY is the term applied to the method of treating diseases of the lung by bringing about collapse of the diseased part through removing the supporting ribs (thoracoplasty), or introducing air into the pleural cavity (artificial pneumothorax).

COLLAR-BONE, or CLAVICLE, is the bone which runs from the upper end of the breast-bone towards the tip of the shoulder across the root of the neck. It serves to support the upper limb, to keep it out from the side, and to give breadth to the shoulders. The bone is shaped like an '*f*' with two curves, which give it increased strength. It is, however, very liable to be broken by falls on the hand, or on the shoulder, and is the most frequently fractured bone in the body. (*See* FRACTURES.)

COLLARGOL is a form of colloidal silver which mixes readily with water and any albuminous fluids and has an antiseptic action. It is used especially for application to the eyes in inflammatory conditions.

COLLATERAL CIRCULATION (*see* ANASTOMOSIS).

COLLES'S FRACTURE is a fracture of the lower end of the radius close to the wrist, caused usually by a fall forwards on the palm of the hand. This fracture is very liable to be of the impacted variety, one end of the broken bone being driven inside the other. Some deformity is usually left after union of the bone has taken place and also some stiffness at the wrist joint.

COLLODION (κόλλα, glue) is a thick, colourless, syrupy liquid, made by dissolving gun-cotton in a mixture of ether and alcohol or with acetone. When painted on the skin the solvent evaporates leaving a tough film behind. *Flexible collodion*, made by adding some castor oil and colophony, is more elastic, and does not crack through the movements of the skin. *Blistering collodion* contains cantharides, and, being painted on, raises a blister, to which at the same time it affords protection. *Medicated collodion* has various substances, such as salicylic acid, benzoin, etc., added to it, in order that these may remain in contact with the skin for a prolonged period.

Uses.—Collodion is mainly used as a covering for wounds, after these have been purified. The objection to its use is that, if a wound, or the surface round it, be not absolutely pure, the discharges from the wound are retained by the collodion, and may carry infection deeply into the tissues. Medicated collodion is used in many skin diseases.

Mode of application.—The wound having been cleaned thoroughly, dried, and all bleeding stopped, collodion is painted over it with a camel's-hair brush. Before this has time to dry, a very thin film of cotton-wool is laid on it and painted down with more collodion. Then another film of cotton-wool, followed by collodion, and so on till five or six layers of each have been applied, the successful application depending on the films of wool being as thin as possible, and upon each layer being applied before that beneath it has had time to dry completely.

COLLOID (κόλλα, glue; εἶδος, form) is the name given to a type of cancer of internal organs, in which a glue-like substance collects in the interior of the tumor. The term is applied to substances existing in a colloidal solution, and also to the viscid iodine-containing material in the spaces of the thyroid gland.

COLLOIDAL SOLUTIONS are solutions in which a substance very finely divided into particles is suspended in another substance, as for example metals like silver and iron suspended in the form of minute particles in water or glycerin. The two constituents of the colloidal solution are called phases. The particles being known as the internal phase and the medium in which they are suspended, the continuous or external phase. The term suspensoid is applied to colloids in which the particles consist of pure solid and the term emulsoid is applied to those in which the particles absorb some of the liquid in which they are suspended.

COLLYRIUM (κολλύριον) means an eye-wash.

COLOBOMA (κολόβωμα, a missing part) is the term applied to a congenital defect or fissure in the lens, iris, or retina of the eye.

COLOCYNTH, or BITTER APPLE, is the fruit of a species of cucumber, *Citrullus colocynthis*, growing on the Mediterranean shores. The dried white pulp is a powerful and much used purgative. It is administered usually as colocynth and hyoscyamus pill, taken in doses of 4 to 8 grains. Compound extract of colocynth is also used in doses of 2 to 8 grains.

COLON (κόλον) is the first part of the large intestine. (*See* INTESTINE.)

COLOPHONY is another name for resin. Resin plaster is now called colophony plaster.

COLOSTRUM (*colustrum*) is the first fluid secreted by the mammary glands for two or three days after childbirth. It contains less casein and more albumin than ordinary milk.

COLOUR BLINDNESS (*see* VISION).

COLPITIS is a term applied to inflammation of the vagina. (*See* WHITES.)

COLPORRHAPHY (κόλπος, the vagina; ῥαφή, stitch) is a term applied to an operation designed to unite the perineum when it has been torn in the act of childbirth.

COLT'S-FOOT is the name given to the leaves of *Tussilago farfara* or *Tussilago petasites*, the butter burr, a composite plant much used in the form of a decoction for the treatment of coughs.

COLYONE (κωλύω, I hinder) is another term for CHALONE.

COMA (κῶμα, deep sleep) is a state of profound unconsciousness, in which not only can the sufferer not be roused, but there are not even reflex movements when the skin is pinched, the eyeball touched, etc. The breathing is generally stertorous, but deep, and the heart's action is strong. The cause of coma is usually apoplexy, but it may also be due to high temperature in fever, diabetes, Bright's disease, alcohol, epilepsy, cerebral tumor, meningitis, injury to head, overdose of insulin, carbon monoxide poisoning, poisoning from opium and other narcotic drugs. If the condition does not begin to pass off in twenty-four hours, death is generally near at hand. (*See* UNCONSCIOUSNESS.)

COMEDONES (*see* ACNE).

COMMISSURE (*committo*, I join) means a joining, and is a term applied to strands of nerve fibres which join one side of the brain to the other, to the band joining one optic nerve to the other, to the junctions of the lips at the corners of the mouth, etc.

COMMOTIO CEREBRI is another term for concussion of the brain.

COMPENSATION is a term applied to the counterbalancing of some defect of structure or function by some other special bodily development. The body possesses a very remarkable power of adapting itself to even serious defects, so that disability, due to these, after a time passes off. The term is most frequently applied to the ability possessed by the heart to increase in size and therefore in power, when the need for greater pumping action arises in consequence of a defective valve or some other abnormality in the circulation. A heart in this condition is, however, more liable to be prejudicially affected by strains and diseased processes, and the term 'failure of compensation' is applied to the symptoms that result when this power becomes temporarily insufficient.

COMPLEX is the term applied to a combination of various actions or symptoms. The term is particularly applied to a set of symptoms occurring together in mental disease with such regularity as to receive a special name.

COMPLEXION (*see* ACNE, SKIN DISEASES, SUNBURN).

COMPOSITOR'S DISEASE is a form of lead poisoning which occasionally attacks those who handle type. (*See* LEAD POISONING.) Compositors are also specially liable to contract consumption. (*See* CONSUMPTION.)

COMPRESS is the name given to a pad of linen or flannel wrung out of water and bound to the body. It is generally wrung out of cold water, and may be covered with a piece of waterproof. It is used to subdue pain or inflammation. (*See* COLD.) A hot compress is generally called a 'fomentation'. (*See* FOMENTATIONS.)

COMPRESSED AIR (*see* AIR).

COMPRESSED AIR DISEASE (*see* CAISSON DISEASE).

COMPRESSION OF THE BRAIN (*see* BRAIN DISEASES).

CONCEPTION signifies the complex set of changes which occur in the ovum and in the body of the mother at the beginning of pregnancy. The precise moment of conception is that at which the male element, or spermatozoon, and the female element, or ovum, fuse together. (*See* FŒTUS.)

CONCRETIONS (*con*, together; *cresco*, I grow) are masses of various sizes and

substances which form in many of the tissues and smaller cavities of the body, in certain circumstances.

Varieties and causes.—There is a special liability to the deposit of lime-salts in damaged or degenerating tissues. The reason of this is probably much the same as that of the same deposit from hard water inside kettles and boilers. The tissues in question being inactive do not produce sufficient carbonic acid gas to keep dissolved the lime salts in the fluids circulating past and through them. Accordingly, healed up areas in the lungs, which have been the seat of tuberculosis, the remains of dead parasites and other foreign bodies, degenerated blood-vessels, tumors, and scars generally, are apt to have lime deposited in and around them till masses of considerable size are formed. The tartar on the teeth, some stones in the bladder, and the calculi sometimes found in the ducts of salivary glands in the cheek or beneath the tongue, are examples of a similar deposit of lime and phosphates, due to the action of bacteria. Similar concretions form in the appendix, and are associated with appendicitis.

Hair-balls, which are common in the stomachs of lower animals that lick themselves, occur sometimes in women who have a habit of chewing their hair, and may reach the size of walnuts or larger. Large balls, formed from the husks of seeds, are found in the bowels, for example, of those who live largely upon undercooked oatmeal, and may give rise to obstruction of the bowels.

Various glands produce secretions, which, by a gradual process of sedimentation build up solid masses in the ducts of these glands. Examples of this are found in the gall-stones, formed of cholesterin separated from the bile, in the uratic stones found in the kidney or bladder of persons suffering from acidity, in the plugs of hardened wax which often give trouble in the ear, and in the cheese-like masses which accumulate in the tonsils and give rise to great fœtor of the breath.

Gout is a disease in which the pain is due to sharp uratic crystals which are deposited on the surfaces of joints, the same crystals being deposited in other tissues also, at a later stage of the disease, so that large solid masses called 'chalk-stones' are ultimately formed. (*See* GOUT.)

CONCUSSION OF THE BRAIN (*see* BRAIN).

CONDIMENTS (*see* DIET).

CONDURANGO is the bark of *Gonolobus condurango*, a South American plant which is much used as a bitter tonic, the tincture being given in doses of 1 to 2 drams.

CONDYLE (κόνδυλος, a knuckle) is the name given to a rounded prominence at the end of a bone, for example, the prominences at the outer and inner sides of the elbow upon the humerus, and the prominences at the outer and inner sides of the knee on the thigh-bone.

CONDYLOMA (κονδύλωμα, a knob) means a localised, rounded swelling of mucous membrane often found about the opening of the bowel, especially in cases of syphilis, and disappearing slowly as this disease is treated, or requiring removal by caustics or by cutting.

CONDY'S FLUID is a powerful disinfectant containing permanganate of sodium in water. (For its action and uses, see PERMANGANATE OF POTASSIUM.) Green Condy's fluid contains manganate of sodium, which has a similar action.

CONFECTIONS, also known as conserves and electuaries, form a method of prescribing certain bulky drugs mixed into a paste with sugar or honey. The best-known confections are those of senna and sulphur, both of which are aperient in action. Compound confection of guaiacum, better known as 'Chelsea Pensioner', is an excellent remedy for constipation and rheumatic pains in elderly people, having received its name from the success of its use among the men of that hospital. The formula for 'Chelsea Pensioner' is—guaiacum, 2 parts; sublimed sulphur, 3 parts; carbonate of magnesia, 2 parts; ginger, 1 part; treacle, 12 parts. The dose of all these confections is about a teaspoonful or more.

CONFLUENT SMALLPOX (*confluo*, I run together) is a very severe form of

this malady, in which the individual pustules of the eruption run together. (*See* SMALLPOX.)

CONGENITAL (*con*, together; *genitus*, begotten) deformities, diseases, etc:, are those which are either present at birth, or which, being transmitted direct from the parents, show themselves some time after birth.

CONGESTION (*congero*, I accumulate) means the accumulation of blood in a part due to over-filling of its blood-vessels. The condition may be due to some weakness of the circulation (*see* CIRCULATION, DISORDERS OF), but as a rule is one of the early signs of inflammation. (*See* ABSCESS, INFLAMMATION.)

CONGESTION TREATMENT is a method sometimes used to stimulate the process of repair in both acute and chronic states of inflammation. It depends upon the principle that when the blood-vessels of an inflamed part are artificially dilated the number and consequently the activity of phagocytes (*see* PHAGOCYTOSIS) is increased. The congestion is brought about either by obstructing the return of blood (*e.g.* in a limb) by means of an elastic bandage, or by diminishing the atmospheric pressure in the case of flat or outlying parts (*e.g.* the back or the finger) by means of a suction cup or cylinder from which a rubber tube leads to a suction pump.

CONIUM (*see* HEMLOCK).

CONJUGATE DEVIATION is the term for describing the persistent and involuntary turning of both eyes in any one direction, and is a sign of a lesion in the brain.

CONJUNCTIVA (*conjungo*, I join together) is the membrane which covers the front of the eye. Beginning at the edge of the lower lid, it clothes the inner surface of that lid, and, at the line where the latter joins the cheek, forms a shallow pocket and passes on to the eyeball. Covering the front of the ball it then passes forward to the upper lid, forming a much deeper pocket between this lid and the ball, and so down to the margin of the upper lid, where it meets the skin. The membrane is transparent, especially over the centre of the eye, where a specialised portion, the cornea, admits light to the interior. The 'white' of the eye is formed by the sclerotic or outer coat of the eyeball shining through the conjunctiva. The membrane is richly supplied with nerves of sensation, and is extremely sensitive, so that the slightest touch produces a reflex closure of the lids.

CONJUNCTIVITIS means inflammation of the conjunctiva. (*See* EYE, DISEASES OF.)

CONSOLIDATION is a term applied to solidificatiou of an organ, especially of a lung. The consolidation may be of a permanent nature due to formation of fibrous tissue, or may be temporary, as in acute pneumonia.

CONSTIPATION, or COSTIVENESS (*con*, together; *stipo*, I cram), means a condition in which the bowels are opened too seldom or incompletely, the motions as a consequence being dry and hard. It should, however, be borne in mind that, though most persons have in health one daily movement of the bowels, some perform this act twice, while, in others, a motion once in two or more days is perfectly natural. Constipation is a chronic condition, and must be carefully distinguished from acute obstruction of the bowels, a much more serious condition. (*See* INTESTINE, DISEASES OF.) The stool of a healthy person, with good appetite, should be light brown in colour, about 5 ounces in weight, and about 5 inches long, should cohere in one or two pieces but should be sufficiently light to float in water. Great variations, however, take place in colour (*see* STOOLS), in amount, and in consistence, according to the nature and quantity of the food and drink taken.

Causes.—The uncommon causes of constipation are mechanical—that is, obstruction by stricture of the bowel, by tumor, by adhesive bands. The common causes are (1) habit, (2) 'a greedy colon', which absorbs water too quickly, (3) a spastic colon, the muscle of which remains in a state of spasm, (4) lack of tone of the colon muscle, sometimes because of too little Vitamin B_1 in the diet, (5) a diet which has not enough 'roughage' in it to stimulate the intestine to activity. Of these, habit is probably most important. Constant neglect to respond to the

sensation in the rectum which indicates that it is full and needs emptying leads to retention of fæces, which become dry and hard. The condition is aggravated by the use of purgatives.

Symptoms and effects.—The stools are, as is well known, dark, hard, and passed with difficulty, and in small amount. There is often swelling of the abdomen, from the retention of large masses of the remnants from digestion. Colic is common, and there is a special liability to the occurrence of such troubles as peritonitis and appendicitis. Piles, which are a cause of increasing constipation, are often brought on by inattention to the bowels to begin with. When the condition has become habitual, the whole digestion is thrown out of gear, and there are foul tongue, bad breath, and loss of appetite. The other bodily functions become impaired also, so that bloodlessness, headache, lassitude, debility, loss of memory, and tendency to apoplexy are all common occurrences.

Treatment.—Assuming that there is no organic cause, such as tumor or other source of mechanical obstruction, the most important matter is, perhaps, the regulation of the daily habits. The person concerned should take a certain amount of exercise daily. Above all things, a habit of opening the bowels, at the same time every day, should be cultivated; a definite hour should be fixed, preferably after a meal, and best after breakfast, and, no matter whether there be a sensation that the bowels will move or not, the attempt should unfailingly be made. The diet is of importance. On the whole, in cases of constipation this errs in being too concentrated and too unirritating, although the same trouble exists among country-people who use a coarse vegetable dietary. As a rule, however, the diet should be changed to include oatmeal porridge, brown bread, green vegetables, and fruit, especially fruits like prunes or brambles, which have a large indigestible residue, while a considerable amount of fluid should be taken. The juice of an orange or grapefruit, or a glass of water, first thing in the morning may help.

The use of aperients and purgatives have usually exaggerated the condition, and as a general rule should be given up.

CONSTITUTION, or DIATHESIS (*διάθεσις*, a disposition), means the general condition of the body, especially with reference to its liability to certain diseases. A sound constitution is one in which the structure and functions of the various parts and organs are so evenly maintained that there is no apparent liability to any disease. The term 'constitutional' is sometimes vaguely applied to diseases which our present knowledge does not permit of our attributing to any definite organ or system. A constitution such as the gouty constitution may be inherited, or it may develop as the result of improper food, habits, and environment; or, on the other hand, a heredity towards some disease may be gradually eliminated by careful and regular life.

CONSUMPTION, or PHTHISIS (*consumo*, I destroy; *φθίσις*, a wasting), is the name given, in popular language,

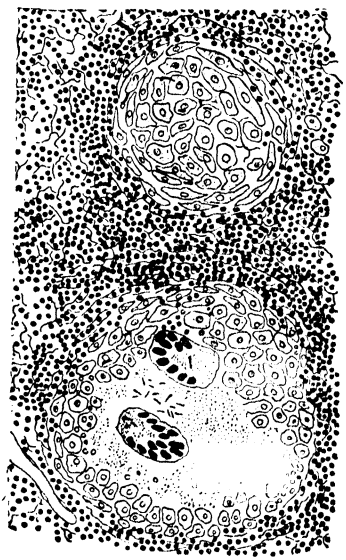


FIG. 111.—Two very small tubercles. The lower one has two giant cells and is breaking down in the centre into caseous material. Magnified by 160. (Thoma's *Pathology*.)

to a disease in which the main symptom is a rapid or gradual wasting away of the body, accompanied by fever, associated with loss of strength and enfeeblement of all the bodily functions, and following on a destructive change

in one or more organs. The name consumption is a general term applied to the malady, no matter in what organ the destructive change which causes it takes place. The term phthisis is usually restricted to consumption due to disease in the lungs, the full technical name being pulmonary tuberculosis. The essential part of the disease receives the general name of tuberculosis, and consists in the formation in the substance of an organ of 'tubercles', fine granules of a size barely visible to the naked eye, these tubercles multiplying and changing in such a way as to lead finally to the destruction of the organ in which they are found. Several other, but quite distinct diseases, present a close resemblance to consumption — for example, the cachexia of cancer, the marasmus due to bad feeding in children, and the feebleness resulting from bloodlessness, or neurasthenia — so that diagnosis may be difficult even for an expert.

Nature of the disease.—Consumption has been recognised as a disease from the earliest times. Hippocrates (460–380 B.C.) bestowed the name of phthisis upon the disease as it affects the lungs, and descriptions of the condition are found in the writings of classical authors. About A.D. 980 Haly Abbas of Bagdad, and again in 1779 Cullen, recognised the infectious nature of phthisis, but not till after the middle of the nineteenth century was it proved, by means of inoculating animals with tuberculous material from phthisical patients, that tuberculosis is really an infective disease, and that the 'tubercles' result from an inflammatory process, due to some poison introduced with the diseased products. The nature of the poison was much disputed till 1882, when Koch announced the discovery of the tubercle bacillus, and so answered this important question.

The manner in which these bacilli gain access to the body is important. There are three possible channels:

(*a*) BY INOCULATION. — A person may prick himself with a knife, etc., contaminated by the sputum of a phthisical patient, or may rub some of this material into a cut. Generally this results merely in a local skin disease, and it occurs only in doctors, nurses, and others busied about consumptive hospitals.

(*b*) BY INHALATION.—The sputum and other discharges from phthisical persons swarm with bacilli. It has been calculated that a person suffering from a cavity in the lung may spit up 4,000,000,000 bacilli in the course of twenty-four hours, and each of these, when dried and blown about on dust, is potent for evil. Neither drying, nor freezing, nor putrefaction, nor the lapse of months destroys these bacilli, but direct sunlight is speedily fatal to them, so that dust which has lain for a short time in the open on a bright day becomes rapidly harmless. In rooms inhabited by phthisical patients, and in hospital wards, the dust from the floor frequently contains tubercle bacilli.

Probably almost all cases in which this disease primarily affects the lungs are due to inhalation of dust laden with the bacilli or inhalation of droplets coughed into the air by a phthisical patient, while those cases, in which the glands of the neck are first attacked, arise by absorption of the bacilli through the tonsils.

That this manner of infection is of great importance is shown by the fact that, of all persons dying of tuberculous diseases generally in England and Wales over four-fifths die from this disease as it affects the lungs.

(*c*) BY INGESTION.—It has long been believed that tuberculosis, like other infectious diseases, can be conveyed by means of milk and other articles of food, and, acting upon this belief, sanitary authorities have enforced regulations designed to protect the public, so far as possible, from the effects of consuming diseased meat and milk. The vital importance of this point appears from the fact that, according to MacFadyean, about 30 per cent of all cows are tuberculous, while in 2 per cent the udders are diseased, so that the milk of these cows almost necessarily becomes infected. So far as meat goes, there is practically no danger, for, as above stated, the muscular tissues are exempt from the disease, and those parts which are diseased being, in the 'dressing' of the meat, carefully removed, any accidental

contact with them is rendered harmless by the cooking of the meat.

It was pointed out by Koch to the British Congress of Tuberculosis held in London in 1901 that the tuberculosis affecting human beings and that affecting cattle are different diseases, for important differences are found between the bacilli from the two sources. The bovine bacillus, seen under the microscope, is shorter and thicker than the human bacillus, it does not grow so readily in cultures, and it is capable of producing acute tuberculosis when injected into oxen or rabbits, which the human bacillus hardly ever does.

The Royal Commission on Tuberculosis in its report issued in 1907, as well as various other observers, found that the bovine bacillus is present in a large proportion of diseased glands in children. It has also been found that in tuberculosis affecting the bones and joints of children from one-third to one-half are caused by the bovine bacillus, the rest by the human bacillus.

We may therefore conclude that the tissues of healthy human adults are more capable of resisting the bacillus of bovine source than are those of children, but that cattle tuberculosis may be, and often is, communicated through milk to children.

It has been proved by several investigators who have examined milk in dairies that the tubercle bacillus can be found in about 16 per cent of all specimens. This means that any person habitually drinking ordinary milk swallows a dose of bovine tubercle bacilli on an average once every week.

The practical outcome of this is that, for children, or for any who may be considered liable to the disease, milk should be carefully sterilised, though for adults this may not be so necessary. Milk can also be obtained from dairies in which the cows are periodically 'tuberculin tested' for their freedom from tuberculosis, and such milk is safe as regards tuberculosis but not necessarily as regards other infections, such as diphtheria, scarlet fever, typhoid fever, etc.

Mortality.—The importance of this disease, in relation to the welfare of the human race, is apt to be overlooked by reason of its commonness. Men have got used to a scourge which sweeps off, every year, numbers compared with which the worst visitations of plague or cholera sink into insignificance.

The following figures are compiled from the Registrar-General's reports:

Deaths in England and Wales from 1881 to 1890

Total deaths	5,244,771
Deaths from phthisis	473,968
Deaths from other forms of tuberculosis	190,995
Total from all tubercular diseases	664,963

Deaths in England and Wales from 1901 to 1910

Total deaths	5,248,779
Deaths from phthisis	396,886
Deaths from other forms of tuberculosis	169,276
Total from all tubercular diseases	566,162

Deaths in England and Wales from 1921 to 1930

Total deaths	4,722,991
Deaths from phthisis	316,405
Deaths from other forms of tuberculosis	77,384
Total from all tubercular diseases	393,789

These tables show the steady decline in the number of deaths due to tuberculosis during the fifty years from 1881 to 1930.

A very much larger number of the population suffer from early tuberculosis (it may be quite unsuspected) and recover. This is proved by the frequent presence on X-ray examination of old calcified tuberculous glands and by healed scars in the lungs found on autopsy.

Causes.—From what has been said it will be seen that the direct cause of the disease is the tubercle bacillus discovered by Koch. (*See* BACTERIOLOGY.) But, in view of the fact that many people suffer from consumption in a mild degree and afterwards recover, and that many limited cases of tuberculosis in bones, skin, glands, etc., are successfully treated, it appears that there are other factors which determine whether a given case is serious or not, and whether it is likely to proceed

towards recovery, if properly treated, or to end inevitably in death.

HEREDITY.—There is probably a hereditary element in the predisposition to the disease. Over a long period those who are susceptible are gradually eliminated by the disease.

AGE is an important point. Young children, as above stated, are liable to tuberculosis affecting the bowels and the glands connected with them. At a slightly later age there is a greater tendency to that type of the disease formerly known as scrofula, the glands of the neck particularly being affected, and the greatest mortality from lung consumption takes place after the age of twenty is reached.

SEX.—There are differences between the two sexes. It used to be supposed that women were more liable than men to consumption, but this holds good, as the Registrar-General's reports show, only up to the age of twenty-five, after which the proportion is only about three deaths among women to every four among men from tuberculous diseases of every kind

ATMOSPHERE.—The character of the atmosphere in which work is carried on has much to do with the onset of phthisis. Those who habitually live and work in ill-ventilated rooms are at a great disadvantage, compared with those who lead an open-air life, or, at all events, keep their rooms well ventilated. It has been noticed that soldiers, sailors, and convicts have a much less liability to contract this disease than men of the same classes living in unhygienic homes. Further, the amount and nature of the dust in the air is highly important. Thus among agricultural labourers there are few deaths from phthisis; among wool-workers, carpet-makers, and masons there are about twice as many; among iron, steel, and copper workers three times; while cutlers, scissors-grinders, and file-makers head the list with four times as many consumptives as the agricultural labourers. It is a noteworthy fact, however, that coal-miners, whose lungs are literally black from inhaled coal dust, die in appreciably fewer numbers from phthisis than do even open-air workers, the coal dust or the nature of the work having, apparently, some protective effect.

OTHER DISEASES are of great importance in relation to phthisis. For example, a person who has long suffered from asthma or bronchitis is very likely to develop consumption in the end, and diabetics so commonly contract this disease, that it is regarded as one of the natural modes of death in a case of diabetes. It must be remembered, too, that several lung diseases closely resemble consumption: for example, chronic catarrh following on a simple cold, bronchiectasis, and interstitial pneumonia. Further, it is not uncommon that a person suffers from consumption and apparently recovers; then, when some business reverse or family trouble comes, the disease reappears and he rapidly succumbs.

Varieties.—The forms of tuberculosis other than lung consumption, such as tuberculous disease of joints and bones, meningitis, lupus, etc., are considered under these headings. The lung disease has, however, itself several varieties, differing much from one another.

1. ACUTE MILIARY TUBERCULOSIS.—In this form not only the lungs, but the whole body becomes studded with the tubercles of the disease distributed by the blood, and the sufferer dies, from fever and exhaustion, in two or three weeks. This is the most rapid form, and, with the second variety, goes under the popular name of 'Galloping Consumption'.

2. ACUTE CASEOUS TUBERCULOSIS is a slightly slower form. The lungs only are affected, and, either in consequence of the bacilli inhaled into the lungs being specially virulent, or, more likely, owing to the person being in a particularly weak state, or of unhealthy constitution, tubercles form, undergo the caseous change, and break down to form cavities with great rapidity, the patient dying in two or three months.

3. FIBRO-CASEOUS TUBERCULOSIS is the usual form and lasts for years. The change which occurs in the lungs is very much the same as in the last form, but, in addition, and in consequence of greater resisting power on the sufferer's part, there is an attempt at nature's cure, and much fibrous tissue is formed. The lung becomes denser, cavities gradually form here and there, and the downward progress is slow or may be arrested.

4. FIBROID TUBERCULOSIS is a form in which areas of the lung are converted

FIG. 112.—Lung showing acute miliary tuberculosis. The small masses of tubercles are seen scattered as white specks on the cut surface. (Miller.)

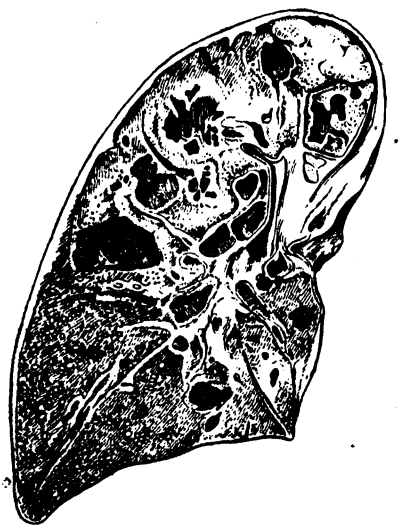


FIG. 113.—Lung showing acute caseous tuberculosis, with large masses of caseous material in the upper half, breaking down to form numerous large cavities. In the lower part are numerous scattered tubercles. (Miller.)

into fibrous masses, which are in reality scars of previous disease that has undergone nature's cure, and there are no cavities.

Symptoms of consumption are well known, since there are few who have not had an opportunity of observing the disease in some relative or friend. In the following brief account, the symptoms of an average case, in which fibrous formation and the caseous change leading to production of a cavity take place side by side, will be described. They fall conveniently into three stages of the disease:

(*a*) EARLY STAGE.—In this stage the tubercles are being deposited in the lung, almost always near the apex;

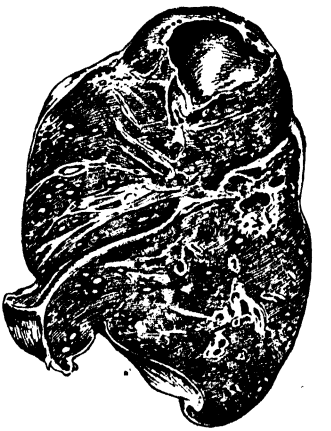


FIG. 114.—Lung showing chronic fibro-caseous tuberculosis, with marked tendency to healing. A large cavity and the healed scar of another are seen near the apex. Numerous scattered nodules of fibro-caseous material, all showing signs of healing, are scattered through the lung. (Miller.)

and this part of the lung becomes, in consequence, more solid. There is cough of an irritative nature, particularly in the morning, either without any expectoration or accompanied by a little clear mucus. Sometimes, the first sign of all is the spitting up of blood, which is never copious at this stage, and is due to congestion caused by the irritation of the tubercles. (*See* HÆMORRHAGE.) There is generally, from the first, loss of appetite, colour, and strength, followed soon by actual emaciation and loss of weight. Perspiration upon slight exertion is usual, and, very often, night sweats are a symptom. A very important sign is a

regular rise of temperature, either in the forenoon, or more often in the early afternoon, with a fall below normal in the early morning, but this is not an invariable symptom of phthisis at this stage. The digestive functions are usually thrown out of gear, and there is apt to be sickness, diarrhœa, or constipation. A slight attack of pleurisy, causing pain in the chest, is very often a precursor of, or accompanies these symptoms. This is the stage in which the disease is readily curable.

(*b*) STAGE OF ADVANCING DISEASE.—By this time, the tubercles have fused to form caseous masses, and these are breaking down and being spat up, considerably below normal in the early part of the day. Drenching night sweats are apt to break out during sleep in the early hours of the morning, and attacks of vomiting or diarrhœa are not infrequent. The disease may at this stage be found in both lungs or in other organs, like the throat or intestine, with which the sputum comes in contact. A very important sign is that of falling in of the chest over the excavated area, so that a flat place or depression is found in its upper part. Recovery in this stage occasionally occurs, but, if the disease gets so far without treatment, a perfect cure is generally out of the question.

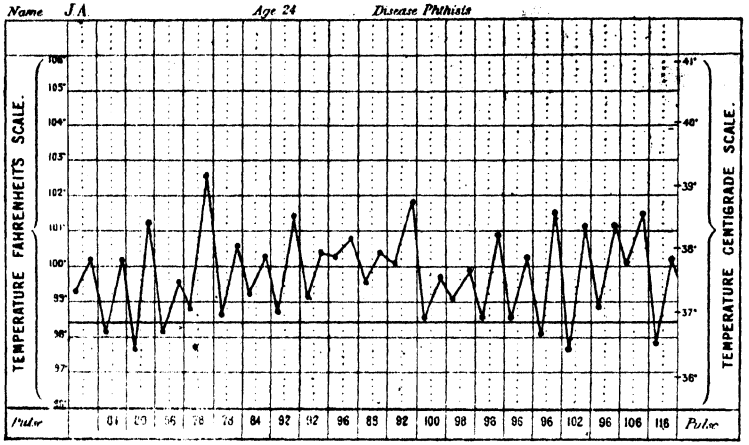


FIG. 115.—Typical temperature chart in a case of consumption, showing the swinging temperature, as taken twice daily.

leaving a ragged cavity, while the disease is slowly advancing to new areas of the lung. The surface of the cavity becomes infected sooner or later with other organisms inhaled on dust, and these keep up the ulcerative process on the surface of the cavity and prevent its healing. The symptoms are mainly an increase of those present in the first stage. The cough is more troublesome and the spit is thick and yellow, contains large numbers of tubercle bacilli, which can be stained and microscopically examined, and is occasionally streaked with blood. The sufferer is much weaker, and has greatly lost in weight. The temperature is of a swinging 'hectic' type, rising to 100° or 101° Fahr. in the late afternoon and falling

(*c*) LATE STAGE.—In this stage, large cavities have usually formed in the lung, or there has been a production of fibrous tissue, the lung being shrunken and consisting of a mass of matted fibrous tissue and smaller cavities. Accordingly, the whole side has usually fallen in considerably. The second lung is by this time extensively affected, and, very often, the voice is husky on account of disease in the throat, or there is troublesome diarrhœa, due to affection of the bowels. Hæmorrhage is not uncommon in this stage, and death may by this means be brought about. There are also swelling about the feet and other signs of gradual failure of the heart. The emaciation is now extreme, and bed-sores are very apt

to form. The swinging temperature and the excessive sweats continue, and the cough is often most troublesome. All through the disease, even to the very end, there is a curious mental state known as the 'spes phthisica', the sufferer being buoyed up by the daily recurring belief that he is better, and is beginning to recover.

The duration of the illness varies much, according to the food which the sufferer receives and the care with which he is nursed. Among the poorest classes, a case may last less than a year, while the average duration of cases which grow steadily worse is between one and three years. Among people in whom the conditions of life are easier, the disease may be indefinitely prolonged, and in persons of comfortable circumstances the average duration is seven or eight years. During a great part of this time patients are usually fit for work that does not involve great strain.

Treatment.—This falls very naturally into two classes—(*a*) preventive, and (*b*) remedial.

(*a*) PREVENTIVE TREATMENT.—The problem of prevention is partly social and partly medical. Tuberculosis is commoner among the ill-fed and the badly housed. Abolition of overcrowding, provision of good homes, an adequate supply of 'protective' foods and enough money to buy them would all go a long way to diminish the incidence of tuberculosis. To a considerable extent, tuberculosis is a social disease. On the medical side, the problem is essentially to prevent uninfected susceptible people— especially children—from coming into contact with the infecting agent—the tubercle bacillus. The great risk to the child is coming into contact with an adult who has tubercle bacilli in his or her sputum. So every attempt must be made (1) to detect all sufferers from tuberculosis, (2) to treat them and isolate them until they know how to safeguard other people by the proper use of sputum pots, etc., and (3) to examine and 'follow up' all 'contact' cases—especially children known to have been in close contact with adults suffering from tuberculosis. Matters would be much eased if a drug were found which would be as effective against the tubercle bacillus as sulphanilamide is against the streptococcus and penicillin against the staphylococcus. Promin (or promanide) is of some help, especially in the treatment of surgical tuberculosis. One preventive measure which perhaps has not had sufficient trial in this country is BCG vaccine (*q.v.*).

(*b*) REMEDIAL TREATMENT.—Many 'cures' for consumption are sold by unscrupulous persons, but it must be evident from what has been said as to the condition of the lungs in advanced cases that even to check the progress of the disease at that stage is almost hopeless. For, even if all the tubercle bacilli be killed out, the lung is left riddled by cavities with ulcerated surfaces; and, if these be closed up, this can only be effected by the falling in of the chest walls. Therefore, in the most favourable of advanced cases the sufferer is left a permanent invalid, with hollow chest and feeble lungs, in which the disease is prone again to arise.

Great interest was manifested in the possibilities of the 'tuberculin' cure brought in by Koch in 1890. Its use was attended at first with disappointment, though recently the employment, in a more cautious manner, of Koch's and other tuberculins has been revived. They are stimulants to the healing process, but are suited especially for early cases, which yield also to other means. Advanced cases are often made worse by tuberculin. It is employed also as a means of diagnosis. (*See* TUBERCULIN.)

A salt of gold known as 'Sanocrysin', and by other proprietary names, has recently been tried. While it has proved helpful in some early cases, its use in advanced cases is attended by danger of hastening the progress of the disease.

Early cases are much benefited by a change of air. Sea-voyages in many cases, mountain air in others, and a winter spent in a dry, bright climate in still a third group are most valuable, and, judiciously entered upon, may effect a perfect cure. (*See* CLIMATE.) Where these are impossible or inadvisable, the sufferer should spend his nights in a well-ventilated, large bedroom, and during the day should pass the whole time walking, sitting, or lying in the open air, protected from rain and wind by a veranda, or in one of the shelters

used at sanatoria. While lying out in the open air, the sufferer must be particularly well wrapped up, especial care being taken to keep the hands and feet warm, because he is more than ordinarily liable to catarrh, which assists the spread of the disease.

Excessive exercises, like running or football, are bad for any case and

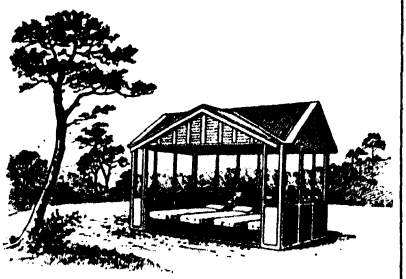


FIG. 116.—Open-air shelter protected on three sides from the weather.

tend to bring on hæmorrhage. The amount of exercise advisable depends greatly upon the nature of the individual case. At many sanatoria patients are graduated for exercise according to the length of time they have been in residence and the stage of their general symptoms somewhat as follows:

1. Walking exercise, morning and afternoon, graduated from one to eight miles per diem.
2. *Grade* 1.—Very light gardening, such as weeding and tidying the garden.

Grade 2.—Ditto and hoeing and planting.

Grade 3.—Light gardening, such as planting and transplanting, mowing the lawns with assistance, and the light work of a kitchen garden.

Grade 4.—Sawing and chopping wood and digging with a small fork or spade.

Grade 5.—Digging and trenching the garden with full-size tools, and garden truck work.

All the above rest an hour before the midday meal.

Grade 6.—Same as Grade 5, without the said hour's rest.

The lower grades are employed more in the general garden, and the higher ones in the kitchen garden.

Other forms of labour are tree-felling and the care of pigs and poultry.

A limited amount of painting, glazing, and carpentering is also done.

All patients keep their own wards clean.

Diet is one of the essentials of treatment. Not only must the quality of the food be good, but the quantity must be as large as, or larger than, that taken in health, despite the fact that the sufferer exerts himself but little. Fat is particularly necessary, and three or four ounces in the form of butter, cream, cod-liver oil, salad dressing, or other soft fat may be taken daily. Milk is perhaps the most valuable food, and various artificial foods may be added to it to vary its insipidity. Some of the artificial milks may be tried when the patient becomes tired of cow's milk. Meat juices are excellent as stimulants, but must not take the place of nutritious food. Care must be taken that the patient be not fed beyond the limit of his digestive powers, and rigid adherence to regular meal-times with an early breakfast is essential. If dyspepsia or diarrhœa appear, the food must be at once decreased in quantity.

Medicines are given for many purposes in the disease. In the early stages, tonics and substances like bitters, which stimulate appetite, are much used. Cod-liver oil is more used than almost any other remedy, either plain or in emulsion. Antiseptic treatment by injection of menthol and guaiacol down the air passages, inhalation of creosote on respirators, and evaporation of formalin over a flame, has been tried and generally abandoned. Cough is quieted by various medicines, of which morphia, hydrocyanic acid, and heroin are the most used, or by inhalations of creosote, benzoin, menthol, etc. Pains of pleurisy in the side are relieved by painting with iodine, blistering, or strapping with belladonna plaster. Sweating is a very troublesome and almost constant complication. In the early stages it is relieved by the open-air treatment, or by a little easily digested food taken just before sleep.

Rest for the affected lung is of great importance. It is gained sufficiently in early cases by the gentleness of breathing maintained through general rest and careful avoidance of all violent movement. In advancing cases when one lung only is affected, this lung is often immobilised by introducing air into the pleural cavity (pneumothorax). This simple operation is carried out by a puncture between the ribs and intro-

duction of a measured quantity of air. The lung collapses towards its root, and goes to a large extent out of action, thus allowing healing to take place in and around the cavities. The operation must be repeated at frequent intervals, as the air is quickly absorbed, until, after several months of treatment, the lung is allowed to expand again.

In certain cases where adhesions have formed between the lung and the chest wall, it is found impossible to produce a complete pneumothorax. If a partial collapse can be obtained through the introduction of a certain amount of air, the collapse in some cases can be made complete by cutting or burning the adhesions through a thoracoscope. A state of partial and permanent rest for the affected lung may, however, be obtained by putting one-half of the diaphragm out of action through the somewhat more serious operation of cutting the phrenic nerve in the neck (phrenicectomy).

In advanced cases with firm adhesions between lung and chest and with large cavities, which cannot close, a good result sometimes follows an operation by which several ribs are removed and the cavities thus permitted to close. This operation (thoracoplasty) is a formidable one and only applicable to cases in which the other lung functions well and the general strength is maintained.

Diarrhœa is due to various causes, to simple weakness, to injudicious dieting, to waxy degeneration of the blood-vessels in the bowel wall, which allows too much fluid to transude, and, in the latest stage of the disease, generally to tuberculous ulceration. These are all treated by changing the diet, by astringents, and by morphia. When diarrhœa is due to ulceration, the import is very grave.

CONTAGION (*contagio*, pollution by touching) means the principle of spread of disease by direct contact with the body of an affected person, while by infection is meant the spread through the air or by other distant means.

CONTINUED FEVERS are typhus, typhoid, and relapsing fevers, so called because of their continuing over a more or less definite space of time.

CONTRACTURE means the permanent shortening of a muscle or of fibrous tissue. Contraction is the name given to the temporary shortening of a muscle.

CONTRE-COUP means an injury in which a bone, generally the skull, is fractured, not at the spot where the violence is applied, but at the exactly opposite point.

CONTUSION (*see* BRUISES).

CONVALESCENCE means the condition through which a person passes after having suffered from some acute disease, and before complete health and strength are regained. Many diseases have special dangers during convalescence, for example, after typhoid fever the effects of over-eating may be disastrous; after measles, pneumonia, and other diseases of the respiratory tract, there is a greater risk than usual of the onset of phthisis; and, while convalescence from scarlatina is proceeding, there is a special risk of kidney inflammation. These are guarded against by working the body at low pressure for a time, exposing it to no strain, partaking of a moderate diet, and taking an ample allowance of rest and sleep, till all the functions have regained their usual activity and vigour. For further details see under each disease.

CONVOLUTIONS (*see* BRAIN)

CONVULSIONS (*convolvo*, I roll up) are rapidly alternating contractions and relaxations of the muscles, causing irregular movements of the limbs or body generally, and usually accompanied by unconsciousness. They form really only a symptom of some other trouble, often, in children, of a very trifling nature, but, on account of the alarm they cause and their occasional seriousness, they are treated of as a disease by themselves.

Causes.—The vast majority of convulsive seizures occur in children, and those which occur in adults are treated of elsewhere as epilepsy, hysteria, etc. It is calculated that, of children under one year old who die of nervous disorders, nearly three-fourths succumb to convulsions. This tendency rapidly passes off as age increases, and is

attributed to the undeveloped state of the brain, and consequent instability of the whole nervous system in young children. It is aggravated by heredity in the children of nervous parents, while, if one child has convulsions, younger members of the same family are likely to have them also at a later date, in consequence of any slight irritation.

Irritation in the bowels is perhaps one of the commonest exciting causes. This may be due to worms, to indigestion caused by unripe fruit, stones, etc., and, in the case of breast-fed infants, to some impoverishment of the mother's milk. Irritation about the mouth from inflamed gums, due to teething, or the presence of thrush, is also very often the cause. Irritation in the ear, such as that due to wax, or in the nose from a foreign body, like a button pushed up by the child, is also sufficient cause. Even some discomfort or pain, set up by the clothes, may be the reason in very nervous children.

Excessive crying, excessive coughing as in whooping-cough, and the onset of some acute disease, like measles or scarlatina, may all be accompanied by convulsions.

Failing any obvious cause, rickets may be coming on, a tendency to convulsions being often one of the early signs of this disease. (*See* RICKETS.) Lastly, serious brain disease, such as meningitis, may, in a small number of cases, be the cause.

Symptoms.—The symptoms of epilepsy and hysteria will be found under these headings. As to simple infantile convulsions, there are generally premonitory symptoms for some days, such as broken sleep, twitchings of the face, and sudden startings. The attack begins generally with twitchings of the face, rolling of the eyes, or grinding of the teeth, then the head and neck after a few seconds are bent back, and the limbs are alternately bent and stretched out. Unconsciousness comes on speedily. There may, for a little time, be blueness of the face, but this passes off, and copious perspiration breaks out. The pulse is feeble, the breathing rapid, and sometimes the bowels and bladder move involuntarily. The duration of the attack may be only a few minutes or may be hours, or the child may pass out of one fit into another. Only occasionally does death result.

Treatment.—A warm bath for the legs and body, with cold cloths to the head, is the usual treatment. Great care must be taken that in the excitement of the moment the bath is not scalding hot. Generally, a hot bath, especially if mustard be added to it, suffices to bring the child round, but, if the fit lasts for hours and is violent, it may be necessary to give an inhalation of chloroform. After the child has come out of the fit the cause is at once sought for. If the gums are inflamed they may be lanced, if some indigestible article of food has been taken an emetic is given, or the throat is tickled with a feather to make the child vomit, or a dose of castor oil may be administered. Very often friction in the bath, or cold applications in bed, along the spine, are of great value in stopping a long fit or a series of fits.

When an attack has passed off, means should be taken to prevent the recurrence of convulsions. Attention must be paid to the state of the gums, the regular movement of the bowels, and the general health of the child. Very nervous children may require some sedative like bromides, while others are benefited by cold or tepid bathing, according to the season, and by daily rubbing of the back and spine. In young children careful attention to the quality and quantity of the milk is essential.

CO-ORDINATION means the governing power exercised by the brain as a whole, or by certain centres in the nervous system, to make various muscles contract in harmony, and so produce definite actions, instead of meaningless movements. It is bound up intimately with the complex sense of localisation, which enables a person with his eyes shut to tell by sensations received from the bones, joints, and muscles, the position of the various parts of his body. The power is impaired in various diseases, such as in locomotor ataxia. It is tested by making the patient shut his eyes, moving his hand in various directions,

and then telling him to bring the point of the forefinger steadily to the tip of the nose, or by other simple movements.

COPAIBA, or COPAIVA, is a mixture of oil and resin in a thick yellow fluid, obtained by cutting into the bark of *Copaifera langsdorfii*, a South American tree. It is excreted by the mucous membranes, especially of the urinary and respiratory organs, which it stimulates.

Uses.—It is used in various chronic inflammations of the urinary organs, and as an expectorant in chronic bronchitis.

COPPER is used in medicine in the two salts, sulphate of copper and nitrate of copper. The former is, in small doses, a powerful astringent, and in larger doses an irritant. Both are caustics when applied externally.

Uses.—Internally, sulphate of copper, also known as blue vitriol and bluestone, is mainly used in fractions of a grain in pills to check diarrhœa. It is also a valuable emetic in doses of 5 to 10 grains, used, for example, in cases of narcotic poisoning. Externally, either is used to rub on unhealthy ulcers and growths, with the view of stimulating the granulation tissue to more rapid healing. In very small amounts copper is necessary for the formation of red blood corpuscles. It is, therefore, sometimes necessary to give copper as well as iron to cases of anæmia, especially in children.

COPPER POISONING is rare. Copper itself is harmless, but sulphate of copper (blue vitriol) and acetate of copper (verdigris) are now and then taken as poisons, while their use in very small quantities to colour peas and other green vegetables put up in bottles is said to lead to occasional unpleasant symptoms.

Treatment.—If one of the salts above named has been taken by mistake, the treatment is that for any irritant poison, viz. milk or white of egg as an antidote, followed by washing out the stomach.

COPROLALIA is the term applied to the condition in which insane people give utterance to filthy and obscene words.

CORAMINE is a proprietary term for nicotinic acid diethylamide, a drug which is a strong heart and respiratory stimulant. The *British Pharmacopœia* term for this drug is NIKETHAMIDE.

CORNEA (*cornu*, horn) is the clear membrane in front of the eye through which light passes to its interior. (*See* EYE.)

CORNS and BUNIONS.—A corn is a localised thickening of the cuticle or

FIG. 117.—Two foot-soles, showing on left natural appearance, on right distortion of toes produced by badly fitting boot, with tendency to bunion.

epidermis, of a conical shape, the point of the cone being directed inwards and being known as the 'eye' of the corn. A general thickening over a wider area is called a 'callosity'. 'Bunion' is a condition found over the joint at the base of the great toe, in which not only is there thickening of the skin, but the head of the metatarsal bone, in consequence of bending outwards of the toe by pointed or too short boots, becomes unduly prominent beneath the thickened skin. 'Hammer-toe' is a condition of the second toe, caused by short boots, in which the toe becomes bent at its two joints in such a way as to resemble a hammer, while corns form over the bends.

Causes.—The cause of bunions is the wearing of ill-fitting boots. Corns are due similarly to the pressure of tight or badly fitting boots, or, when on the under surface of the foot, to unevenness in the sole. The skin grows more

rapidly in consequence of the irritation, and becomes changed by the pressure into a species of horn. Where the corns are between the toes, they become moist and sodden, and are called soft corns.

Treatment.—The first requisite is to wear sufficiently large and properly shaped boots. The inner side of the sole should be straight, not cut away to a point, and the width of the sole at the level of the little toe should be as great as that of the bare foot when the weight of the body is thrown on it. Relief from the pain of a corn may be obtained by wearing a ring of felt (corn plaster) round the corn, so as to free it from pressure and distribute the pressure of the boot over the surrounding skin. To remove the corn, the foot should be soaked in hot soapy water, and the corn then cut or scraped away with a knife or pair of scissors. After drying, the site of the corn should be covered with a small piece of soap plaster or painted inside the felt ring with salicylic acid collodion. This consists of salicylic acid (8 parts), extract of cannabis indica (1 part), and flexile collodion (60 parts). This preparation softens and breaks up the corn, which may be picked away gradually or rubbed down with pumice-stone. After the corn is removed, the skin of the foot should be hardened by daily bathing for some time in salt water or in spirit. A tendency to bunions, flat foot, and corns can sometimes be checked by wearing boots of which the sole is slightly thicker along the inner side than on the outer side.

Soft corns and the deformities of bunion and hammer-toe should be treated by wearing socks made like gloves with a compartment for each toe, or in slighter cases by inserting a piece of boracic lint each morning in the spaces between the toes. In bad cases of bunion the opening of the boot should run forwards to between the first and second toes where the lace, or a peg known as a 'toe-post', is fixed to the sole in order to keep the great toe in its proper place; or a rubber pad may be worn between the toes. In old-standing cases of bunion and hammer-toe, an operation in which the protruding toe joint is excised may be necessary for cure.

CORONARY (*coronarius*, crown-like) is a term applied to several structures in the body encircling an organ in the manner of a crown. The coronary arteries are the arteries of supply to the heart which arise from the aorta, just beyond the aortic valve, and through which the blood is delivered with great pressure to the muscle of the heart. Disease of the coronary arteries is a very serious condition producing various unusual forms of heart action and the disease angina pectoris. (*See also* THROMBOSIS.)

CORONARY THROMBOSIS.—When the coronary arteries are diseased in arteriosclerosis they may become so narrow that the blood, slowing down in its flow, clots or thromboses. This cuts off the supply of blood to part of the heart, and the result may be fatal. This condition—coronary thrombosis—became much more common in the third decade of the twentieth century.

CORPORA QUADRIGEMINA form part of the mid-brain. (*See* BRAIN.)

CORPULENCE, or OBESITY, is a condition of the body characterised by over-accumulation of fat under the skin and around certain of the internal organs. The extent to which obesity may proceed is illustrated by numerous well-authenticated examples, of which only a few can be here mentioned. Thus Bright, a grocer of Maldon, in Essex, who died in 1750, in his twenty-ninth year, weighed 616 lb. In the *Philosophical Transactions* for 1813 a case is recorded of a girl four years of age who weighed 256 lb. But the most celebrated case is that of Daniel Lambert of Leicester, who died in 1809 in his fortieth year. He is said to have been the heaviest man that ever lived, his weight being 739 lb. (52 st. 11 lb.). Lambert had publicly exhibited himself for some years prior to his death, which occurred suddenly at Stamford. At the inn where he died two suits of his clothes were preserved, from which some idea of his enormous dimensions may be obtained when it is stated that his waistcoat could easily enclose seven persons of ordinary size. Lambert ate moderately, drank only water, and slept less than most persons. He is said to have had an excellent tenor voice.

For some persons, and particularly among some races, a degree of corpulence is natural, and though the following table represents the average weight and chest measurement for men at thirty years of age, of varying height, it must be accepted as true for health only with a wide margin. A person's weight may be one-seventh over the figures given and yet within the limit of health, while, on the other hand, if the weight is not more than one-seventh below the average weight this is not indicative of bad health. The average woman should weigh rather less for her height than the figures shown in the table. The heights are given without shoes.

Height.		Weight.		Chest Circumference.	
ft. in.	mm.	st. lb.	kgm.	in.	mm.
5 2	1575	9 0	57·15	35	889
5 3	1600	9 7	60·33	35	889
5 4	1626	9 13	63·05	36	914
5 5	1651	10 2	64·41	37	940
5 6	1676	10 5	65·77	37½	953
5 7	1702	10 8	67·13	38	965
5 8	1727	11 1	70·31	38½	978
5 9	1753	11 8	73·48	39	991
5 10	1778	12 1	76·66	39½	1003
5 11	1803	12 6	78·93	40	1016
6 0	1829	12 10	80·74	40½	1029
6 1	1854	13 0	82·56	41	1041

The average weight of the clothing is $\frac{1}{24}$ of the male body, and the above weights include clothing. An addition of about three pounds for every four years of age over thirty must be made to the above figures, as the weight tends naturally to increase until old age sets in. (*See* WEIGHT AND HEIGHT.)

Causes.—Various causes are assigned for the production of corpulence, but it must be admitted that in many cases it cannot be accounted for. In some families there appears to be a hereditary predisposition to an obese habit of body, upon which precautions in living seem to have very little effect. But, beyond this, it is unquestionable that certain habits favour the occurrence of corpulence.

A luxurious, inactive, or sedentary life, with over-indulgence in sleep and absence of mental occupation, are well-recognised predisposing causes. The more immediate exciting causes are over-feeding and the large use of fluids of any kind, but especially alcoholic liquors. Fat persons are not always great eaters, though many of them are, while again, leanness and inordinate appetite are not infrequently associated. Still, it may be stated generally that indulgence in food beyond what is requisite to repair daily waste goes towards the increase of fat. This is more especially the case when the non-nitrogenous (the fatty, sugary, and starchy) elements of the food are in excess. It is generally held that the fat of the body is mainly, if not entirely, formed from these foods, while nitrogenous (albuminous) foods increase oxidation and lead to tissue waste. Alcoholic liquors, when taken to a considerable extent, also tend to the formation of fat, partly because many of them, *e.g.* beer, contain much sugar, and partly no doubt because a portion of the body heat is derived from the alcohol and a corresponding amount of the starchy and sugary food spared, and converted into fat.

Women are prone to become more corpulent than men, and appear to take on this condition more readily after having borne a child, and after the cessation of the function of menstruation. Probably their more sedentary life, and the fact that a woman's blood is relatively poorer in oxidising power than that of a man, have much to do with this. For the same reason, girls suffering from bloodlessness tend to become fat as well as pale and weak. Fat is an incomplete oxidation product, and when it is either burned, or utilised for the supply of heat or energy in the body, it is converted into carbonic acid gas and water, this change failing to take place under the above conditions either because the supply is too great, or because the demand of the body for heat and energy is small.

In young persons excessive corpulence is sometimes associated with defective action of some of the endocrine glands, especially the pituitary and thyroid glands. In slighter cases of such defect the gland usually gains its full development as life advances, and the corpulence passes off when adult age is reached.

Defective muscular exertion has been mentioned as a cause of corpulence, but it is sometimes observed that stout men, when they begin to take active exercise, become fatter still, the reason

being that the appetite is sharpened and still more food is taken.

Several drugs have the power of producing a fatty change in the tissues, among which arsenic and mercury may be specially mentioned, so that persons taking these for a long period tend to become fat.

Symptoms.—Health cannot be long maintained under excessive obesity, for the increase in bulk of the body, rendering exercise more difficult, leads to relaxation and defective nutrition of muscle, while the accumulations of fat in the chest and abdomen occasion serious embarrassment to the functions of the various organs in these cavities. In general, the mental activity of the highly corpulent becomes impaired, although there have always been notable exceptions to this rule.

In fat people the tissues of the body generally are of poor quality. The corpulent are at least as liable as the spare to be attacked by acute diseases, and they succumb much more readily to them than do the latter. A fever or other sharp illness is, however, sometimes beneficial to a corpulent person, in so far as it reduces his unnecessary fat, and enables him to make a fresh start, and, by judicious means, prevent its re-accumulation. Gout and diabetes, which are both, like corpulence, the result of defective oxidation processes, are apt to arise in stout and overfed people. Various skin conditions, such as eczema, and particularly a chafed and painful condition of the skin at folds where two surfaces meet (*see* CHAFING), are also troublesome.

Treatment.—For the prevention of corpulence and the reduction of superfluous fat, many expedients have been resorted to, and numerous remedies recommended. These have embraced such regimen as bleeding, purging, starving, the use of different kinds of baths, and of drugs innumerable, most of which means have been found to fail in accomplishing the desired object.

The drinking of vinegar was long popularly supposed to be a remedy for obesity. It is related of the Marquis of Cortona, a noted general of the Duke of Alba, that by drinking vinegar he so reduced his body from a condition of enormous obesity that he could fold his skin around him like a garment. Such a result was only a proof of the injury done to his health, and probably to his digestive organs, by the excessive use of vinegar. There is no evidence whatever that this liquid has any direct influence in removing fat, while its pernicious effects on the health, when taken in large quantity, are well known.

Extract of thyroid gland is the remedy necessary in the disease known as myxœdema, and in some cases of corpulence related apparently to this disease its use has been of great benefit. The extract of thyroid gland is sometimes administered by itself and sometimes along with other glandular extracts, especially that of pituitary gland.

Of far greater importance than any drugs is the question of the regulation of habits as to diet, exercise, and sleep. In 1863 a pamphlet appeared, entitled a *Letter on Corpulence, Addressed to the Public by William Banting*, in which was narrated the remarkable experience of the writer in accomplishing the reduction of his own weight in a short time, by the adoption of a particular kind of diet. Mr. Banting described the condition of obesity in which he was in August 1862, and which, although certainly less than those examples above mentioned, appears to have been sufficient to prove a source of much discomfort and even of actual suffering. After trying almost every known remedy without effect, he placed himself upon an entirely new form of diet, which consisted chiefly in the removal, as far as possible, of all sugary, starchy, and fat food, the reduction of liquids, and the substitution of meat or fish and fruit in moderate quantity at each meal, together with the daily use of an antacid draught. Under this regimen his weight was reduced 35 lb. in the course of a few weeks, while his health underwent a marked improvement. Mr. Banting's experience induced many to follow his example, and in numerous instances the effects were all that could be desired. Such a rapid loss of weight is, however, apt to be attended with serious impairment of health, and, generally speaking, it is not advisable to aim at losing weight at a greater rate than about three or four pounds in each week.

THE SALISBURY TREATMENT introduced by an American physician. Under this system, the person lives upon an entirely meat diet, consuming daily during a week or ten days about 3 lb. of lean beef, boiled, roasted, or minced according to taste. The meat is divided into three meals every day, and each meal is preceded by a copious draught (one pint) of hot water. After the week of treatment has elapsed, the person gradually reverts to an ordinary diet, avoiding thereafter certain forbidden articles. This method is often very successful, but is quite inadmissible for any one of gouty tendency or suffering from Bright's disease.

THE SCHROT TREATMENT was instituted by a Silesian peasant of that name, and consisted of a regime in which the persons under treatment were restricted in diet to stale bread and a limited amount of water. It was practically a starvation cure.

Various Continental bathing-places have elaborate courses of treatment, in which rigid rules are laid down. Since a person submits himself more easily to, and obeys more implicitly the rules in these places than he would do at home, such a 'cure' is attended with special benefit.

The articles of diet (*see* DIET) which are admissible to a person striving to reduce his excess of adipose tissue, include the following: lean meat, fish, sweetbread, clear soup, fowls, game, eggs, cheese, green vegetables, fresh fruit, toast, skimmed milk, and buttermilk, which has been specially recommended by some. Alcohol should be avoided, and tea and coffee partaken of sparingly.

The exercise should be abundant, and the clothing should be light when an attempt is made to reduce corpulence, but care must be taken that the food is not at the same time increased to satisfy the sharpened appetite, or the effect of exercise is defeated. The sleep is a matter of importance. The person should go to bed early, and should limit the duration of rest to seven or at most eight hours, while the habit of sleeping during the day should be broken off.

CORPUSCLE (*corpusculum*) means a small body. (*See* BLOOD.)

CORPUS LUTEUM is the mass of cells formed in the ruptured Graafian follicle in the ovary from which the ovum is discharged about fifteen days before the onset of the next menstrual period. When the ovum escapes the follicle fills up with blood. This is soon replaced by cells which contain a yellow fatty material. The follicle and its luteal cells constitute the corpus luteum. In the human the corpus luteum begins to disappear after ten days, unless the discharged ovum is fertilised and pregnancy ensues. In pregnancy the corpus luteum persists and grows and secretes the hormone progesterone (*q.v.*).

CORRIGAN PULSE is the name applied to the throbbing pulse found with incompetence of the aortic valve.

CORROSIVES are poisonous substances which corrode or eat away the mucous surfaces of mouth, gullet, and stomach with which they come in contact. Examples are strong mineral acids like sulphuric, nitric, and hydrochloric acids, caustic alkalies, and some salts like chlorides of mercury and zinc. (*See* POISONS.)

CORROSIVE SUBLIMATE, or PERCHLORIDE OF MERCURY, is a powerful antiseptic and an irritant poison. It is not to be confounded with subchloride of mercury, or calomel. (*See* ANTISEPTICS, DISINFECTION, MERCURY.)

CORTIN (*see* ADDISON'S DISEASE).

CORYZA (κορύζα, a running at the nose) is the technical name of a 'cold in the head'.

COSTAL (*costa*, a rib) means anything pertaining to the ribs.

COSTALGIA means pain in the ribs.

COSTIVENESS (*see* CONSTIPATION).

COTTON-WOOL is a downy material made from the hairs on cotton plant seeds (*Gossypium barbadense*). Ordinary cotton-wool is non-absorbent, owing to its containing a considerable quantity of cotton-seed oil. The absorbent form is produced by removing this with alkalies. The non-absorbent wool is of great use for purposes of protection to injured parts by reason of its

combined warmth and cheapness. It is highly inflammable. The absorbent wool is medicated with various substances, such as perchloride of mercury (sublimated wool), salicylic acid, etc., for use in dressings.

Cotton-seed oil can be used for purposes similar to those of olive oil, and taken in doses of ½ to 1 fluid ounce.

COUNTER-IRRITANTS (*see* BLISTERS AND COUNTER-IRRITANTS).

COW-POX is a disease affecting the udders of cows, on which it produces vesicles. It is communicable to man, and there has for centuries been a tradition that persons who have caught this cow-pox from cows do not suffer afterwards from smallpox. This formed the basis for Jenner's experiments on vaccination. (*See* VACCINATION.)

COXALGIA (*coxa*, the hip; ἄλγος, pain) means pain in the hip-joint.

COXA VARA (*coxa*, the hip; *varus*, bent outwards) is a condition in which the neck of the thigh-bone is bent so that the lower limbs are turned very much outwards and lameness results.

CRAB-LOUSE is another name for PHTHIRIUS INGUINALIS, a louse that infests the pubic region. (*See* INSECTS.)

CRACKED-POT SOUND is a peculiar resonance heard sometimes on percussion of the chest over a cavity in the lung, resembling the jarring sound heard on striking a cracked pot or bell.

CRAMP is a painful spasmodic contraction of muscles, most frequently occurring in the limbs, but also apt to affect certain internal organs. This disorder belongs to the class of diseases known as local spasms, of which other varieties exist in such affections as spasmodic asthma, tetany, and colic. The cause of these painful seizures resides in the nervous system, and operates either directly from the great nerve centres, or, as is generally the case, indirectly by reflex action, as, for example, when attacks are brought on by some derangement of the digestive organs.

TEMPORARY CRAMP.—In its most common form, that of cramp in the limbs, this disorder comes on suddenly, often during sleep, the patient being aroused by an agonising feeling of pain in the calf of the leg or back of the thigh. During the paroxysm, the muscular fibres affected can often be felt gathered up into a hard knot. The attack in general lasts but a few seconds and then suddenly departs, the spasmodic contraction of the muscles ceasing entirely; or, on the other hand, relief may come more gradually during a period of minutes or even hours. A liability to cramp is often associated with a rheumatic or gouty tendency, but occasional attacks are common enough apart from this, and are often induced by some peculiar posture which a limb has assumed during sleep. Exposure of the limbs to cold will also bring on cramp. It is likewise of frequent occurrence in the process of parturition.

Treatment.—This painful disorder can be greatly relieved and often entirely removed by firmly grasping or briskly rubbing the affected part with the hand, or by anything which makes an impression on the nerves, such as the application of some cold substance to the part, or occasionally by warmth. Even a sudden and vigorous movement of the limb, in such a direction as to stretch the affected muscle, will often succeed in terminating the attack.

CRAMP OF SWIMMERS includes usually spasm of the arteries as well as of the muscles due to cold and exertion, so that death is apt to occur from stoppage of the heart. If treatment can be applied, friction of the limbs, warmth, and hot drinks are essential.

CRAMP OF THE STOMACH, or GASTRALGIA, usually is a symptom in connection with some form of gastric disorder (*see* STOMACH, DISEASES OF). For cramp affecting the muscular wall of the bowels, see COLIC.

HABIT SPASMS, or FUNCTIONAL SPASMS, are liable to occur in individuals of almost any handicraft, and are often extremely troublesome.

Symptoms and varieties.—*Writer's Cramp*, or *Scrivener's Palsy*, is a spasm which affects certain muscles when engaged in the performance of acts, the result of education and long usage,

and which does not occur when the same muscles are employed in acts of a different kind. This disorder owes its name to the relative frequency with which it develops in persons who write much, although it is by no means confined to them.

The symptoms are in the first instance a gradually increasing difficulty experienced in conducting the movements required for executing the work in hand. At an early stage of the disease, the difficulty may be to a large extent overcome by persevering efforts, but ultimately, when the attempt is persisted in, the muscles of the fingers and occasionally also those of the forearm, are seized with spasm or cramp, so that the act of writing is rendered impossible. Sometimes the fingers, instead of being cramped, move in a disorderly manner and the pen cannot be grasped, while in other rare instances a kind of paralysis affects the muscles of the fingers, and they are powerless to make the movements necessary for holding the pen. It is to be noted that it is only in the act of writing that these phenomena present themselves, and that, for all other movements, the fingers and arms possess their natural power. Similar symptoms are observed and similar remarks apply in the case of musicians, typists, telegraphists, artists, compositors, seamstresses, tailors, and many mechanics.

Spasmodic Wry-neck is one of the most frequent forms which the disease takes. This comes on in shoemakers, tailors, and persons generally whose employment necessitates their following, with the head, movements which the hands are making. The result is that the muscles of the neck assume the unpleasant habit of drawing the head to one side whenever the slightest attempt is made to turn and look at anything. Indeed, although actually a rare disease, no muscle or group of muscles which is specially called into action in any particular occupation is exempt from liability to this functional spasm, which is therefore ascribed to over-use of the parts concerned.

Treatment.—In the treatment of habit spasms, the only effectual remedy is absolute cessation for a time (it may be a month or longer) from the work with which the attack is associated. It is sometimes recommended that the opposite hand or limb be used so as to afford the affected part entire rest, but this may be followed by the extension of the disorder to that locality also. Peculiar forms of penholder and other mechanical contrivances have been suggested so as to enable the occupation to be carried on, but they do not afford any relief to the disease, for the cure of which entire rest is important. There is often a strong psychological element in such cases, and psychotherapy is indicated. Where the spasmodically acting muscles are not of great importance to the bodily economy, their action can be controlled by division of their nerves of supply. For example, spasmodic wry-neck can be checked by division of the spinal accessory nerve on one side of the neck. Such a procedure is out of the question in the case of the hand.

CRAMPS is another term for HEAT-CRAMPS, which are painful contraction of muscles occurring in men (*e.g.* stokers) working in high temperatures. The cramps are due to excessive loss of salt in the sweat, and can be cured by giving salt water to drink.

CRANIAL NERVES (*see* BRAIN) are those arising from the brain.

CRANIUM (κρανίον) means the part of the skull enclosing the brain as distinguished from the face.

CRASIS (κρᾶσις, blend) is the term applied to the individual temperament or constitution. (*See* CONSTITUTION.)

CREAM is the oily or fatty part of milk from which butter is prepared. Average cream when purchased contains about 18 per cent of fat. A food known as '20 per cent cream' is much used by diabetics, and consists of the upper 4 oz. skimmed off a quart of milk which has stood for twenty-four hours. Heavy cream or whipped cream may contain about 48 per cent of fat. (*See* MILK.)

Various medicinal preparations are known also as cream, *e.g.* cold cream, which is a simple ointment containing rose-water, beeswax, borax, and almond oil scented with oil of rose.

CREAM OF TARTAR is another name for bitartrate of potassium.

Imperial Drink consists of a teaspoonful of cream of tartar, a squeeze of lemon, two lumps of sugar, and a pint of cold water.

CREATINE (*κρέας*, flesh) is a nitrogenous substance, methyl-guanidine-acetic-acid. In the adult human body there are about 120 grammes of it, and 98 per cent of this is present in the muscles. Much of the creatine in muscle is combined with phosphoric acid as phosphocreatine, which plays an important part in the chemistry of muscular contraction.

CREATININE is the anhydride of creatine and is derived from it. It is purely a waste product.

CREOLIN is a coal-tar product, useful for removing smells, if a few teaspoonfuls be added to a pint of water and the mixture be sprinkled on floors, etc. It has a powerful antiseptic action.

CREOSOTE, or CREASOTE, is a clear, yellow liquid, of aromatic smell and burning taste, prepared by distillation from pine-wood or from beech-wood, the product of the latter being of better quality. It mixes readily with alcohol, ether, chloroform, glycerin, and oils.

It is a powerful antiseptic and disinfectant. It has also a soothing action upon parts with which it is brought into contact. It is unchanged after absorption into the blood, and, being excreted by the lungs and exhaled on the breath, it exercises a potent effect upon these organs.

Uses.—Creosote is an ingredient of some disinfectant fluids; it is also used in the form of a vapour, containing creosote 80 drops, light carbonate of magnesia 30 grains, water 1 ounce, of which a teaspoonful is added to a pint of hot water and inhaled in cases of suppurating throat, fœtid breath, etc. In cases of phthisis 2 to 10 drops are given either internally, or are inhaled from a respirator to soothe cough and exert an antiseptic influence upon the interior of cavities in the lung. In cases of vomiting due to ulcerated stomach, sea-sickness, etc., it checks this, if given in similar doses.

CREPITATIONS (*crepito*, I rattle) is the name applied to certain sounds which occur along with the breath sounds, as heard by auscultation, in various diseases of the lungs. They are signs of the presence of moist exudations in the lungs or in the bronchial tubes, are classified as fine, medium, and coarse crepitations, and resemble the sound made by bursting bubbles of various sizes.

CREPITUS (*crepitus*) means a grating sound like that made by rubbing the hair between the fingers. It is found in cases of fractured bones when the ends rub together; also in cases of severe chronic arthritis by the rubbing together of the dried internal surfaces of the joints.

CRESOL, or METHYL PHENOL, is an oily liquid obtained from the tar distilled out of coal, beech-wood, or pine. It is a powerful antiseptic and disinfectant.

Uses.—It is used combined with soap to form a clear saponaceous fluid which can be mixed with water in any proportions. For the disinfection of linen, bed-pans, drains, or surgical instruments a convenient strength is 2 per cent (one tablespoonful to 1½ pints of water); for washing the hands 1 per cent (one tablespoonful to 2½ pints); and for a douche ½ per cent (one tablespoonful to 5 pints) is commonly used.

CRETA is a Latin name for chalk. It is used especially in the form mistura cretæ, or chalk mixture, to check diarrhœa, in doses of a tablespoonful or more, repeated as often as necessary.

CRETINISM (Swiss *crétin*, a Christian) is a peculiar form of idiocy which develops among the children in certain localities, possibly in consequence of atmospheric and geographical conditions, which are not well understood, and in association with hereditary predisposition and unsuitable diet. Not only is the mind feeble, but the whole body remains undeveloped, and there are deformities of the bones, changes in the thyroid gland, and a swollen condition of the skin. The defect in the thyroid gland is believed to be responsible for most of the other bodily and mental peculiarities. The affected child rarely reaches middle age. The condition is met with particularly in Switzerland, Northern Italy, and Tyrol,

but cases crop up now and then in England, America, etc.

Treatment consists in attending to the general health and in giving extract of thyroid regularly: it is important for the disease to be diagnosed at an early stage if treatment is to have effect.

CRISIS (κρίσις, a decision) is a word used with several distinct meanings.

1. The usual meaning is that of a rapid loss of fever and return to comparative health in certain acute diseases. For example, pneumonia ends by a 'crisis', usually on the eighth day, the temperature falling in twenty-four hours to normal, the pulse and breathing becoming slow and regular, and the patient passing from a partly delirious state into natural sleep. This occurs in several acute diseases. The opposite mode of ending to crisis is by 'lysis', for example, in typhoid fever, where the patient slowly mends during a period of a week or more, without any sudden change.

2. A popular use of the word 'crisis', and still more frequently of 'critical', is to signify a dangerous state of illness in which it is uncertain whether the sufferer will recover or not.

3. The word 'crisis' is also used to signify a paroxysm of pain in the larynx, stomach, or bowels occurring during the course of locomotor ataxia.

CROTON OIL is a powerful purgative, producing copious watery evacuations, and, in large quantities, acting as an irritant poison.

Uses.—In apoplexy, delirium tremens, and head injuries, where it is wished to produce a copious motion rapidly, one drop of croton oil is given on a lump of sugar, or mixed with a few drops of olive oil or of milk, and generally acts within an hour. Externally, croton liniment forms an excellent counter-irritant, applied to the chest in chronic bronchitis.

CROUP (Scottish word) is a disease of childhood, commonest during its second and third years, in which swelling and partial blockage of the entrance to the larynx occur, often with considerable suddenness, causing difficulty of breathing and partial suffocation.

Spasmodic Croup, or Laryngismus, is another condition to which children are liable. very similar in symptoms, but of a purely nervous nature (*See* LARYNGISMUS.)

Causes.—Croup has been much confused with diphtheria, which is a much more serious complaint. The reason of this is that, originally, one of the constantly described symptoms of croup was the formation of a 'false membrane', resembling chamois-leather, on the throat. Later it was shown that this occurs most frequently in serious cases of throat inflammation due to a particular bacillus (the Klebs-Loeffler bacillus), and these cases have been separated off as the special disease called diphtheria. Croup includes the other cases due to slighter forms of inflammation, such as the effects of a chill, breathing of irritating vapours, swallowing of very hot water, etc., and there may be, or frequently is not, a false membrane. In any case the throat, and particularly the entrance to the larynx, which in young children will barely admit the tip of the little finger, becomes inflamed and swollen till the opening is almost closed. The passage is still further narrowed by mucus excreted from the inflamed surfaces, and by spasm in the muscles of the larynx.

Symptoms. — The attack usually comes on at night, when the child is in bed, and follows a chill caught during the day, or an ordinary cold that has lasted perhaps for some days. The breathing is hoarse and croaking (hence the name of the disease), the voice thin, the cough paroxysmal and metallic in tone, and the air passes in with a harsh, loud noise. The child is frightened and excited at first, but later gets feeble and livid. Still later, pallor, sweating, and great struggling for breath come on, and may last half an hour or several hours. After this the symptoms begin to abate, gradually pass away, and the child falls asleep, but there is always a danger that the larynx may become completely blocked, in which case death ensues in a few minutes. A fatal termination is rare if the child receive proper treatment, and the alarming symptoms usually abate on the day following the attack, to return, it may be, on the succeeding night. A child who has once had croup is liable to have future attacks, and so should be specially guarded against cold and damp till he has outgrown the tendency.

Treatment.—The child should be put into a hot bath to which a tablespoonful of mustard has been added, in order to relieve the congestion of internal organs, and a tent should be made with a blanket over the bath, so that he may inhale the steam. When he is put back into bed the tent should be put over the bed, and the nozzle of a steam kettle brought within it. To the water in the kettle may be added a teaspoonful of compound tincture of benzoin, of vapour of creosote (*see* CREOSOTE), or of other soothing substance. At the commencement, an attack is often checked by the administration of a teaspoonful of ipecacuanha wine every ten minutes till vomiting takes place. Sometimes, when the spasm of the laryngeal muscles seems very great, inhalation of chloroform is resorted to.

CRUCIAL LIGAMENTS (*crux*, a cross) are two strong ligaments in the interior of the knee-joint, which cross one another like the limbs of the letter X. They are so attached as to become taut when the lower limb is straightened, and they prevent over-extension or bending forwards at the knee.

CRURAL (*crus*, the leg) means something connected with the leg.

CRUSH SYNDROME is the term provisionally given to a new condition described in 1941 in which kidney ailure occurred in patients who had been crushed under fallen masonry in the course of air raids. The fundamental injury is damage to muscle. The limb swells. The blood volume falls. Blood urea rises; there is also a rise in the potassium content of the blood. The patient may survive; or he dies with renal failure. Post-mortem examination shows degeneration of the tubules of the kidney, and the presence in them of pigment casts.

CRUTCH-PALSY (*see* DROP-WRIST).

CRYMOTHERAPY is the term applied to the treatment of disease by refrigeration. The temperature either of the whole body or of a part can safely be lowered by 10° F. to 18° F. For the former the patient is put into a special air-conditioned, thermostatically controlled room. General crymotherapy, or 'frozen sleep', has been found to ease the severe pain of advanced cancer and diminish the need for narcotics.

Crymotherapy, or, as it is becoming more generally termed, HYPOTHERMIA, is also being used as a form of anæsthesia—REFRIGERATION ANÆSTHESIA. For example, a gangrenous leg in chronic diabetes or arteriosclerosis is kept by means of ice bags at a temperature of 5° C. for from 1 to 5 hours. This unusual form of anæsthesia much reduces the risks of shock and infection.

CRYOSCOPY (κρύος, frost; σκοπέω, I examine) means the method of finding the concentration of blood, urine, etc., by observing their freezing-point.

CTAB is the recognised abbreviation for cetyltrimethyl ammonium bromide. This is a synthetic detergent, or cleansing agent. In a 1 per cent solution it is more effective than most antiseptics in ridding the skin of bacteria. It has also been used for cleansing burns and wounds. Ctab is bacteriostatic in high dilutions. It is a most effective agent for cleansing and disinfecting greasy and infected bowls and baths.

CUBEBS is the fruit of *Piper cubeba*, used similarly to copaiba.

CUPPING is used in cases of deep-seated congestion to draw blood to the surface. It causes sudden dilatation of the superficial blood-vessels, and so probably contracts those of underlying organs. But whatever the explanation,

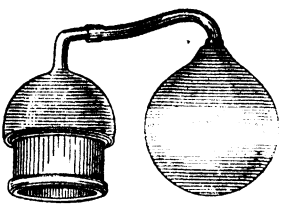


FIG. 118.—Cupping-glass with suction bulb attached.

it undoubtedly gives great and immediate relief in difficulty of breathing due to asthma, bronchitis, and heart disease, and relieves congestion of the kidneys in acute Bright's disease. Cupping is of two kinds, *dry-cupping* and *wet-cupping*. To dry-cup, one takes a cupping-glass (or an ordinary thick glass tumbler), puts a few drops of

methylated spirit upon a fragment of blotting-paper into it, ignites this, and, while it is still burning, claps the mouth of the glass tightly on the back of the patient. A vacuum is produced, and the skin swells up into the glass as blood rushes into its small blood-vessels. This is repeated four, six, or eight times in different places. Wet-cupping is rarely used these days. The skin is first dry-cupped, the swollen skin is next scarified with a lancet or a special instrument for the purpose, and then the cupping-glass is again applied, and blood drawn off into it. The vacuum for dry- or wet-cupping may also be produced by a suction bulb.

CUPRALUM is a useful disinfectant, composed of copper sulphate, alum, bichromate of potassium, and terebene.

CUPRUM is the Latin word for copper.

CURARE, known also as CURARA, WOORARI, WOURALI, URARI, and TICUNAS, is a dark-coloured extract from some trees of the *Strychnos* family. It is used by the South American Indians as an arrow poison, and is extremely potent, its action depending upon an alkaloid, curarine, that it contains. It is almost devoid of action when given by the mouth, because the kidneys excrete the poison as rapidly as it is absorbed; but when injected under the skin, in minute doses, it paralyses quickly the nerve endings in muscle. Thus the person or animal poisoned by it lies motionless, and finally death ensues as the result of stoppage of the breathing, caused by failure of the inspiratory muscles to act. Thus in curare poisoning, if artificial respiration be performed until the poison is discharged from the system, the patient may recover.

CURDLED MILK (*see* CASEIN).

CURETTE, or CURET, is a spoon-shaped instrument used in surgery for scooping out the contents of any cavity of the body, *e.g.* the uterine cavity.

CUSHING'S SYNDROME is the term applied to the changes that take place in the body as the result of a tumor of the pituitary gland. The changes are: obesity, hairiness, curvature of the spine, impotence, and the appearance of red lines in the skin. Cushing was a famous American brain surgeon who died in 1939.

CUSPARIA, or ANGOSTURA, is the dried bark of *Galipea cusparia*, a tree of tropical America. An infusion is much used as a bitter, in doses of one, two, or more tablespoonfuls.

CUTANEOUS (*cutis*, the skin) means belonging to the skin. (*See* SKIN DISEASES.)

CUTICLE (*see* SKIN).

CUTS (*see* WOUNDS).

CUT-THROAT is an injury which may be due to suicide or murder, an expert being able to tell at a glance the one from the other. Death, when it occurs at once, is usually due to bleeding from the large vessels of the neck, and later may be caused by inflammation of the air passages. Another danger is that air will enter the large veins in such amount as to bring the circulation of the blood to a standstill. In a case of cut-throat, if any vessel be seen to bleed, the hæmorrhage should be checked by pressure with the finger till surgical assistance can be got.

CYANIDES are salts of hydrocyanic or prussic acid. They are highly poisonous, and are also powerful antiseptics. (*See* PRUSSIC ACID, WOUNDS.) Double cyanide of mercury and zinc is specially powerful as an antiseptic used to impregnate gauze and cotton-wool for dressing wounds.

CYANOSIS (κυάνεος, blue) is a condition of blueness seen particularly about the face and extremities, accompanying states in which the blood is not properly oxygenated in the lungs. It appears earliest through the nails, on the tips of the ears, and over the cheeks. It may be due to blockage of the air passages, or to disease in the lungs, or to a feeble circulation as in heart disease.

CYCLOPROPANE ($CH_2 . CH_2 . CH_2$) is a new anæsthetic gas which has come into increasing use during recent years.

CYESIS is another term for pregnancy.

CYNANCHE (κυνάγκη) is an old name for severe sore throat with choking; it is shortened now to 'quinsy'.

CYRTOMETER (κυρτός, curved; μέτρον, a measure) is an instrument for measuring the shape of the chest.

CYSTITIS (κύστις, a bladder) means inflammation of the bladder. (*See* BLADDER, DISEASES OF.)

CYSTOSCOPE (κύστις, the bladder; σκοπέω, I view) is an instrument for viewing the interior of the bladder. It consists of a narrow tube carrying a small electric lamp at its end, a small mirror set obliquely opposite an opening near the end of the tube, and a telescope which is passed down the tube and by which the reflection of the brightly illuminated bladder wall in the mirror is examined. It is of great value in the diagnosis of conditions like ulcers and small tumors of the bladder.

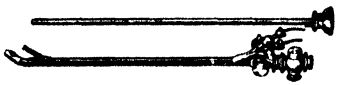


FIG. 119.—Cystoscope, showing above the telescope which is passed down the interior in order to see the interior of the bladder; also two catheters which can be passed up the ureters to the kidneys.

Fine catheters can be passed along the cystoscope, and by the aid of vision can be inserted into each ureter and pushed up to the kidney, so that the urine from each kidney may be obtained and examined separately in order to diagnose which of these organs is diseased.

CYSTS (κύστις, a bladder) are hollow tumors containing fluid or soft material. They are almost always simple in nature and seldom return after removal, though in the case of certain types there are apt to be several of various sizes.

Varieties.—(*a*) RETENTION CYSTS.—In these some cavity which ought naturally to contain a little fluid becomes, in consequence of irritation or other cause, distended to a great extent, or the natural outlet from the cavity becomes blocked. Wens are caused by the blockage of the outlet from sebaceous glands in the skin, so that an accumulation of fatty matter takes place. Ranula is a clear swelling under the tongue, due to a collection of saliva in consequence of an obstruction to a salivary duct. Cysts in the breasts are, in many cases, the result of blockage in milk ducts, due to inflammation. Cysts also form in the kidney as a result of obstruction to the free outflow of the urine.

(*b*) DEVELOPMENTAL CYSTS.—Of these the most important are the huge cysts that originate in the ovaries. The cause is doubtful, but the cyst commences probably at a very early period of life, gradually enlarges, and buds off smaller cysts from its wall. The contents are usually a clear gelatinous fluid. Very often both ovaries are affected, and the cysts may slowly reach a great size, often, however, taking a lifetime to do so.

A similar condition sometimes occurs in the kidney, and the tumor may have reached a great size in an infant even before birth (congenital cystic kidney).

Dermoid cysts are small cavities, which also originate probably early in life, but do not reach any great size till fairly late in life. They appear about parts of the body where clefts occur in the embryo and close up before birth, such as the corner of the eyes, the side of the neck, the middle line of the body. They contain hair, fatty matter, fragments of bone, scraps of skin, even numerous teeth.

(*c*) HYDATID CYSTS are produced in many organs, particularly in the liver, by a parasite, which is the larval stage of a tape-worm found in dogs. They occur in people who keep dogs and allow them to contaminate their food. (*See* PARASITES.)

(*d*) CYSTS IN HARD TUMORS occur occasionally, especially where these tumors spring from glands.

Treatment.—The best treatment for cysts of all sorts is complete removal by careful dissection, after which they do not recur. Failing this, in the case of small cysts the contents may be let out, the inner surface of the cyst wall destroyed by scraping, or by injecting irritating fluids, and the cavity compelled to close completely from the bottom by stuffing the opening leading to the exterior, so as to prevent it from closing too quickly.

CYTO- (κύτος, a cell) is a prefix meaning something connected with a cell or cells.

CYTODIAGNOSIS means diagnosis of disease by examining the cells found in blood effusions from cavities, etc.

CYTOMETER is an instrument for counting and measuring cells.

DACRYOCYSTITIS (δάκρυον, a tear; κύστις, bladder) means inflammation of the tear-sac at the side of the nose near the inner angle of the eye.

DACTYLITIS (δάκτυλος, a finger) means inflammation of a finger or toe. The term is most frequently applied to tuberculous disease in the finger.

D.A.H. is an abbreviation for DISORDERED ACTION OF THE HEART. (*See* EFFORT SYNDROME.)

DAMP is the name applied generally by miners to noxious gases in a mine. 'Fire damp' is an explosive mixture of gases, chiefly marsh gas. 'After damp' or 'white damp' is the term applied to carbon monoxide. 'Choke damp' and 'stink damp' are terms applied to an evil-smelling mixture of gases following the use of explosives containing sulphuretted hydrogen and other irritating compounds. 'Black damp' is the name applied to the stagnant air of old workings and wells from which the oxygen has disappeared, and which consists of nitrogen and carbon dioxide. (*See* AIR, VENTILATION, COAL GAS, ASPHYXIA.)

DANDELION (*see* TARAXACUM).

DANDRUFF (*see* BALDNESS).

DANDY-FEVER is another name for dengue.

DANGEROUS DRUGS. This term is applied to certain drugs which are scheduled under the Dangerous Drugs Act, and which must be dispensed only under certain stringent regulations. These include morphine, cocaine, ecgonine, diamorphine (commonly known as heroin), extracts and tinctures of Indian hemp and opium, as well as any preparation containing one part in 500 or more of morphine or one part in 1000 or more of cocaine, ecgonine or diamorphine. Certain preparations of opium are exempted, such as opium plaster, liniment of opium, Dover's powder and ointment of galls and opium, and hospitals are also exempted from the provisions of the regulations in regard to these drugs. Prescriptions containing any of these drugs must be written, dated and signed by a practitioner, and must give the name and address of the person for whom the prescription is intended, as well as the total amount of the drug to be supplied.

All other poisonous substances are scheduled in two classes: (1) those containing the more deadly poisons, which may not be sold by chemists except to persons known to the seller, and regarding which the name and address of the purchaser must be entered in a book; (2) less deadly poisons, including various disinfectants, which must be labelled with the word 'poison' when they are sold. Certain colourless poisons such as arsenic must be coloured with indigo or soot.

DARTOS is the thin muscle just under the skin of the scrotum which enables the scrotum to alter its shape.

DAY BLINDNESS is a condition in which the patient sees better in a dim light or by night than in daylight. It is only found in conditions in which the light is very glaring, as in the desert and on snow, and is relieved by resting the retina, for example by wearing coloured glasses for a time.

DEAD, DISPOSAL OF THE.—Practically only three methods have been used from the earliest times: (*a*) burial; (*b*) embalming; (*c*) cremation.

(*a*) **Burial** is perhaps the earliest and most primitive method, and, because of its practice among the Jews, and the popularly accepted idea as to the resurrection of the body, has become intimately bound up with the Christian religion. It was customary to bury the bodies of the dead in consecrated ground around the churches till the earlier half of the nineteenth century, when the utterly insanitary state of churchyards led to legislation for their better control, and, now that cemeteries are supposed to be situated outside towns and in proper sites, the interment of the dead should seldom be a menace to the health of the living. If a light coffin and porous soil surround the body its decay should be rapid and harmless, and in a year or two only the bones should remain. (*See* PUTREFACTION.) Burials in Britain take place usually upon production of a certificate from a registrar of deaths, to whom notice of the death, accompanied by a medical certificate, should be sent by the nearest relatives within five days of the death.

(*b*) **Embalming** was practised by several races of antiquity, notably by

the Egyptians, with the view of preserving from decay the bodies of dead friends. It is seldom resorted to now. The process consists in removing the internal organs by small openings and filling the body cavities with various aromatics of antiseptic power, the skin being swathed in bandages or otherwise protected from the action of the air. Bodies are also preserved by injecting the blood-vessels with strong antiseptics like perchloride of mercury. In certain circumstances bodies become naturally changed to a non-putrefying substance known as adipocere.

(*c*) **Cremation** was practised among the Greeks and the early Aryan races generally, and furnishes a much speedier reduction of the body to its simple components than does burial, and one devoid of any harmful tendencies to the living. It is opposed partly on the sentimental ground that its speediness renders it a greater shock to the feelings of survivors, partly that its completeness obliterates at once all trace of possible crime. The latter objection would be obviated, if the practice became general, by more thorough medical examination of bodies before cremation. The law does not distinguish in England or America between cremation and burial, but special formalities are insisted upon by the crematorium authorities. The ceremony is conducted similarly to a burial ceremony, the coffin is lowered from the mortuary chapel, through an opening, on to a trolley which bears it direct to the furnace. About fifteen shillings' worth of fuel is required to incinerate each body, and the process takes between one and two hours. About five to seven pounds of ash result from the combustion of the body, and there is no admixture with that from the fuel. The process is not in itself an expensive one, but at present the fees and formalities necessary render it almost as dear as burial.

DEAD FINGERS (*see* RAYNAUD'S DISEASE).

DEADLY NIGHTSHADE is the popular name of *Atropa belladonna*, from which atropine is procured. Its poisonous black berries are sometimes eaten by children. (*See* ATROPINE.)

DEAFNESS, although generally due to some trouble in the ear, is of many different types, and is an unfortunate complaint in that few cases of long standing admit of great benefit.

Varieties and causes.—Deafness is divided into three classes, according to the section of the ear at fault, and this division is of great practical importance, because, while the external ear is readily accessible for examination and treatment, the middle ear requires most delicate manipulation, and the internal ear is beyond the reach of any remedies other than general ones.

EXTERNAL EAR is the passage, about 1½ inches in length, leading inward from the surface to the drum. When the deafness has its cause in this part, it is due simply to obstruction of the passage by a tumor, by a foreign body,

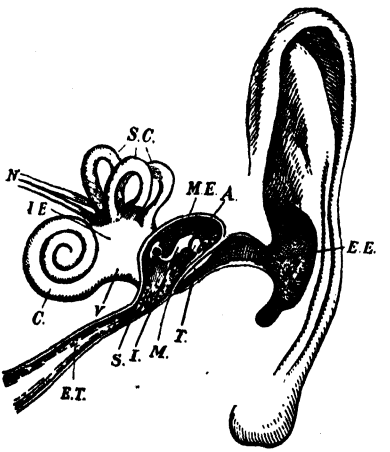


FIG. 120.—Diagram of section through the ear. *EE*, external, *ME*, middle, *IE*, internal, ear; *T*, tympanic membrane; *M*, malleus; *I*, incus; *S*, stapes; *A*, opening to mastoid antrum; *ET*, Eustachian tube; *C*, cochlea; *SC*, semicircular canals; *V*, utricle; *N*, auditory nerve. (Schmeil's *Zoology*.)

such as a pea, or a polypus, or, most commonly of all, by a plug of hardened wax. In fact, the vast majority of cases of deafness, accompanied by ringing in the ear, are due to the presence of wax.

MIDDLE EAR is the drum or tympanum separated by the tympanic membrane from the outer ear, and communicating with the mastoid antrum, a hollow in the skull, behind, and with the Eustachian tube, which leads to the throat, beneath. These

communications are important, because the connection with the throat explains the deafness that accompanies cold in the head, and other forms of inflammation, which spread from the nose and throat up into the middle ear; while the connection with the antrum shows why suppuration in the antrum causes great destruction of the delicate mechanism in the middle ear. Acute inflammation in the throat, for example in scarlatina and measles, or chronic conditions like adenoids in children, are very liable to produce middle-ear disease, perforation of the drum, and deafness. Tearing of the drum in consequence of a box on the ear, or of an explosion, as a rule heals and leaves no deafness; but a perforation following inflammation in the antrum or middle ear is accompanied by suppuration, discharge from the ear, and other changes and generally attended by impairment of hearing. When fat people become deaf, the condition is sometimes due to a deposit of fat actually pressing on the Eustachian tube, and preventing the entrance into the middle ear of air, which is necessary for good hearing. It is a peculiarity of deafness in middle-ear disease that the hearing is often better during a loud noise; for example, a conversation is more clearly heard while church bells are ringing, or in the noise of a railway train.

INTERNAL EAR AND BRAIN constitute the receptive and perceptive apparatus for sound, the outer and middle ear forming parts of the conducting and collecting apparatus. Certain fevers, like typhus and typhoid, tumors of the brain, meningitis, Ménière's disease, mumps, and fractures of the base of the skull may all bring on a greater or less degree of deafness by interference with the perceptive apparatus. Some drugs produce a temporary deafness, notably quinine and salicin. Boiler-maker's disease is a condition of deafness, due apparently to a gradual wearing out of the nervous mechanism by the constant noise of hammering, and comes on in a few years, especially in boiler-makers, but also in sawyers, threshing-mill tenders, and persons similarly subject to constant noise. Hereditary deafness comes on in several members of some families about middle life, owing to hardening changes in the middle ear or inner ear, and practically defies all treatment.

Treatment.—Deafness due to causes in the external ear is readily dealt with, and, considering the frequency of hardened wax, it is a good and safe procedure to syringe out the ear with a tumblerful of warm water containing a teaspoonful of baking soda (bicarbonate). The stream of water is directed along the upper wall of the passage and flows out below. In cases where deafness accompanies nasal catarrh, adenoids, enlarged tonsils, etc., these conditions must be remedied by nasal douches, gargles, operation, etc. (*See* NOSE, DISEASES OF.) In a case of perforation of the drum, accompanied by a chronic discharge, particular care must be taken to keep the ear clean, because there is otherwise a danger not only of increased deafness but of retained matter infecting some neighbouring part, and causing dangerous abscess in the brain, meningitis, or suppuration in the mastoid antrum. (*See* EAR, DISEASES OF.) Boiler-maker's deafness generally improves if the occupation be changed, otherwise it grows steadily worse. Deaf-mutism is a condition where deafness has been complete from early life, usually from birth, and the child has never learned to speak, though its voice-producing organs are perfect. Such children may, with patience, be taught to carry on a fluent conversation by means of 'lip-reading', or by the finger language and signs. (*See* DUMBNESS.)

Various aids to hearing have been devised for use in middle-ear deafness. Speaking tubes and trumpets give some help. Artificial drums are extremely useful in certain cases, especially where there is a large perforation, and one of the best consists simply of a piece of tightly rolled cotton-wool, pushed in so as to rest lightly on the remains of the drum. An audiphone, which is a fan-like instrument made of vulcanite that is placed against the teeth in order to send the sound-waves through the bones of the head direct to the ear, is very useful now and then. Recently various instruments have been produced consisting of microphone receiver, electric battery, and a telephone ear-piece by which the voice of any one addressing the deaf person is magnified so as

to be clearly heard. These instruments are highly successful in the case of many deaf persons, though not of great use in others. Each instrument requires to be carefully tuned for the deaf person using it.

DEAMINATION is the term applied to the process of removal of the amino group $-NH_2$ from amino-acids not required for building up body protein. This is carried out mainly in the liver by means of an enzyme, deaminase. The fatty acid residue is either 'burnt up' to yield energy, or is converted into glucose.

DEATH, CAUSES OF.—Although the final cause of death is usually failure of the vital centres which govern the beating of the heart and the act of breathing, the practical question is the disease or injury which leads to this failure. A general idea of the extent to which different causes operate in terminating life can be obtained from the following table of causes of death in order of importance in England and Wales, taken from the Registrar-General's return for the year 1936. The total population at the middle of the year was 40,839,000, and the deaths from all causes were 495,764. Of these 35,425 (or 7·2 per cent) were deaths of infants under one year of age.

1.	Organic heart disease	126,584
2.	Cancer and other tumors	69,029
3.	Tuberculosis	28,268
4.	Pneumonia	28,182
5.	Apoplexy	27,599
6.	Diseases of blood-vessels	26,168
7.	Congenital malformations and debility of early infancy	19,206
8.	Bronchitis	17,600
9.	Old age	17,089
10.	Accidents	16,205
11.	Bright's disease	15,723
12.	Various infectious diseases, excluding tuberculosis and influenza	13,444
13.	Nervous and mental diseases, excluding apoplexy and epilepsy	10,748
14.	Diabetes	7,119
15.	Influenza	6,057
16.	Suicide	5,079
17.	Diarrhœa, colitis, etc.	4,990
18.	Rheumatic diseases	4,926
19.	Prostatic disease	4,768
20.	Diseases of the blood	4,698
21.	Gastric and duodenal ulcer	4,683
22.	Hernia and intestinal obstruction	4,643
23.	Appendicitis	2,866
24.	Childbirth	2,301
25.	Epilepsy	2,119
26.	Goitre	2,080
	Other diseases in small numbers	23,587

DEATH, SIGNS OF.—There are some minor signs, such as relaxation of the facial muscles, which produces the staring eye and gaping mouth of the *Hippocratic countenance*, as well as a loss of the curves of the back, which becomes flat by contact with the bed or table; *discoloration of the skin*, which becomes of a wax-yellow hue, and loses its pink transparency at the finger-webs; *absence of blistering and redness* if the skin be burned (Christison's sign); and *failure of a ligature* tied round the finger to produce, after its removal, the usual change of a white ring, which, after a few seconds, becomes redder than the surrounding skin in a living person.

Most important for the immediate recognition of death are *stoppage of the heart* for a couple of minutes, as listened for by placing the ear on the chest at the inner side of the left nipple, and *cessation of breathing*, as noted by observing that a mirror held before the mouth shows no haze, that a feather placed on the upper lip does not flutter, or that the reflection on the ceiling from a cup of water placed on the chest of the dead person shows no movement. An important sign is that if a cut be made in the skin or a vessel be opened no bleeding takes place after death.

Four points are important in determining the time that has elapsed since death. *Hypostasis*, or congestion, begins to appear as livid spots on the back, often mistaken for bruises, four hours or more after death. It is due to the blood running into the vessels in the lowest parts. *Loss of heat* begins at once after death, and the body has become as cool as the surrounding air after 15 or 20 hours, though this is delayed by hot weather, death from asphyxia, and some other causes. *Rigidity* begins at 4 to 10 hours after death in the muscles of the neck, spreads to the other muscles, and is complete a few hours later, remaining for 2 to 4 days, and passing gradually off. It comes on

more quickly after death from wasting diseases, and often suddenly after injuries to the brain, so that a suicide may be found firmly grasping the revolver with which he has shot himself. If a joint be forcibly bent, rigidity does not return, while in the rigidity of catalepsy such a joint becomes as stiff as before. *Putrefaction* is a certain sign, and begins in 2 or 3 days, as a greenish tint over the abdomen. (*See* PUTREFACTION.)

DEBILITY (*debilitas*) means a state of weakness in which the body or one of its systems becomes unable to bear strains put upon it, or even, in severe cases, to discharge the ordinary functions of life. The condition may be hereditary, owing to weakness or age in parents, or may be an early stage of some disease, such as consumption, or come on as a developmental change. (*See* CLIMACTERIC *and* NEURASTHENIA.)

Treatment.—The cause must, so far as possible, be removed. The essential is rest, combined with regulated exercises, good food, and tonics. The person must be specially guarded, for the time being, from strains of all sorts and exposure to infectious diseases.

DECAPSULATION is the term applied to an operation performed upon the kidney in some cases of Bright's disease. The capsule is stripped off, so that the kidney may expand.

DECHOLIN is a proprietary term for dehydrocholic acid, obtained from bile acid. Administration of dehydrocholic acid is said to raise the pressure in the bile passages and thus to be of possible value in expelling gall-stones from them.

DECIDUA (*decido*, I fall off) is the name of the soft coat which lines the interior of the womb during pregnancy and which is cast off at birth.

DECLINE is a popular name for the weak state induced by consumption. (*See* CONSUMPTION.)

DECOCTION (*decoquo*, I boil down) is the name for a preparation made by boiling various plants in water and straining the fluid. Examples are decoction of broom-tops, of cinchona, and of sarsaparilla. The dose of all is from one to several tablespoonfuls.

DECOMPENSATION means a failing condition of the heart after compensation has been established in a case of valvular disease.

DECUBITUS (*decumbo*, I lie down) is the name applied to the peculiar positions taken up in bed by patients suffering from various conditions. For example, patients with pleurisy or pneumonia prefer to lie upon the affected side; patients suffering from peritonitis on the back; much exhausted persons far down in the bed.

DECUSSATION (*decussatio*) is a term applied to any point in the nervous system at which nerve fibres cross from one side to the other, *e.g.* the decussation of the pyramids in the medulla, where the motor fibres from one side of the brain cross to the other side of the spinal cord.

DEFÆCATION (*defæco*, I cleanse) means the act of opening the bowels. (*See* CONSTIPATION, DIARRHŒA.)

DEFICIENCY DISEASE is the term applied to any disease resulting from the absence from the diet of any substance essential to good health, *e.g.* one of the vitamins.

DEFORMITIES may be present at birth, or they may be the result of injuries, of disease, or simply produced by bad habits, like the curved spine occasionally found in children. (*See* BURNS; CHEST, DEFORMITIES OF; CLUB-FOOT; FINGERS; FLAT-FOOT; KNOCK-KNEE; LEPROSY; PALATE, DEFECTS OF; PARALYSIS; RICKETS; SCAR; SKULL; SPINE, DISEASES OF; JOINTS, DISEASES OF.)

DEGENERATION (*degenero*, I degenerate) means a change in structure or in chemical composition of a tissue or organ by which its vitality is lowered or its function interfered with. Degeneration is of various kinds, the chief being fatty, fibroid (*see* CIRRHOSIS), calcareous (*see* CONCRETIONS), waxy (*see* WAXY DISEASE), colloid, and mucoid.

Causes of degeneration are, in many cases, very obscure. In some cases heredity plays a part, particular organs, for example the kidneys, tending to show fibroid changes in successive generations. Fatty, fibroid, and calcareous degenerations are part of the natural

change in old age. Defective nutrition may bring them on prematurely, so may excessive and long-continued strain upon an organ like the heart. Various poisons, like alcohol, arsenic, and phosphorus, play a special part in producing the changes, and so do the poisons produced by various diseases, particularly syphilis and tuberculosis.

DEGLUTITION (*deglutio*, I swallow) means the act of swallowing. (*See* CHOKING.)

DELHI BOIL is a form of chronic sore occurring in Eastern countries, caused by a protozoan parasite.

DELIRIUM (*deliro*, I rave) is a state of perverted consciousness in which an irregular discharge of nervous energy goes on, causing incoherent talk, delusions, and ill-regulated muscular action.

Varieties.—There are three types:

LOW DELIRIUM is associated with exhaustion, and consists mainly of muttering or rambling talk, in which past events are jumbled together. Surrounding persons and objects are not heeded, or their identity is totally mistaken. The fingers are sometimes busily employed in picking at the bed-clothes, or there is a constant twitching of the muscles in the arms, legs, and face, which is a sign of great weakness.

TREMBLING DELIRIUM (delirium tremens) is the form most commonly due to alcoholism. (*See* ALCOHOLISM, ACUTE.) In this form the mind is more active and delusions more extraordinary. Trembling is a specially marked feature, particularly in the early stages.

RAVING DELIRIUM sometimes appears in acute fevers, often is due to alcoholism, and is characterised by violent activity of the muscular system, acting in response to such wild delusions that it may result in suicide or homicide. A special variety of this type of delirium, associated with great anxiety or fear, is found in persons suffering from impending heart failure, the patient being in a state of fear of some impending disaster, although he does not know exactly what he fears.

Treatment is, as a rule, the treatment of the fever, etc., which causes the delirium. (*See* also ALCOHOLISM, ACUTE.) As the delirium in fevers is due partly to high temperature but mainly to nervous exhaustion, good feeding, careful nursing, and stimulants are specially necessary. When delirium banishes sleep and aggravates exhaustion, sleeping draughts are often necessary, such as a mixture of bromide and chloral, chloralamide, bromidia, and in severe cases even morphia or hyoscine.

DELIVERY means the final expulsion of the child in the act of birth. (*See* LABOUR.)

DELTA WAVES is the term given to abnormal electrical 'waves' observed in the electro-encephalogram (*see* ELECTRO-ENCEPHALOGRAPHY). The frequency of the normal 'alpha' waves is ten per second. That of the delta waves is seven or less per second. They occur in the region of tumors of the brain, and in the brains of epileptics.

DELTOID (the letter Δ; εἶδος, form) muscle is the powerful triangular muscle attached above to the collar-bone and shoulder-blade, and below, by its point, to the humerus, nearly half-way down the outer side of the upper arm. Its action is to raise the arm from the side, and it covers and gives roundness to the shoulder.

DELUSIONS (*deludo*, I mock) are errors in judgement, regarding simple facts, which interfere with the ordinary conduct of life. Thus a man may have the delusion that he has no stomach and refuse to take food. No amount of argument or demonstration will convince the subject of a delusion as to the error of his belief. The existence of a delusion, of such a nature as to influence conduct seriously, in the mind of a mentally disordered person, is one of the most important signs in certifying the case as one of insanity.

DEMENTIA (*dementia*, folly) is a form of insanity consisting of mental feebleness rather than derangement. It may come on acutely after some trouble like influenza, but, as a rule, is chronic, and often succeeds other forms of insanity like melancholy and mania. Dementia is one of the changes almost natural in old age, and, whatever be the cause, it is one of the least hopeful forms of insanity. (*See* INSANITY.)

DEMENTIA PRECOX—now more often referred to as schizophrenia (split mind)—is a form of insanity appearing in

young persons, especially between twenty and thirty, in which introversion is marked and the personality is 'split'. There is disorder in thinking and behaviour. Thinking becomes incoherent; morbid ideas and delusions and hallucinations are common. Behaviour may be peculiar, bizarre, excited, impulsive. There is increasing withdrawal from the outside world to an exclusive preoccupation with the self. Finally there is gradual deterioration until the patient lives little more than a vegetative existence. Until recent years treatment was of little avail, but the method of administering shocks to the brain either by electricity or by injections of insulin or of cardiazol has brought about improvement in a number of cases.

DEMENTIA PARALYTICA is another name for general paralysis of the insane. (*See* GENERAL PARALYSIS.)

DEMEROL (*see* PETHIDINE).

DEMULCENTS (*demulceo*, I stroke down) are substances which exert a soothing or protective influence upon the surface of the alimentary canal.

Varieties.—Mucilaginous substances like gum, isinglass, Iceland moss; oils like olive, linseed, and almond oils; starchy substances like arrowroot; also glycerin, borax, and mild alkalies, and fine powders like subnitrate of bismuth.

Uses.—They are used in cases of inflammation, particularly of the throat and stomach, in gargles or draughts, to protect these parts from the irritation of their own secretions; and after injury, such as that due to swallowing a corrosive poison, in order to soothe the pain and encourage healing in the injured part.

DENGUE (Spanish word), also called BREAK-BONE FEVER, DANDY-FEVER, and THREE-DAY FEVER, is a disease of tropical and subtropical regions caused by a filterable virus transmitted to man by the mosquito *Aëdes ægypti*. It is a sudden and short infectious fever, characterised mainly by swelling and pains in the joints, and by eruptions.

Symptoms.—It begins usually with suddenness by pain in a joint and fever. Next appears redness of the face, spreading later over the body, very much like the rash of scarlatina. There are also sore throat and running of the eyes, and the muscles and joints generally become very painful. These symptoms endure for about three days, and then gradually pass off, leaving the person very weak. After two or three days a relapse generally takes place, very similar to the first attack, except that the rash more resembles that of measles. There may be a third or even a fourth relapse, and recovery from the weakness and pains in the joints is often slow, very lasting over months. Death hardly ever occurs.

Treatment.—Salicylate of soda, or phenacetin, relieves the pains and reduces the temperature. If the fever be marked, liquor ammoniæ acetatis (Mindererus spirit), in tablespoonful doses, with spirit of nitrous ether in teaspoonful doses, may be given three or four times in the day, and cold sponging of the limbs and body is very beneficial. During convalescence, tonics and a light but plentiful diet are necessary.

DENTINE is the dense white material of which the greater part of the teeth is composed, and which constitutes ivory. The dentine is pierced by numberless fine tubules which communicate with the sensitive pulp in the central hollow of the tooth, hence its sensitiveness, when the enamel, which covers the dentine with a thin transparent shell, is eaten away or broken. The dentine is specially liable to decay, so that, when the enamel is defective in one spot, a large cavity is apt to form beneath it. (*See* TEETH.)

DENTITION (*see* TEETH).

DEODORANTS (*de*, from; *odoro*, I make a perfume) are substances which remove or lessen objectionable odours. Some, which have a powerful odour, simply cover other smells, but the most effective act by giving off oxygen, so as to convert the objectionable substances into simple and harmless ones.

Varieties.—Volatile oils of plants, such as eucalyptus and turpentine, chlorine water, and chlorinated lime, peroxide of hydrogen, charcoal, dry earth, sawdust, and permanganate of potassium, are among the most powerful.

Uses.—The main use is to purify sewage, bilge-water, and water-closets. Many powerful deodorants act, at the same time, as disinfectants. They are also used in sick-rooms to cover the smell of discharges, and the like. For the manner of use see under the individual deodorants.

DEPILATION (*de*, from; *pilo*, I make bald) is the process of destroying hair; substances and processes used for this purpose being known as depilatories. The purpose may be effected in three ways: (1) by removing the hairs at the level of the skin surface; (2) by pulling the hairs out (epilation); (3) by destroying the roots and so preventing the growth of new hairs.

Shaving is the most effective way of removing superfluous hairs. Rubbing morning and night with a smooth pumice stone is said to be helpful. The alkaline sulphides used as depilatories tend to erode the skin as well as the hairs. Electrolysis and diathermy have a limited use. In some cases of excessive hairiness in women the cortices of the suprarenal glands may be hypertrophied. Surgical correction of this is said to have been followed by a dropping out of the excessive hairs.

DEPLETION (*depleo*, I empty out) means the emptying, to some extent, of the blood-vessels of part of the body, or a reduction of the amount of blood in the whole body. Thus, in congestion of the liver, the portal blood-vessels are depleted by purgatives; in congestion of the brain the vessels generally, including those of the brain, are made less full by the same means.

DEPRESSOR is the name given to a nerve by whose stimulation motion, secretion, or some other function is restrained or prevented, *e.g.* the depressor nerve of the heart slows the beating of this organ.

DERBYSHIRE NECK is a name for goitre, which is fairly common in Derbyshire. (*See* GOITRE.)

DERMATITIS (δέρμα, skin) means any inflammation of the skin, though the name is usually restricted to those affections in which the cuticle comes off in large flakes, leaving a red surface behind. (*See* SKIN DISEASES.)

DERMOGRAPHIA (δέρμα, skin; γράφω, I write) is a condition in which tracings made on the skin leave a distinct swollen, reddish mark. This is due to defective nervous control of the blood-vessels.

DESOXYCORTICOSTERONE ACETATE is a synthetic chemical compound having the same action as 'cortin', the extract of the cortex of the suprarenal gland. It has been used successfully in the treatment of Addison's disease.

DESQUAMATION (*de*, away; *squama*, a scale) means the scaling off of the superficial layer of the cuticle, particularly after scarlatina.

DETERGENTS (*detergo*, I cleanse) are substances which clean the skin surface, such as water, soap, alcohol, alkalies, turpentine, sand, sawdust, and borax.

DETOXICATION (*de*, away from; *toxicum*, poison) means reduction or removal of the toxic properties of poisons or remedies. (*See* VACCINES.)

DEVONSHIRE COLIC is caused by drinking cider which has been stored in contact with lead, so that colic comes on as a result of lead poisoning. (*See* COLIC, LEAD POISONING.)

DEXTRIN (*dexter*, right) is a soluble carbohydrate substance into which starch is converted by diastatic ferment or by dilute acids. It is a white or yellowish powder which, dissolved in water, forms mucilage. Animal dextrin, also known as glycogen, is a carbohydrate stored in the liver after meals, often to considerable amount.

DEXTROSE is another name for purified grape sugar or glucose.

DIA- (διά, through) is a prefix meaning through or thoroughly.

DIABETES (διαβήτης) is a disease described originally by Aretæus in the first century A.D., and characterised by a habitually excessive discharge of

urine. Two forms of disease have received this name, *Diabetes mellitus*, in which sugar (glucose) is present in excess in the blood and in the urine, and *Diabetes insipidus*, in which excessive quantities of urine are excreted.

DIABETES INSIPIDUS is characterised by constant thirst and an excessive flow of urine, which, however, is not found to contain any abnormal constituent. The disease is in general very slow in its progress. In some cases the health appears to suffer very slightly. Some cases have been found associated with disorder in the region behind the mid-brain or in the pituitary body. It is best treated by tonics and generous diet, while the symptoms in some cases are relieved by pituitary extract.

DIABETES MELLITUS (διαβήτης; μέλιτος, of honey) is a constitutional disorder in which the power of the muscles and other tissues to utilise sugar circulating in the blood for purposes of nutrition is greatly diminished or lost. In consequence of this weakness, various other symptoms appear, while the sugar accumulates in the blood and is excreted in the urine and lost to the system.

Causes.—The presence of sugar in the urine in cases of diabetes has been known in India from early times, but in Europe was only discovered by Willis in the seventeenth century. The harmful effect of taking an excessive amount of food has long been known, and various forms of limitation in the diet have been proposed. Rollo as early as 1797 advocated limitation to a meat diet. As the result of important researches by Claude Bernard in 1857, followed by Schiff, Harley, Pavy, Opie, and others, the production of diabetes was ascribed in the latter half of the nineteenth century to failure of the bodily chemical processes to store up in the liver as glycogen the carbohydrates derived from the food, or to inability to use stored-up glycogen as required for maintaining the activity of the muscles. In this way it was supposed that first the material absorbed from the food, and later the fat and muscular tissues, were broken down to form sugar which was excreted in the urine. In 1889 Mering and Minkowski found that diabetes very frequently followed removal of the pancreas from animals; and it was later observed that disease in the pancreas was often found after death in human beings who had suffered from diabetes, a defect in certain small collections of cells, called 'islands of Langerhans', being specially noted.

In about 50 per cent of diabetic cases the pancreas is diseased in some way, softened, shrunken, or otherwise markedly changed. In a certain number of cases, however, no change can be found in the pancreas, and it is known that a severe degree of glycosuria may also follow disorders of the thyroid gland or injury to the brain in the region of its base.

There appears to be, however, in all cases of diabetes a defect in the chemistry of the body, whereby the muscles cannot absorb the sugar derived from the food, so that a gradual wastage takes place in the muscular tissue all over the body. This defect was attributed by Sharpey-Schafer so long ago as 1909 to the failure of the pancreas to produce a hormone for which he proposed the name of 'insulin'. Despite the general acceptance of this theory, insulin was not isolated until the year 1921, when it was successfully obtained for the first time by Banting and Best taking advantage of the degeneration in the pancreas of an animal which follows ligature of the duct of the gland. Insulin after that date was obtained in large quantities by extracting the pancreas of cattle and other animals with alcohol, and further improvements in its preparation have more recently been made in England.

It ought to be mentioned that small quantities of sugar are frequently found in the urine in many diseases, and even in health after articles of food rich in starch or sugar have been eaten, as also in some forms of poisoning. Further, individuals vary considerably as to the amount of sugary food that they can assimilate without the appearance of sugar in the urine. Diabetes is more prevalent during middle age in corpulent people than in persons of average physique. With regard to the exciting causes of diabetes, the disease usually appears

quite insidiously and has in most cases been present for some time before an examination of the urine reveals the condition by chance. Exposure to wet and cold, privation, depressing mental conditions or mental overwork have in various cases been assigned as causes; but these seem to be of little importance as compared with prolonged excess of food. There appears to be a distinct tendency for diabetes to run in families. It is most common among adults and occurs more frequently in men than in women. Certain races are particularly prone to this disease, such as the Jewish race and Hindus, but this increased liability is probably in large part due to habits of life and diet. The disease is much commoner in America than in England.

Symptoms.—The symptoms of diabetes are usually very gradual in onset, and the disease is often discovered by chance before the patient complains of any definite symptoms. The first symptoms which attract attention are usually failure of strength and increasing thinness along with great thirst and passage of an increased amount of urine. In consequence of the drying up of the other secretions, dryness of the skin and mouth and constipation also form frequent complaints. The urine, from the normal quantity of between 2 and 3 pints in 24 hours, may be increased to 10, or even 20 pints. It is usually clear, pale in colour, possesses a sweet taste, and is of high specific gravity (1030 to 1050). When diabetic urine is boiled with cupric salt, which has a bluish or green colour, the latter is reduced to a cuprous salt having a brown or yellow colour, and a process depending upon this chemical reaction forms the usual method of recognising and estimating the amount of sugar present in the urine. The sugar can also be tested by measuring the amount of carbonic acid gas set free on fermentation by yeast and by the extent to which a specimen of the urine rotates the plane of polarised light. The quantity of sugar passed in 24 hours may vary from a few ounces to several pounds, and it is of course markedly increased after sugary or starchy food has been taken. Sugar may also be found in the saliva, tears, and almost all the other excretions of persons suffering from this disease. The amount of sugar circulating in the blood rises from about 0.1 per cent, which is normal, to 0·2, 0·3, or more per cent, and it remains high for several hours after a meal instead of being rapidly absorbed.

A very troublesome symptom is the intense thirst, which the patient is constantly seeking to allay, and the quantity of liquid consumed is proportional to the amount of urine passed. There is sometimes a voracious appetite. The mouth is always parched and a faint sweetish odour can be recognised at times on the breath, owing to the escape of acetone and diacetic acid from the blood into the air in the lungs. The patient gradually becomes more and more emaciated and suffers from increasing muscular weakness; the temperature is lowered and dyspepsia and constipation are commonly present; the teeth frequently decay. Owing to the poor vitality of the tissues, various skin eruptions appear, boils and carbuncle being especially common, and, in fact, sometimes giving the first sign of the presence of disease. The sugar deposited from the urine is very liable to cause itching about the groins, and eczema of various parts of the body is set up by the presence of sugar in the sweat. The skin, as the disease advances, becomes dry and harsh with a peculiar papery consistency. There is a special tendency to gangrene of the skin of the feet, commencing with the toes, and this forms a very serious complication of diabetes and a not uncommon form of fatal issue.

Diabetes, as a rule, advances comparatively slowly except in the case of young people, in whom its progress is apt to be rapid. Indeed in a general way it is more serious the younger the subject of the disease. Various complications arise in its course, among which may be mentioned dimness of vision due to cataract, weakness and pains in the limbs due to neuritis, inflammatory chest affections, of which pulmonary consumption is the most common and is a frequent termination of diabetes. Occasionally death occurs from exhaustion or from the condition

known as diabetic coma, in which acetone and similar bodies, known as ketones, accumulate in the system, and in which the breathing becomes slower and slower, the person becoming gradually more deeply unconscious, and death ensuing in a few hours or days.

Cases may continue for many years without material change for the worse, and sometimes, especially in cases where great care is taken with the diet, complete cure apparently takes place. The most unfavourable cases are those in young persons, also cases in which serious chest or other complications have arisen and cases in which the disease has already become of severe and established character before it is recognised.

Treatment.—Diet is the most important matter in a case of diabetes. In general the diet should be diminished, and in the case of elderly and stout diabetics, this may be all that is necessary for treatment. When the amount of food is lessened, the bodily activities must in general also be curtailed. Special care ought to be taken to cut down the sugary and starchy foods, and the following forbidden articles must be taken at least very sparingly: sugar, bread, potatoes, cereal and farinaceous foods, tapioca, sago, arrowroot, jam, sweet cakes, pastry, sausages, thick soups, liver, beer, wines, sweet drinks, and most sweet fruits. Protein foods such as meat, fish, eggs, and meat soups unthickened by flour are permissible, but even these protein materials must be limited, because protein is convertible in the body to the extent of half its weight into sugar. Fats such as cream, butter, and fat bacon form a diet of strong nutritive value (more than double the energy producing power of carbohydrates), but in excessive amounts have the disadvantage that they are imperfectly consumed in the body and then produce danger from the formation of ketone bodies, with liability to the onset of diabetic coma. It is obvious therefore that the diet must be carefully balanced between these three classes of foodstuff. Generally speaking, a sufficiency of protein food must first be supplied, the carbohydrates must be cut down, and the fats increased. The theoretic limit for the amount of fat to be taken is that its weight must not exceed twice that of the carbohydrates plus one-half of the proteins in the diet. Certain materials, such as water, tea, coffee, and soups made entirely from meat extracts, may be taken in any quantity, since they supply the fluid necessary for the body and act as stimulants without having sufficient nutritive value to disturb the balance of the diet. Certain flavouring materials may be treated in the same way, including saccharin, lemon juice, vinegar, salt, mustard, pepper, and essences. Some vegetables also contain so little carbohydrate that they may be freely used to increase the bulk of the food, for example, lettuce, spinach, marrow, celery, mushrooms, and grape-fruit.

In the case of a diabetic who requires more definite treatment than simple reduction in the total amount of food, the effect of starvation for a day may be tried provided no acetone is present in the urine. The repetition of a fasting day at regular intervals, say once a week, when only the non-nutritious materials above mentioned are taken, may in some cases be found sufficient.

In the average case, a definite diet must be prescribed, and its amount varies with the age, weight, and activity of the person concerned as well as with the stage reached by the diabetes. The amount of energy that must be supplied by the food in order to carry on the vital processes of life, such as body warmth, the beating of the heart, the movements of the chest in breathing, and the chemical activities of the secreting glands, is, for an adult of about 140 lb. in weight, approximately 1600 calories daily. For a patient lying quietly in bed, little more is needed; for sedentary occupations such an individual requires about 2000 calories; while if he is doing muscular work, the equivalent of 3000 calories is needed. For most diabetics, when going about and doing light work, a little over 2000 calories is sufficient, but it must be remembered that if heavy work is undertaken, the diet must be proportionately raised. This is sometimes expressed as follows: 25 calories per kilo (2·2 lb.) of body weight are

necessary in bed; 30 calories for sedentary work, and 35-40 calories for active life.

When the patient is first put on a diet, it is usual to begin with one of about 900 calories, because the patient, being usually stout, is benefited by being underfed for a time. This also reduces the amount of sugar in the blood and should cause it to disappear from the urine. Such a diet must in the first place contain about 1 gram of protein per kilo (2·2 lb.) of the patient's body weight. Thus for the patient of 140 lb. weight, 63 grams (slightly over 2 oz.) would be necessary. The remainder is divided between carbohydrates and fats. The healthy individual usually eats about five times as much of carbohydrates as of fats, but for the diabetic the amount of carbohydrate together with protein and that of fat are at first usually made nearly equal, and as treatment proceeds the amount of carbohydrate is gradually increased so as to bring the food as nearly as possible into the proportions of a normal person's diet.

The following is one example of a diet equal to 900 calories:

Breakfast.—Tea or coffee with cream, 1 oz.; vegetable, such as tomato, cabbage, brussels sprouts, cauliflower, 5 oz.; butter, ½ oz.; one egg; bacon, 1 oz.; orange, 3 oz.

Lunch.—Vegetable as above, 5 oz.; butter, ½ oz.

Tea.—Tea or coffee with cream, 1 oz.; vegetable, 5 oz.; butter, ½ oz.

Dinner.—Vegetable, 5 oz.; butter, ½ oz.; one egg; oatcake, ½ oz.; orange, 3 oz.

If the urine becomes free from sugar on such a diet, it is then the usual custom to increase the food by about the equivalent of 200 calories every two days, the urine being regularly tested for sugar. If sugar appears, the process of increasing the diet is slowed down, but otherwise the food is gradually increased until the patient is taking sufficient for his physique and activity on the scale mentioned above. These additions to the diet may be made with the help of the following table which gives the number of grams of carbohydrates, proteins, and fats contained in 1 oz. (30 grams) of fifteen commonly used foods, together with the calories supplied by 1 oz. of each.

	Carbohydrate. Grms.	Protein. Grms.	Fat. Grms.	Calories.
Vegetable 5 per cent group *	1	0·5	..	6
Oatmeal (oatcake)	20	5	2	120
Bread (white)	15	2	..	70
Bread (brown)	13	1·2	..	65
Potato	6	1	..	25
Milk	1·5	1	1	20
Meat (cooked, lean)	..	8	5	80
Chicken (cooked, lean)	..	8	3	60
Fish, cod, haddock (cooked)	..	5	..	20
Butter or margarine	..	..	24	220
Egg (one = 2 ounces and contains)	..	6	6	80
Cheese (full milk)	..	8	11	130
Bacon	..	5	15	150
Cream, 20 per cent	1	1	6	65
Orange	3·5	0·8	..	15

* NOTE.—These vegetables include tomato, cabbage, cauliflower, brussels sprouts, kale, leek, turnip.

When the daily diet has been built up to the amount of food required by the patient's weight, activity, etc., without sugar appearing in the urine, he may continue this diet indefinitely, the urine being tested from time to time to make sure that sugar remains absent.

Various special schemes of diet have been introduced to facilitate the calculation of amounts of food. One of the best known of these is the 'line ration' diet in which for various common foods that consist chiefly of sugar or starch, the weight containing 10 grams of carbohydrate is given, as also for other common foods that consist chiefly of protein and fat the weights containing 7½ grams of protein and 15 grams of fat are given. Any one carbohydrate food with any one protein and fat food is called a 'line' (containing 10 grams of carbohydrate, 7½ grams of protein and 15 grams of fat), and the patient having had a certain number of lines prescribed for him, chooses these according to his fancy and has only the trouble of weighing correct amounts of the foods.

If, however, it is found impossible to increase the diet to one sufficient to maintain nutrition and prevent loss of weight, without sugar appearing in the urine, insulin becomes necessary, and the patient is immediately put upon a diet sufficient for his requirements, providing say 1500 to 1700 calories. The insulin is injected about one hour

before the principal meal or meals of the day and it is important that this meal should contain a fair amount of carbohydrate. The dose of insulin may vary from 5 to 20 units, and it may require to be administered from one to three times in the day before meals. Speaking generally, one unit of insulin can provide for the absorption of 1 to 2 grams of carbohydrate in the food. If too much insulin is given, the blood-sugar falls below the normal 0·1 per cent and symptoms, of which hunger, sweating, trembling, and breathlessness are the most prominent, appear—the condition known as *hypoglycæmia*. If these symptoms appear, they quickly subside when a few spoonfuls of orange juice or of sugar in water are taken. If an excessive dose of insulin were to be taken, these symptoms might become dangerous. Frequently, after a patient has taken insulin for some time, the dose may gradually be diminished, and ultimately the remedy may be discontinued altogether.

Dangers. — The danger which is always present in cases of diabetes, especially when too much protein and fat are taken in the food, is the occurrence of *acidosis* which in severe cases proceeds to *diabetic coma*. An indication of the presence of this condition is given when a large amount of acetone along with sugar is found in the urine. This condition is specially dangerous when it is combined with a feverish state, as in some infectious disease. It is checked to a certain extent by the administration of large quantities of water and alkalies; but the remedy which is of special efficacy in preventing or abolishing it is the administration of an additional amount of carbohydrate in the food with large doses of insulin.

Another serious danger incurred by the subject of diabetes is the occurrence of *gangrene* in the skin, especially about the toes. In order to avoid this, special care must be taken to keep the feet in a healthy condition by frequent washing, treatment of corns and abrasions, and avoidance of tight shoes. Other forms of infection, such as boils, must also be treated with special care on ordinary principles. In consequence of the generally poor vitality of the tissues, diabetic patients form bad subjects for *surgical operations*, which are therefore not performed except in cases of urgent necessity, the cases then being carefully prepared by several days' treatment with insulin and glucose. The frequency with which *chest complications* supervene in diabetics has been mentioned, and special precautions must be taken to avoid catarrhs.

DIACHYLON (*see* LEAD).

DIAGNOSIS (διάγνωσις) is the art of distinguishing one disease from another, and is essential to scientific and successful treatment. The name is also given to the opinion arrived at as to the nature of a disease. It is in diagnosis more than in treatment that the highest medical skill is required, and, for a diagnosis, the past and hereditary history of a case, the symptoms complained of, and the signs of disease found upon examination are all weighed. Many methods of laboratory examination are used at the present day in aiding diagnosis, such as tests for various bacilli, agglutination tests, the Wassermann reaction, etc. Often an absolute diagnosis cannot be made at once, and it becomes necessary to proceed tentatively with treatment, a careful watch being kept upon its result.

DIAMIDINO-DIPHENOXYPENTANE. An aromatic diamidine used in the treatment of trypanosomiasis. (*See also* CHEMOTHERAPY.)

DIAMIDINO-STILBENE. An aromatic diamidine which has been successfully used in the treatment of trypanosomiasis and kala-azar. (*See* CHEMOTHERAPY.)

DIAMORPHINE and DIACETYLMORPHINE are other names for heroin.

DIAPHORESIS (διά, through; φορέω, I carry) is another name for perspiration. (*See* PERSPIRATION.)

DIAPHORETICS (from διαφορέω, I carry through) are remedies which promote perspiration. By imperceptible perspiration, the body loses over a pint of moisture daily. Under exertion or in a heated atmosphere, this natural function of the skin is increased, sweating more or less profuse follows, and, evaporation going

on rapidly over the whole surface, little or no rise in the temperature of the body takes place. In many forms of disease, such as fevers and inflammatory affections, the action of the skin is arrested, and the surface of the body feels harsh and dry, while the temperature is greatly elevated. The occurrence of perspiration frequently marks a crisis in such diseases, and is in general regarded as a favourable event. In some chronic diseases, such as diabetes and some cases of Bright's disease, the absence of perspiration is a marked feature. (*See* PERSPIRATION.)

Varieties and uses.—Many means can be used to induce perspiration, among the best known being baths, either in the form of hot-vapour or hot-water baths, or the exposure of the body to a dry and hot atmosphere or to beams of electric light in a special apparatus. (*See* BATHS.) Such measures, particularly if followed by the drinking of hot liquids and the wrapping of the body in warm clothing, seldom fail to excite copious perspiration. Numerous medicinal substances have a similar effect, such as the well-known diaphoretics—Mindererus spirit (acetate of ammonia), guaiacum, nitrous ether, and jaborandi. Opium acts powerfully as a diaphoretic, especially when in combination with ipecacuanha, as in Dover's powder, and alcohol, as well as phenacetin, aspirin, and similar drugs, also produces perspiration. (See under these headings.) Diaphoretics are of great service in many diseases. When employed at the commencement of a catarrh or common cold, they frequently check it. In dropsy due to kidney disease, such as that which sometimes results from scarlet fever, the hot-air or hot-water bath is a valuable remedy, and even in dropsical accumulations of long standing, when diaphoresis can be induced, marked improvement in the symptoms generally follows. In certain circumstances, however, diaphoretics, particularly in the form of baths, may be unsafe, especially where there is any affection of the heart or lungs attended with embarrassed respiration.

DIAPHRAGM (διάφραγμα) is the muscular partition which separates the cavity of the abdomen from that of the chest. It is only a small fraction of an inch in thickness, and is of a dome shape, extending up on the right side to the space beneath the fourth rib, on the left to that beneath the fifth. In contact with its lower surface are, on the right side, the liver, right kidney, and suprarenal body, and to the left the stomach, pancreas, left kidney, suprarenal body, and spleen; while upon its upper surface lies the heart, with a lung on either side. The diaphragm is attached by its edge to the lower margin of the chest all round, and consists of muscular fibres meeting round a trefoil-shaped piece of fibrous tissue in the centre. It completely shuts off the above-named cavities from one another, being pierced only by openings for the gullet, the aorta, and the inferior vena cava, with a few minute openings for nerves and small vessels. The diaphragm is of great importance in respiration, playing the chief part in filling the lungs, especially in men.

DIAPHYSECTOMY is the term applied to the operation whereby a part of the shaft of a long bone (*e.g.* humerus, femur) is excised.

DIARRHŒA (διαρρέω, I flow away), or looseness of the bowels, is, except in its mildest forms, a most serious condition. It is really a symptom of some disease situated in the bowels, but deserves special mention because of its serious import.

Varieties and causes. — Diarrhœa forms the chief symptom of several *serious diseases*, but it would be a great mistake to imagine that, by checking the diarrhœa, the disease is of necessity successfully treated. For example, the severity of an attack of cholera or dysentery is gauged mainly by the extent to which diarrhœa is present; in typhoid fever, persons, fed upon ordinary diet, have much diarrhœa, so that this is a usual feature in early stages of this disease; in tuberculous ulceration of the intestine (consumption of the bowels) a diarrhœa is set up which speedily brings down the sufferer; and in hysteria, diarrhœa is occasionally a troublesome manifestation. In some diseases of the liver, kidneys, lungs, or heart, diarrhœa ensues as a result of congestion of the bowels, or through the bowels taking up in part the eliminating functions of the damaged organs. In

such cases the diarrhœa may actually be a salutary thing. These special forms are considered under the headings of the respective diseases which produce them. Recurring attacks of diarrhœa occur in some cases of habitual constipation, owing to irritation caused by the presence of hard fæcal masses.

Catarrhal diarrhœa is the ordinary form, and in it the intestinal mucous membrane is in much the same condition of congestion and swelling as the nasal mucous membrane during a 'cold in the head', and secretes, in great amount, clear, viscid mucus of a similar nature. This catarrhal diarrhœa may be produced in a slight degree by indigestible food, by nervous excitement, or as the result of a chill. In a severer form, it may be due to infection by micro-organisms of the food-poisoning group (*see* SALMONELLA GROUP), to drugs such as mercury and arsenic. Atmospheric conditions also play an important part, some persons taking an attack of diarrhœa upon a change of weather, just as others develop a catarrhal condition in the air-passages. In children again, summer diarrhœa, commencing as an epidemic in June, reaching its greatest extent in July, and falling off again during August and September, used to form one of the greatest and yearly-recurring menaces to life in early years. A child runs the greatest risk from this in its second year, particularly if it be fed on artificial foods, and if the weather be very sultry.

Choleraic diarrhœa, or 'cholera nostras', is an extremely severe type of diarrhœa due to similar causes, and resulting very often in death. Its symptoms are hardly distinguishable from those of true cholera. (*See* CHOLERA.)

Lienteric diarrhœa is a chronic form, in which the taking of food brings on shortly a movement of the bowels. The condition may become so aggravated that food passes rapidly and undigested through the body, and the sufferer becomes very thin.

Pancreatic diarrhœa is a form occasionally met in children of imperfect development, in consequence of failure by the pancreas to secrete its proper digestive fluid.

Mucous colitis is a chronic condition, in which attacks of diarrhœa recur from time to time, accompanied by the discharge of large quantities of clear mucus, or of strings, and long, ragged pieces of hardened mucus resembling skin.

Diarrhœa may also be a symptom of ulceration or gangrene of the bowels, and is then associated with the passage of *blood and mucus*, or even of shreds of membrane produced by the destruction of the inner surface of the bowels.

Treatment.—The treatment of diarrhœa which is an incident of special diseases like cholera, typhoid fever, dysentery, etc., is considered under these heads.

ACUTE DIARRHŒA, it must be remembered, is often merely a symptom, either of one of the above diseases, or of some local disease like intussusception, so that if the symptom be treated as if it were the real disease, the consequence may be disastrous to the sick person. Assuming that we are dealing simply with cases of uncomplicated *catarrhal diarrhœa*, we may consider the treatment of an adult and child separately.

In adults, if the attack has followed the eating of some indigestible substance, a dose of castor oil (two tablespoonfuls) or of calomel (4 grains) may be given, together with, or followed in an hour or two by, 15 drops of laudanum. If, after this has acted, the diarrhœa lasts more than a couple of days, an enema consisting of starch cream (4 ounces) with laudanum (20 drops) is very useful, given every six hours. It may be supplemented by aromatic chalk powder, or carbonate of bismuth in 30-grain doses by the mouth taken three or four times daily. The diet must be bland and unirritating, milk alone, or milk with a little arrowroot or cornflour, in most cases being most suitable. To the milk may be added two or three tablespoonfuls of lime-water for every tumberful; or isinglass, one teaspoonful to a pint of warmed milk; or the milk may be peptonised with advantage. (*See* PEPTONISED FOODS.) In some cases, however, milk is found irritating, especially when the stools are acid, with a sour but not very offensive smell. In these cases barley-water, the white of an egg stirred up in water, or meat juice in water, is most suitable. In any case,

fluid food should be given every two or three hours, and only about 6 ounces at a time. After the severer symptoms of diarrhœa have passed off the affected person must exercise great caution for several days in respect to diet. A gradual return should be made to ordinary food, consisting at first of eggs, milk, and milk puddings, followed later by fish, and only after the lapse of several days by meat and vegetables. Protection of the abdomen by a special binder or cholera belt for some time is advisable.

In children, under similar conditions, a dose of castor oil, varying, according to age, from a teaspoonful to a dessertspoonful, may be tried at first. No opium preparation should, as a rule, be given to children, who are powerfully affected by this drug, but, if diarrhœa be excessive, Dover's powder, or aromatic chalk and opium powder may be given to the extent of 1 grain for every year of the child's age. In violent diarrhœa also, cold-water cloths or mustard leaves to the abdomen give great relief from pain. As to diet, the nature of this should be similar to that for adults. When the stools are alkaline, fermenting, and offensive, milk and starchy foods form the best diet; and when the stools are acid, sour in smell, and green in colour, albuminous fluids like barley-water and meat juice suit best, but this is not an absolute rule. If milk be given it should be boiled, and in the case of young children should be diluted with water, one tablespoonful of lime-water being added, in any case, to each half-pint of the fluid. Peptonising is often helpful (*see* PEPTONISED FOODS). A great tendency exists to give too much food, which sometimes prolongs an attack; and it is often a good plan to administer only water and sips of barley-water for a day. Various antiseptics like salol, salicylate of bismuth, grey powder, calomel, dimol, etc., are given, particularly when the stools are alkaline and offensive, but they are often both ineffectual and irritating. Perhaps the least objectionable is grey powder, given in half-grain doses to a young child several times in a day. Irrigation of the bowel with warm normal saline solution through a soft india-rubber tube is often practised, with most beneficial results. If the child become very collapsed, or if it be receiving no food, whisky may be given every few hours to the extent of 20 drops in a teaspoonful of water. In cases of threatened collapse the child is often transfused with normal saline solution into the subcutaneous tissues.

CHRONIC DIARRHŒA requires, above all things, complete rest in bed and a simple diet, such as peptonised milk, or white of egg in water, or tea and toast. Washing out of the lower bowel through a soft rubber tube, and the injection of various soothing and astringent fluids, is of great benefit. Among the few useful drugs are carbonate of bismuth in large doses of a teaspoonful, and salicylate of bismuth in smaller doses. Kaolin in doses of 1 teaspoonful or more in water after meals has sometimes a very beneficial effect. In many cases, particularly in nervous forms, tonics may do much good. If the diarrhœa is tuberculous, appropriate general treatment must be adopted.

DIARSENOL is a preparation of arsenic similar to salvarsan.

DIASTASE is the name of a ferment found in germinating seeds, and is contained in large quantity in malt, which has the property of converting starch into sugar. It can be extracted as a white soluble powder. *Takadiastase* is a diastatic ferment produced by the action of a fungus, *Aspergillus oryzae*, upon wheat bran. It is much used as a medicine in cases where starch is improperly digested through deficiency of saliva or owing to gastric acidity.

DIASTASIS (διάστασις, separation) is a term applied to separation of the end of a growing bone from the shaft. The condition resembles a fracture, but is more serious because of the damage done to the growing cartilage through which the separation takes place, so that the future growth of the bone is considerably diminished.

DIASTOLE (διαστολή) means the relaxation of a hollow organ. The term is applied in particular to the heart, to indicate the resting period between the

beats (systoles), while blood is flowing into the organ.

DIATHERMY (*διά*, through; *θέρμη*, heat) is a process by which electric currents can be passed into the deeper parts of the body so as to produce internal warmth and relieve pain; or, by using powerful currents, to destroy tumors and diseased parts bloodlessly. The form of electricity used consists of high-frequency oscillations produced by a special form of apparatus developing some 500 or 800 volts, and the rate of oscillation of the currents being upwards of 1,000,000 per second. The current may be applied by bare electrodes grasped in each hand, or by sheets of metal applied firmly in direct contact with the skin or covered with cloths saturated in brine. When the current passes, a distinct sensation of increasing warmth is experienced and the temperature of the body gradually rises; the heart's action becomes quicker; there is sweating and increased excretion of waste products. The general blood-pressure is also distinctly lowered. The method is used in painful rheumatic conditions, both of muscles and joints, and in severe cases of neuritis, such as sciatica. It has also been largely used in conditions where symptoms are dependent on high arterial pressure. By concentrating the current in a small electrode, the heating effects immediately below this are very much increased, and the method may be used to produce the effects of a cautery in surgical conditions. It differs from ordinary forms of cautery because it is cold when brought into contact with the patient, and gradually becomes heated by the current. Its surgical application has been used in treating malignant ulcers, particularly of the mouth, throat, and bladder, where ordinary surgical means are not readily available.

DIATHESIS (*διάθεσις*, a disposition) is another name for constitution. (*See* CONSTITUTION.)

DICEPHALUS is the term applied to a fœtal 'monster' having two heads.

DICK TEST is a test devised for discovering those children who are specially susceptible to contract scarlet fever. (*See* SCARLET FEVER.)

DICOUMARIN. — 3 : 3′-methylene bis-(4-hydroxycoumarin). A substance isolated from spoiled sweet clover which causes a hæmorrhagic disease in cattle. Dicoumarin has been synthesised and used in clinical medicine to reduce the coagulability of blood in conditions in which this is desired—*e.g.* in the prevention and treatment of thrombosis. It is active when given by mouth and much cheaper to prepare than heparin.

(Coumarin, $C_9H_6O_2$, occurs naturally in the Tonka bean and gives it its characteristic odour.)

DICROTIC (*δίς*, double; *κρότος*, a stroke) pulse is one in which at each heart-beat two impulses are felt by the finger. A dicrotic wave is naturally present in a tracing of any pulse as recorded by an instrument for the purpose, but in health it is imperceptible to the finger. In fevers, a dicrotic pulse indicates considerable nervous prostration, in which the heart continues to beat violently while the small blood-vessels have lost their 'tone'.

DIET is a subject of the greatest importance. Information as to the changes in diet necessary in special diseases will be found under the head of these diseases, and what will be said here refers to general principles of feeding. Details regarding the diet of young children are given under INFANT FEEDING. Of late the subject has been much studied, either by measuring the amount of heat given off and work done by a man shut into a closed chamber, from which the food necessary to supply this energy may be calculated; or by comparing, by means of chemical analysis, the food taken in with the excretions discharged by the bowels, kidneys, etc.; or by estimating the rate at which oxygen is absorbed.

Dietetic principles.—The body is in many respects comparable to an engine. Like a piece of mechanism it requires fuel to supply the muscles, etc., with energising power for the various bodily activities, and it like-

wise needs building materials to repair loss from wear and tear. For the latter purpose, food containing nitrogen is necessary, the protein of which the muscles and other tissue are composed being replaceable only by fresh nitrogen-containing protein. For the necessary supply of energy, on the other hand, protein would suffice; but, as its use for this purpose would throw upon the kidneys and other excretory organs the necessity of getting rid of a large residue, fats and carbohydrates (including starch and sugars), which contain only carbon, hydrogen, and oxygen, are more convenient for the purpose. In addition to these three varieties of food, water must be taken in sufficient quantity to make up for the loss by the urine, sweat, etc., and also various salts, of which, however, there is always a surplus in the food. Certain substances known as vitamins, of which the chemical composition is in many instances known, are present in small quantities in a variety of foods.

Views have fluctuated about the daily protein requirement of the average man. It is now believed that this should be between 70 and 100 grammes a day, or a bit more than 1 gramme of protein for every kilogramme of body weight a day. Growing children require, in proportion to their weight, a greater allowance of protein than the adult.

The scientific mode of expressing the food requirements is stated in terms of energy-producing power. 'Kilocalory' is the name applied to the amount of heat necessary to raise the temperature of a kilogramme of water (2 pounds) 1° centigrade, and of these calories of energy 4·1 are obtainable by burning a gramme of protein or of carbohydrate, and 9·3 by combustion of the same amount of fat. In estimating the energy expended by an individual in climbing a mountain, doing his daily work, etc., one expresses it as so many 'calories', while the amount of food which is burned up in the body by the process may be similarly stated.

Quantity of food.—The total daily amount of food necessary for a fair-sized man, doing average hard work, should provide over 3000 calories of energy, and since about 4 ounces of

the daily food must, as above stated, be protein, to supply wear and tear, this leaves 2500 calories to be supplied by carbohydrate and fat together. The

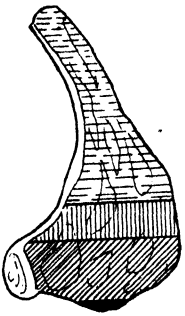


FIG. 121.—LAMB CHOP

Fuel value per lb. = 1475 calories

	Per cent
Water	53·1
Protein	17·6
Fat	28·3
Ash	1·0

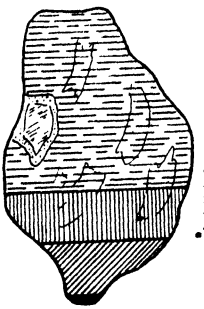


FIG. 122.—BEEF STEAK

Fuel value per lb. = 1090 calories

	Per cent
Water	61·9
Protein	18·6
Fat	18·5
Ash	1·0

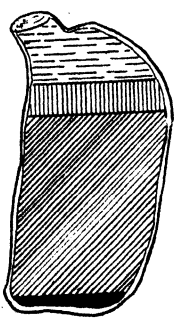


FIG. 123.—BACON

Fuel value per lb. = 3090 calories

	Per cent
Water	18·8
Protein	9·4
Fat	67·4
Ash	4·4

proportion of these to one another depends upon minor considerations; for example, the Esquimaux make it up in fat, because, in the northern regions, sugar and cereals are un-

obtainable. The natives of India, and the poorer classes of the world in general, use cereal food because of its great cheapness as compared with fat, and persons of feeble digestive power consume large quantities of soft fats,

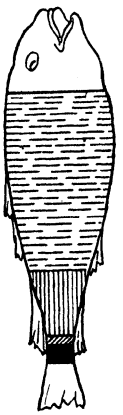


FIG. 124.—COD

Fuel value per lb. = 300 calories

	Per cent
Water	82·6
Protein	15·8
Fat	0·4
Ash	1·2

FIG. 125.—SMOKED HERRING

Fuel value per lb. = 1305 calories

	Per cent
Water	34·6
Protein	36·4
Fat	15·8
Ash	13·2

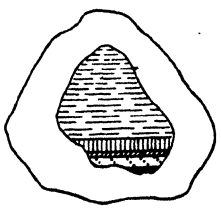


FIG. 126.—OYSTER

Fuel value per lb. = 230 calories

	Per cent
Water	86·9
Protein	6·2
Fat	1·2
Carbohydrate	3·7
Ash	2·0

because—fat being, bulk for bulk, more than double the caloric value of carbohydrate — the digestion of a sufficiency of food is rendered easier by the use of the former in excess. For a diet giving about 3000 calories a day these may be suitably provided thus: carbohydrate, 398 grammes; fat, 112 grammes; protein, 90 grammes, —providing respectively 1590, 1050, and 360 calories.

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Atwater made investigations upon this subject; the proportions in the

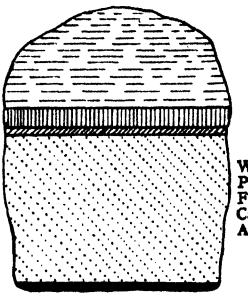

FIG. 127.—WHITE BREAD

Fuel value per lb. = 1180 calories

	Per cent
Water	35·3
Protein	9·2
Fat	1·3
Carbohydrate	53·1
Ash	1·1

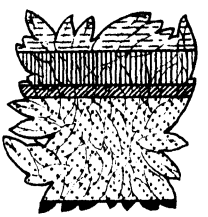

FIG. 128.—OATS (DRY)

Fuel value per lb. = 1670 calories

	Per cent
Water	11·0
Protein	11·8
Fat	5·0
Carbohydrate	69·2
Ash	3·0

diet of various classes are selected from his researches as follows:

	Protein. Grms.	Fat. Grms.	Carbohydrate. Grms.	Energy. Calories.
Trappist monk with little exercise	68	11	469	2304
Japanese students	97	16	438	2343
German soldiers	114	39	480	2798
English blacksmith	176	71	667	4117
College football team	181	292	557	5742
Average of 53 Americans	103	138	436	3494

To contrast these figures with the ideal. The Trappist monk and the Japanese students led a life that was free both from wear and from hard bodily work, and so they needed little protein and little energising food. The German soldier came nearest the ideal, but had a slightly diminished diet on account of his passive barrack life. The English blacksmith and college football team had a great increase all round to maintain their great exertions, though the latter probably ate far too much fat. Finally, the average American took too much fat, as all the richer

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classes tend to do, substituting fat for the cheaper, less palatable, and more bulky carbohydrate.

Quality of food.—After the energising power of a substance has been ascertained, there remain several other factors which determine its suitability as a food. *Digestibility* is one of the most important, for, while petroleum, sawdust, and the like have a high

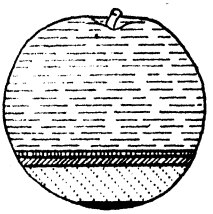

FIG. 129.—APPLE

Fuel value per lb. = 285 calories

	Per cent
Water	84·6
Protein	0·4
Fat	0·5
Carbohydrate	14·2
Ash	0·3

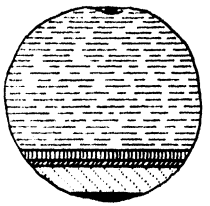

FIG. 130.—ORANGE

Fuel value per lb. = 233 calories

	Per cent
Water	87·7
Protein	0·8
Fat	0·2
Carbohydrate	10·6
Ash	0·7

FIG. 131.—BANANA

Fuel value per lb. = 445 calories

	Per cent
Water	75·3
Protein	1·3
Fat	0·6
Carbohydrate	22·0
Ash	0·8

energy-producing power, they are absolutely useless as foods. *Absorbability* is also of importance, for few substances are completely absorbed into the system, and some, like vegetable proteins and white of egg, are even rejected if taken as food in large amounts, and passed by the bowels unchanged. Thus a considerable amount of all food eaten, and especially of the coarser kinds, remains unused. *Satisfying power* is of great importance, and depends partly upon the bulk of the food and partly upon its preparation. Food should not be capable of too rapid digestion, or it cannot be fully utilised by the tissues; hence a food like oatmeal is more sustaining, in persons of good digestive power, than meat essences; and hence also the value of cooking certain foods with fat, which, when it penetrates the other food, retards digestion. As a rule, the more satisfying a food is, the less digestible it proves; and this is one of the chief reasons that different foods and different methods of cooking suit persons of diverse physique

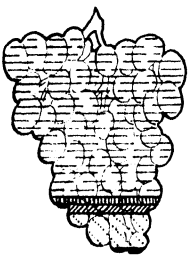

FIG. 132.—GRAPES

Fuel value per lb. = 435 calories

	Per cent
Water	77·4
Protein	1·3
Fat	1·6
Carbohydrate	19·2
Ash	0·5

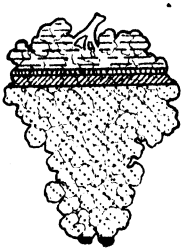

FIG 133.—RAISINS

Fuel value per lb. = 1560 calories

	Per cent
Water	14·6
Protein	2·6
Fat	3·3
Carbohydrate	76·1
Ash	3·4

and digestive powers. *Preparation* by grinding, cooking, etc., is also important. The effect of cooking is partly to develop flavours in the food, and so make it more palatable and digestible; partly to kill organisms and animal parasites which may be present in it; and, mainly in the case of meats, to soften the connective tissues which bind the meat proper, and, in the case of vegetables, to burst or tear the fibres and capsules of cellulose which surround the starchy and sugary material. *Cheapness* is of immense importance to the working classes. Animal protein, as beef, forms the dearest food, and bread is by far the cheapest, well deserving

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the name of 'the staff of life'. Among the cheapest and most efficient forms of protein food are skimmed milk, cheese, and fish. Fat has double the energy-producing power of carbohydrates, but butter is more than four times as expensive as its equivalent in bread. Hence fatty foods are called 'rich foods'. Nevertheless margarine falls into the list of cheap foods and is quite as nutritious as butter, and for the war period (beginning September 1939) all margarine will have the vitamins A and D added up to the level of summer butter. *Freshness* is important, since preserved foods tend to lose their vitamins, and the daily diet should include vegetables, fruit, milk, butter, cheese.

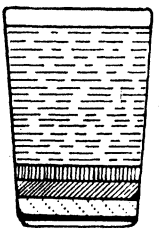

FIG. 134.—FRESH MILK

Fuel value per lb. (roughly ½ pint) = 315 calories

	Per cent
Water	87·0
Protein	3·3
Fat	4·0
Carbohydrate	5·0
Ash	0·7

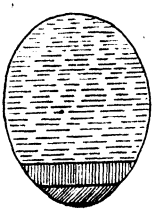

FIG. 135.—EGG

Fuel value per lb. = 695 calories (80 calories each)

	Per cent
Water	73·7
Protein	14·8
Fat	10·5
Ash	1·0

The *source* of food is not indifferent. It might be thought that a person well fed on peas would have the same powers as one fed on their equivalent in beef, but those races and individuals who feed upon a largely animal diet are characterised by the power of doing work more rapidly, by greater spirit, and by greater power of resisting disease. Although, as a general principle, this is undeniably true, and although it forms the main argument against the suitability of vegetarianism for those doing severe work involving any mental or highly skilled effort, it may be carried to a very fanciful extreme, as in the case of Kean, the actor, who would choose his dinner according to the part he was to play, taking pork for a tyrant, beef for a murderer, and mutton for a lover. Probably, in such a case, ease of digestion had more to do with the effect of the food than its source.

Salisbury diet is an extreme form of protein feeding consisting chiefly of lean meat and water. Though the system is useful in the treatment of obesity and some forms of dyspepsia, it can be tolerated by very few persons for any length of time. The great objection to *vegetarianism*, on the other hand, apart from that stated above, lies in the enormous bulk of vegetable food necessary, mainly in consequence of its wateriness. Thus, if one were to subsist on nothing but lentil porridge, about 5 pounds of it would be necessary daily; or if one lived solely on green vegetables and succulent fruits, the impossible weight of about 30 lb. every day would be necessary to a fairly hard-working healthy man. Those vegetarians who add milk, eggs, and cheese to their food reach at once a healthy and rational diet, and one which, in those liable to gout and rheumatism—and for most people—is more salutary than a full ordinary diet. In illustration of the sufficiency and cheapness of such a simple diet, the following comparative table of two lunches, supplying equal amounts of building

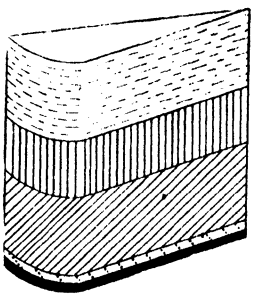

FIG. 136.—ENGLISH CHEDDAR CHEESE

Fuel value per lb. = 1939 calories

	Per cent
Water	33·7
Protein	25·2
Fat	33·4
Carbohydrate	3·1
Ash	4·6

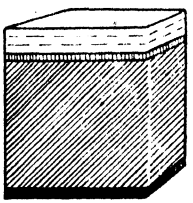

FIG. 137.—BUTTER

Fuel value per lb. = 3405 calories

	Per cent
Water	13·0
Protein	1·0
Fat	83·0
Ash	3·0

and energising material, is taken from a pamphlet on 'Milk as Food' issued by the U.S. Department of Agriculture, the prices being revised for the year 1937:

LUNCH OF SKIM-MILK AND BREAD

Ingredients.	Amount.	Cost.	Fuel Value in Calories.
Bread	10 oz.	1½d.	755
Skim-milk	1 pint	1½d.	170
Totals	..	3d.	925

RESTAURANT LUNCH

Ingredients.	Amount.	Cost.	Fuel Value in Calories.
Soup	8 oz.	..	75
Beef	2 ,,	..	275
Potatoes	2 ,,	..	100
Turnips	1 ,,	..	15
Bread	4 ,,	..	300
Butter	½ ,,	..	100
Coffee—			
Milk	1 ,,	..	20
Sugar	½ ,,	..	55
Totals		2s.	940

External conditions produce great differences in the need for food. In cold climates, or in those persons unusually exposed to the weather, a special addition of fats or carbohydrates must be made to the diet in order to maintain the body heat. For the same reason a tall, spare man requires a much greater supply of these foods than a short, fat man of the same weight. Such a difference in configuration may mean the necessity for adding one quarter or more of the amount of food.

Age and sex are important considerations. A woman requires about four-fifths of the diet of a man about the same size and build, the reduction affecting chiefly the starchy and sugary elements of her food. Children require much more protein—*i.e.* building material—in proportion to their size than adults; while old people, on the other hand, if they wish to keep healthy, must be very sparing eaters, particularly of animal foods.

Articles of diet.—Further details, regarding the various articles in common use as foods, are given under BREAD, TINNED FOODS, FARINACEOUS FOODS, MILK, NITROGENOUS FOODS, INFANT FEEDING. Some of the substances more frequently added to foods are mentioned under ADULTERATION OF FOODS. The articles which may most suitably be taken in various diseased conditions are mentioned under the headings of the various diseases.

Training diet.—Athletes and those who do hard labour require much more food than others, the proportion being indicated in the first table. Formerly a 'training diet' was much restricted in fats and sugars and increased in beef. This was probably a mistake, except in the case of jumpers or sprinters, as better staying power can be got on an ordinary diet, while the essential really consists in maintaining a good digestion. Langworthy gave the following record of Sandow's training diet, and though of course

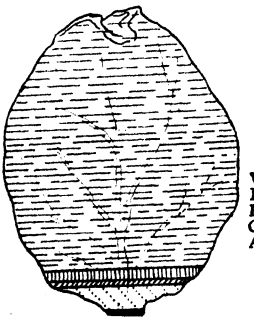

FIG. 138.—CABBAGE

Fuel value per lb. = 123 calories

	Per cent
Water	93·0
Protein	1·6
Fat	0·3
Carbohydrate	4·5
Ash	0·6

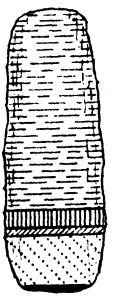

FIG. 139.—GREEN MAIZE

Fuel value per lb. = 460 calories

	Per cent
Water	75·4
Protein	3·1
Fat	1·1
Carbohydrate	19·7
Ash	0·7

FIG. 140.—STRING BEAN

Fuel value per lb. = 190 calories

	Per cent
Water	89·2
Protein	2·3
Fat	0·3
Carbohydrate	7·4
Ash	0·8

the amount is large, commensurably with a great muscular system, it gives an idea of the proper nature of a training diet. The ordinary man,

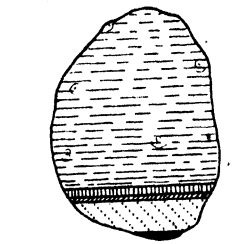

FIG. 141.—POTATO

Fuel value per lb. = 375 calories

	Per cent
Water	78·3
Protein	2·2
Fat	0·1
Carbohydrate	18·4
Ash	1·0

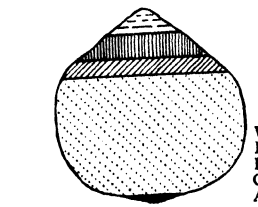

FIG. 142.—CHESTNUT

Fuel value per lb. = 1820 calories

	Per cent
Water	5·9
Protein	10·7
Fat	7·0
Carbohydrate	74·2
Ash	2·2

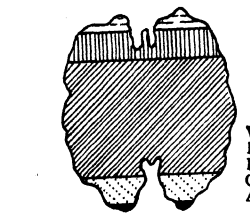

FIG. 143.—WALNUT

Fuel value per lb. = 3180 calories

	Per cent
Water	2·5
Protein	16·6
Fat	63·4
Carbohydrate	16·1
Ash	1·4

doing hard work, would require about two-thirds only of this amount.

Breakfast.—Cup of weak tea and slice of bread.

Second Breakfast at Noon.—Vegetable soup (9 oz.), two potatoes, veal (3 oz.), green peas (½ oz.), roast beef (2 oz.), bread pudding (4½ oz.), cake (½ oz.), beer (½ pint).

Dinner at 6 P.M.—Oysters (2 oz.), soup (10 oz.), celery (1 oz.), fish (3 oz.), potatoes (1 oz.), oyster plant (2 oz.), green peas (1 oz.), tomatoes (1 oz.), bread (2 oz), roast beef (2 oz.), chicken (2½ oz.), ice cream (4 oz.), sherbet (3 oz.), cakes (½ oz.), butter (1 oz.), Burgundy wine (11 oz.).

Supper, 12 P.M.—Roast beef (8 oz.), rye bread (7½ oz.), cheese (3½ oz.), biscuit (2 oz.), cakes (3½ oz.), beer (3½ pints).

The total represents about 4462 calories. Appetite forms the best guide to the amount, but one should always stop eating short of repletion. We may compare with this the diet suggested by the Scottish Prison Commissioners for an average convict doing hard labour in a northern clime, which represents slightly less, though still quite sufficient energising power of much cheaper material (3500 calories).

Breakfast.—Porridge (8 oz. meal), milk (½ pint).

Dinner.—Broth (1 pint), beef (7 oz.), potato (1 lb.), bread (6 oz.).

Supper.—Coffee (1 pint), bread (12 oz.).

The ordinary *standard ration* in the British navy was as follows:

1 lb. bread, ½ lb. fresh meat, 1 lb. fresh vegetables, ½ pint spirit, 4 oz. sugar, ½ oz. tea, ½ oz. chocolate, ½ oz. condensed milk, 1 oz. jam, 4 oz. preserved meat twice weekly.

The whole supplies approximately 3000 calories, which is sufficient for ordinary duty but barely enough for the hardest work and exposure.

Invalid diet.— *Illness* requires considerable change of diet, usually by way of diminution. In any feverish state, when the person is confined to bed, not more than half the diet of health, and of this very little as protein, must be taken. The two tables overleaf give the amounts of different foods and a typical diet-sheet for a large hospital, as used by one of the large Scottish Infirmaries.

DIETL'S CRISES (*see* KIDNEY DISEASES *under* MOVABLE KIDNEY).

DIGESTER (*digero*, I dissolve) is an appliance in which active principles, gelatine, etc., are extracted from drugs and food-stuffs by means of water and heat. The best known is Papin's digester, a strong iron vessel for extracting gelatine from bones and sinews by means of superheated steam.

DIGESTION, ABSORPTION, and ASSIMILATION are the three processes by which food is incorporated in the living body. In digestion, the food is softened and converted into a form which is soluble in the watery fluids of the body, or, in the case of fat, into very minute globules. In absorption,

Full or Ordinary Diet.		Convalescent Diet.		Beef-tea Diet.		Milk Diet.	
	Calories.		Calories.		Calories.		Calories.
Meat, 8 oz. (incl. 2 oz. bone)	500	Fish, 8 oz., or chicken, 6 oz., or mince collops, 6 oz.	400	Meat for tea, 10 oz.; or chicken, ½ for broth	120	Bread, 16 oz.	1200
Vegetables, 12 oz.	100	Bread, 16 oz.	1200	Bread, 14 oz.	1050	Milk, 3 pints	1200
Bread, 16 oz.	1200	Vegetables, 8 oz.	60	Rice, sago, cornflour, etc., 1½ oz.	150	Rice, sago, arrowroot, cornflour, etc., 1½ oz.	150
Barley, pease, or rice (for soup, with boiled meat), 1½ oz.	150	Rice, 1½ oz.	150	Milk, ½ pint	200	Milk, ½ pint	200
(Farinaceous or suet pudding once a week in lieu of soup)		Tea, ½ oz.		Sugar, 1 oz.	100	Sugar, 1 oz.	100
Tea, ½ oz.		Sugar, 1 oz.	100	Egg, 1	80		2850
Sugar, 1 oz.	100	Milk, 1 gill	100	Tea, ½ oz.			
Milk, 1 gill	100	Butter, 1 oz.	250	Sugar, 1 oz.	100		
Butter, 1 oz.	250	Soup	90	Milk, 1 gill	100		
(Porridge and ½ pint milk)	400		2350	Butter, 1 oz.	250		
(Coffee, ½ oz.)				(Custard pudding occasionally)			
	2800				2150		

Half a pint of sweet milk and a slice of bread in addition, to those patients requiring it = 300 calories.

These are apportioned as follows:

Breakfast.	*Breakfast.*	*Breakfast.*	*Breakfast.*
Coffee or tea. Butter, ½ oz.; bread, 6 oz.; with porridge and ½ pint milk, if desired.	As ordinary.	Tea. Bread, 4 oz. Butter, ½ oz.	Milk, 1 pint. Bread, 4 oz.
Lunch.	*Lunch.*	*Lunch.*	*Lunch.*
Milk, ½ pint, and bread, 1 slice.	Milk, ½ pint, and bread, 1 slice.	Milk, ½ pint, and bread, 1 slice.	Milk, ½ pint, and bread, 1 slice.
Dinner.	*Dinner.*	*Dinner.*	*Dinner.*
Meat (boiled or roast), 8 oz. Vegetables, 12 oz. Bread, 4 oz. Soup. (Farinaceous or suet pudding once a week in lieu of soup.)	Fish, 8 oz.; or chicken, 6 oz. (roast, boiled, or steamed); or minced collops, 6 oz.; or mutton cutlets or tripe, if desired. Vegetables, 8 oz. Bread, 4 oz. Soup.	Beef-tea, or chicken broth. Farinaceous pudding. (Custard occasionally.) Bread, 6 oz.	Farinaceous pudding. Milk, ½ pint. Bread, 6 oz.
Tea.	*Tea.*	*Tea.*	*Tea.*
Tea. Bread, 6 oz. Butter, ½ oz.	As ordinary.	As breakfast.	As breakfast; sago, or arrowroot, 1 oz. in addition, if desired.

These quantities are much in excess of the food actually served or required.

the substances formed are taken up from the bowels and carried throughout the body by the blood. In assimilation, these substances, deposited from the blood, are united with the various tissues for their growth and repair. For the maintenance of health each of these must proceed in a regular manner.

SALIVARY DIGESTION begins as soon as the food enters the mouth. Saliva runs from the minute orifices of the salivary gland ducts, and contains a ferment named ptyalin, which actively changes the starch of bread, potatoes, and the like, into sugar. The object of chewing is not only to bruise the food, and make it more permeable for the gastric juice, but also to mix the starchy parts thoroughly with saliva. This process goes on, after swallowing, for the first twenty minutes or half-hour that the food remains in the stomach, after which the action of the saliva is checked by the acid of the gastric juice.

GASTRIC DIGESTION begins a little time after the food enters the stomach, the gastric juice exuding rapidly from the openings of the minute glands with which the interior surface of this organ is covered. The gastric juice begins to be secreted even before

the food enters the stomach at the sight and smell of food (psychic secretion): This juice contains two ferments, named pepsin and rennin, the former having the power of breaking down the proteins of food into smaller molecules containing fewer amino-acids, the latter being concerned with the digestion of milk. There are also present free hydrochloric acid, which aids the action of the pepsin and prevents putrefaction of the food, and acid salts, such as phosphate of soda, which have a similar action. The slow, churning movements which take place in the walls of the stomach have the effect of thoroughly mixing the food and gastric juice, and, to a slight extent, of breaking up the former. It should be remembered that digestion in the stomach does not prepare the food for absorption, but is intended merely to warm it, mix thoroughly its different constituents, and by a softening process convert it into a grey, semi-fluid mass called 'chyme'. In many persons, gastric juice is wanting, so that digestion does not take place at all in the stomach, and indeed in the case of both men and animals the stomach has been completely removed without serious effect. In most persons, however, defective gastric digestion when it occurs is a painful process, which interferes much with their ordinary employments. (*See* DYSPEPSIA.) Very soon after soft food has been taken, waves of movement may be seen on X-ray examination, the orifice at the lower end of the stomach (pylorus) opens, and the food is squeezed quickly in small quantities into the bowel; but if any hard food comes in contact with the stomach wall near the exit the orifice at once closes. Hence it is an error to partake of food till the stomach has completely emptied itself of the previous meal. Gastric digestion of a simple meal of tea, bread, butter, and jam should be complete in about an hour, a meal containing milk, eggs, or light meat requires three or four hours, while a heavy dinner with soup, meat, fruit, and wine or beer is not entirely treated by the stomach till six or seven hours have elapsed. Hence the English plan of taking the heavy meal of the day (dinner) in the early evening is a sound one, giving time during the night for the later stages of digestion.

INTESTINAL DIGESTION.—The softened food, or chyme, which leaves the stomach is exposed in the bowels to the action of four factors—(*a*) bile, (*b*) pancreatic juice, (*c*) intestinal juice, (*d*) bacteria. Bile is collected from the liver and gall-bladder into the common bile-duct, which, together with the duct from the pancreas, opens into the duodenum a short distance from the exit of the stomach. The bile consists mainly of certain complex salts and pigments, which assist in digesting the fats of the food, and partly consists of waste products removed from the blood. The pancreatic juice contains four powerful ferments, which have the following effects: one breaks down fats into glycerine and fatty acids; a second curdles milk; a third completes the digestion of starch; and the fourth carries on the breaking down of proteins begun in the stomach. Intestinal juice contains ferments (enzymes) which (1) complete the breakdown of proteins into the constituent amino-acids; (2) act upon the disaccharides maltose, sucrose, and lactose, converting them into the monosaccharide glucose; (3) split fats into fatty acids and glycerine. Bacteria are normal inhabitants of both small and large intestine. In the former they have a fermentative, in the latter a putrefactive, action. In the former they act upon carbohydrate to produce acetic, butyric, and lactic acids. In the latter, bacteria decompose protein into such products as histamine, phenol, cresol, indole, skatole, etc. These are no longer, however, believed to be responsible for the ill-effects of constipation.

ABSORPTION.—The only substance absorbed from the stomach to any extent is alcohol. Water is quickly passed from the stomach into the intestine, and considerable quantities are there absorbed in a few minutes. But it is only after subjection to digestion in the intestine for several hours that the bulk of the food is taken up into the system. The semi-solid chyme which leaves the stomach is converted into a yellowish fluid of creamy consistence called 'chyle' by the action of bile and

pancreatic fluid. From this the fats, in the form of a fine emulsion, are taken up by lymph vessels called ' lacteals ', and ultimately reach the blood, while

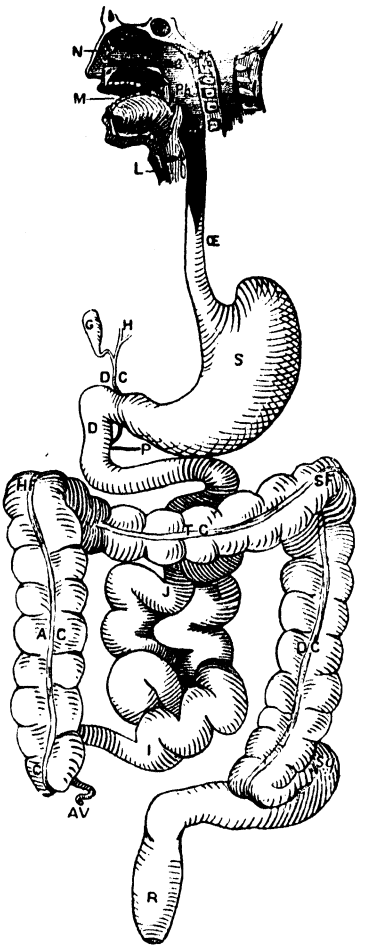

FIG. 144.—Diagram of alimentary canal to illustrate the organs concerned in digestion. *M*, Mouth; *Ph*, pharynx; *Œ*, œsophagus; *S*, stomach; *D*, *J*, *I*, small intestine; into the duodenum *D* open *P*, the pancreatic duct, and *DC*, the common bile duct; *G*, gall-bladder; *H*, hepatic duct; *C*, *AC*, *TC*, *DC*, large intestine; *R*, rectum; *AV*, appendix. (*Ency. Brit.*)

sugars, salts, and amino acids formed from proteins pass directly into the small blood-vessels of the intestine. The process is facilitated by the extreme unevenness of the intestinal

wall, which is folded into many ridges and pockets, while in microscopic structure the surface is covered by fine finger-like processes named ' villi ', which are bathed in the fluids passing down the intestine. Further, absorption is probably assisted by the ' leucocytes ', or white cells of the blood, which are enormously increased in numbers after a meal, and which have the power of wandering out of the blood-stream and taking up particles into their substance. Food materials are absorbed almost exclusively by the small intestine. The large intestine, or colon, absorbs water

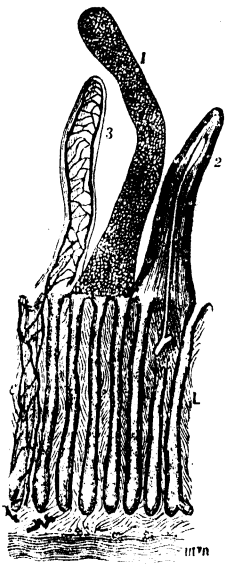

FIG. 145.—Diagram of a section through the mucous membrane of the small intestine, showing three of the ' villi ' with which the inner surface is covered. 1 shows the cells covering the villus; 2 is a section showing the lymphatic vessel in its centre; 3 shows the network of blood-capillaries continuous with those in the deeper part of the mucous membrane *c*; *L* is opposite the tube-shaped glands that secrete the intestinal juice; *mm*, muscle of mucous coat. (Turner's *Anatomy*.)

and salts. The food is passed down the intestine by the contractions of its muscular coat, and, finally, the indigestible residue, together with various waste substances excreted from the liver and intestinal walls, is cast out of the body in the stools.

ASSIMILATION takes place more

slowly, the blood circulating through every organ, and each taking from it what is necessary for its own growth and repair. Thus the cells in the bones extract lime salts, muscles extract sugar and protein, and so forth. When the supply of food is much in excess of the immediate bodily requirements it is stored up for future use, fat being deposited in various sites, sugar being converted into glycogen in the liver. The greater bulk of nutriment is assimilated by the muscles for heat production and work, the sugar and amino acids being built up into a substance which forms the permanent part of the muscle. The substance so formed undergoes chemical changes, and is broken down to form carbonic acid, lactic acid, and other waste products as the muscle does work. Various hormones, such as insulin, which is an internal secretion of the pancreas, circulate in the blood and are concerned in these processes. All these changes are carried on in solution in water, of which about three pints are drunk or taken with the food and absorbed daily, a similar amount being discharged from the body in the urine, perspiration, and other excretions.

DIGITALIS is the leaf of the wild fox-glove, *Digitalis purpurea*, gathered when the flowers are at a certain stage, dried, and powdered. The leaf contains several active principles, which can be extracted in various ways. Its action is to strengthen involuntary muscular contraction, particularly that of the muscle fibres in the heart and blood-vessels. It is one of the most valuable remedies we have in cases of disease of the heart, associated with rapid or irregular beating of this organ, and with dropsy. Upon the heart it has the double action of increasing the strength of each beat, and of lengthening each intervening pause (diastole), so that the muscle of the damaged organ obtains longer periods for rest and repair. It also lessens the 'conductivity' of the heart muscle so that feeble and ineffective beats tend to disappear, when the action is irregular. By thus acting on the heart, and by its constricting action upon the walls of the small arteries and veins over the body, it raises the general pressure of the blood, and thus, in cases where the pressure is already low, causes the production of more urine by the kidneys and a consequent decrease of existing dropsy.

Uses.—Digitalis is given as a powder, as tincture, as infusion, and also in the form of sugar-coated 'granules', which contain the active principle of the drug. The most common form of administration is the tincture, of which 5 to 15 drops, or more in special circumstances, are given. It is ordered in all sorts of cardiac disease associated with rapidity or irregularity of the pulse, except in cases where the aortic valve is insufficient; but, on account of its being a drug which tends to accumulate in the system, and to produce suddenly a very powerful action, it should never be taken otherwise than under skilled supervision. Digitalis is chiefly employed in the condition known as auricular fibrillation, in which the heart-beats are very irregular, and by checking the irregular ventricular contractions produced by the fibrillating auricles it renders the pulse regular.

DIGITALIS POISONING may occur from taking medicinal doses over too long a period, or from taking a single overdose. In the two cases the symptoms are similar. The heart, which is made slower and more regular by taking small doses, becomes again quicker and more irregular as the result of excessive administration. At the same time breathing gets more difficult, and there may be convulsions or unconsciousness. The amount of urine passed gets less and less, thus causing retention in the system of the drug, which is naturally got rid of by the kidneys.

Treatment.—The drug must be stopped. If a single overdose has been swallowed, the stomach should be washed out with weak potassium permanganate solution and stimulants administered.

DILANTIN (*see* DIPHENYLHYDANTOINATE).

DILAUDID is a keto derivative of morphine, has the same action as this drug, is given in a smaller dose, and is

said to be less apt to start a drug habit in the patient.

DILL is the seed-like fruit of *Anethum graveolens*, containing a large amount of volatile oil. (*See* OILS.)

DILUENTS (*diluo*, I wash) are watery fluids of an unirritating nature, which are given to increase the amount of perspiration or of urine, and carry solids with them from the system. Examples are water, milk, barley-water, and solutions of alkaline salts.

DIOPTER is a term used in the measurement of the refractive or focussing power of lenses; one diopter is the power of a lens with a focal distance of one metre and is the unit of refractive power.

DIPHENYLHYDANTOINATE is the most powerful drug yet discovered in the treatment of epilepsy. It controls the convulsions of epilepsy better than any other drug, but is very toxic and so must be prescribed with care. It is known under the proprietary terms DILANTIN, EPANUTIN, and SOLANTOIN.

DIPHTHERIA (διφθέρα, a skin or membrane) is the term applied to an acute infectious disease, which is accompanied by a membranous exudation on a mucous surface, generally on the tonsils and back of the throat or pharynx. Under the name of the *Malum Egyptiacum*, Aretæus in the first century gives a minute description of a disease which in all its essential characteristics corresponds to diphtheria. In the sixteenth, seventeenth, and eighteenth centuries, epidemics of diphtheria appear to have frequently prevailed in many parts of Europe, and were described by physicians under various titles; but it is probable that other diseases of a similar nature were included in their descriptions, and no accurate account of this affection had been published till M. Bretonneau of Tours in 1821 laid his celebrated treatise on the subject before the French Academy of Medicine. By him the term *Le Diphthérite* was first given to the disease. Among the most important discoveries on the subject have been that by Klebs in 1883 of a bacillus which is constantly found in the throat of those suffering from the disease, and the confirmation soon afterwards by Loeffler of this bacillus as the cause of the disease, by means of its cultivation in the laboratory and the experimental production of the disease in animals by inoculation from these cultures. In their honour, the bacillus is known as the Klebs-Loeffler bacillus.

Causes.—The infection is essentially a local one in the throat due to the development there of the special organisms of the disease, and the general symptoms are referable to the absorption of poisonous substances formed by these organisms. Among the first signs of the disease appears, as described below, an inflammation of the throat, where there develops a false membrane, composed partly of the dead surface of mucous membrane and partly of products effused from the blood and lymph. In this membrane Klebs-Loeffler bacilli swarm, along with many other varieties of organism, particularly streptococci.

There is no doubt that the disease is generally conveyed by direct contagion, as by kissing an affected person, using his cup or spoon, or receiving a drop of saliva or fragment of membrane upon the lips or face through incautiously approaching him when he is coughing.

The bacillus grows freely in milk, and infection may be conveyed in this way. Three strains of bacillus are now recognised as causing clinical diphtheria: *gravis*, *intermedius*, *mitis*. *Gravis* and *intermedius* strains are almost always virulent; about 10 per cent of *mitis* strains are non-virulent.

As already noted, diphtheria has frequently appeared as an epidemic, but it occurs more commonly in single cases. It is sometimes endemic in certain localities where hygienic conditions are bad. The influence of climate, weather, and condition of soil appears to be inappreciable, but it is noticeable that the number of cases occurring in a community generally increases in autumn, and is greatest during the winter months.

Children appear to be more liable to diphtheria than adults; and although the most robust people may be attacked, those whose health is weakened by any cause are specially predisposed.

Especially is this the case with regard to scarlet fever, and it is no uncommon thing for a person convalescing from the latter disease to be attacked by diphtheria. A method known as '*Schick's test*' has been devised for detecting the susceptibility of children to diphtheria, and is used to a considerable extent in the case of schools and other institutions where children are collected together. A minute quantity of toxin filtered off from growing diphtheria bacilli is injected with a very fine needle into the skin of the arm. Children possessing naturally a considerable amount of antitoxic power show no reaction, but if the child has very little resisting power to diphtheria, an area of inflammation is produced on the skin at the site of the injection. The test is harmless and is a valuable indication of the children whom it is specially necessary to protect against diphtheria. These susceptible children can then receive from one to three injections of diphtheria toxin rendered harmless by formalin and heat (toxoid), or of a mixture of toxoid and antitoxin, which produces lasting immunity against diphtheria. A common way of giving 'diphtheria prophylactic' is to inject two doses of alum-precipitated toxoid (A.P.T.), with a month's interval between the two.

Symptoms.—The severity of diphtheritic inflammation in general, and the fact that it is accompanied by serious constitutional symptoms, suffice usually to distinguish this disease from croup, which, though resembling diphtheria, differs from it in being a merely local inflammation of the larynx. There are several other diseases of the throat, such as acute suppurative quinsy, which are even more liable to be mistaken for diphtheria. The diagnosis is often difficult, even for a skilled physician, and it must be observed that the mere existence of a sore throat accompanied by some membranous exudation does not constitute diphtheria, as is often erroneously supposed.

In doubtful cases, the deciding point is generally accepted to be the following. A swab of cotton-wool mounted on a wire is rubbed against the throat, and then sent to a skilled bacteriologist for examination. A culture of the organisms from the swab is made upon dried serum, for 16 to 24 hours at the body temperature, and if the organisms found in the resulting culture be pronounced to be diphtheria bacilli, the case can be safely diagnosed as one in which this disease is present.

Cases of diphtheria differ as to their intensity, from the mildest forms, which resemble an ordinary catarrhal sore throat, to those of the most severe character (such as the gangrenous form), in which the disease is hopelessly intractable from the first.

In general, following an incubation period of about two days after infection, symptoms set in like those commonly accompanying a cold, viz. chilliness and depression. Sometimes very severe disturbances usher in an attack, such as vomiting and diarrhœa. A slight feeling of uneasiness in the throat is experienced along with some stiffness of the back of the neck. When looked at, the throat appears reddened and somewhat swollen, particularly in the neighbourhood of the tonsils, the soft palate, and upper part of pharynx, while along with this there is tenderness and swelling of the glands at the angles of the jaw. The affection of the throat spreads rapidly, and soon the characteristic exudation appears on the inflamed surface in the form of greyish-white specks or patches, increasing in extent and thickness until a yellowish-looking false membrane is formed. This deposit is firmly adherent to the mucous membrane beneath, or is incorporated with it, and, if forcibly removed, it leaves a raw, bleeding, ulcerated surface, upon which it is reproduced in a short period. The appearance of the exudation has been compared to wet parchment or washed leather, and it is dense in texture. It may cover the whole of the back of the throat, the cavity of the mouth, and the posterior nares, and may spread downwards into the air passages on the one hand and into the alimentary canal on the other, while any wound on the surface of the body is liable to become covered with it. But it is usually limited to part of the area named. This membrane is apt to be detached spontaneously, and, as it loosens, it becomes decomposed, giving a most offensive and characteristic

odour to the breath. There are pain and difficulty in swallowing, but, unless the disease has affected the larynx, no affection of the breathing. The voice acquires a snuffling character. When the disease invades the posterior nares, an acrid, fetid discharge, and sometimes also copious bleeding, take place from the nostrils. Along with these local phenomena there is evidence of constitutional disturbance of the most severe character. There may be no great amount of fever, and the temperature seldom rises above 102° or 103°, but there are marked depression and loss of strength. The pulse becomes small and rapid, the countenance pale, the swelling of the glands in the neck increases, which, along with the presence of albumin in the urine, testifies to a condition of blood-poisoning. Unless favourable symptoms emerge, death takes place within three or four days or sooner, either from the rapid extension of the false membrane into the air passages, giving rise to asphyxia, or from a condition of general collapse, which is sometimes remarkably sudden. Sometimes death takes place suddenly, even when convalescence is progressing, from acute dilatation of the weakened heart, if a considerable effort be made at too early a period. Death may also ensue if the temperature rises excessively.

In cases of recovery, the change for the better is marked by an arrest in the extension of the false membrane, the detachment and expectoration of that already formed, and the healing of the ulcerated mucous membrane beneath. Along with this, there is a general improvement in the symptoms, the power of swallowing returns, and the strength gradually increases, while the glandular enlargement of the neck diminishes, and the albumin disappears from the urine. These favourable symptoms should appear within three or four days, but recovery is generally slow, and it is many weeks before full convalescence is established. During this period it is particularly necessary in the case of diphtheria to guard against premature over-exertion, and for this reason patients are kept in bed for several weeks even though feeling quite well.

Even when diphtheria ends quite favourably, peculiar sequels are apt to follow, generally in a period of two or three weeks after all the local evidence of the disease has disappeared. These effects, which are due to neuritis caused by the effect of the diphtheria toxin upon various nerves, may occur after mild as well as after severe attacks, and they are principally in the form of paralysis affecting the soft palate and throat, causing difficulty in swallowing with regurgitation of fluid through the nose, and giving a peculiar nasal character to the voice. Another form of paralysis is one affecting the muscles of the eye, and producing loss of the power of accommodation and consequent difficulty in reading without glasses, which often lasts for a period of several months; another form may be paralysis of a limb, or of both legs, or even of the respiratory muscles. These symptoms, however, after continuing for a variable length of time, almost always ultimately disappear.

Treatment.—Regard must be had both to the local and to the general nature of the disease. With increasing improvements in the manufacture of antitoxic serum, and with more knowledge of how to use it, treatment of the local condition of the throat has become of much less importance than the early administration of antitoxin — a life-saving measure.

In general, the second important measure in treatment is rest, the patient being kept strictly flat. The effect of the disease upon the patient's strength is so marked that from the very beginning there is an urgent demand for strong nourishment which should be freely administered in the form of milk, soup, etc., as long as there exists the power of swallowing, and when this fails, nutrient enemata should be resorted to. The rigid maintenance of the recumbent position is of great importance in preserving the strength of the heart. If the infection spreads to the larynx (laryngeal diphtheria), antitoxin is given and the patient is kept in a steam tent. If obstruction to breathing is not relieved by this it may be necessary to perform the operation of tracheotomy. Another operation known as intubation was

introduced to avoid the inconvenience and danger of an open wound in the throat. This consists in pushing into the larynx by way of the mouth a short metal tube, which serves to keep open a passage for the air when there is danger of the larynx becoming completely blocked with membrane. It is prevented by a thickening at the upper end, and also by a silk thread, from going too far down, and the operation has the advantages, in practised hands, of being performed in a few seconds, and of being done without any cutting. Nevertheless it is far from being so efficient or so suitable, in the great majority of cases, as tracheotomy.

Most cases of diphtheritic paralysis recover without special treatment. In cases where the respiratory muscles are paralysed, it may be necessary for a time to resort to artificial respiration. This can be effected for as long as may be necessary, till the paralysis passes off, by means of some form of apparatus which rhythmically inflates and deflates the chest, such as Drinker's apparatus, which is to be found in many large hospitals.

Since about 1894, an antitoxic serum, prepared from the blood serum of horses which have been rendered by inoculation immune against diphtheria, has come into use and has greatly improved the results of treatment in this disease. The serum containing the antitoxin is prepared by several of the large firms of manufacturing chemists in great quantity. It is injected by means of a syringe and hollow needle into the subcutaneous tissue either of the back or of a limb. Prior to this date, the mortality in public hospitals of all cases of diphtheria was about 30 per cent, while, since antitoxic treatment became general, it is said to have been reduced to less than half that figure. Cases in private practice which are seen earlier and therefore receive more prompt treatment show an even more satisfactory change. Further, cases which receive this treatment early in the disease appear to run a much milder course than those not so treated. The use of antitoxic serum is in most cases harmless, although occasionally it is followed by a rash and feverishness or even by collapse, the general phenomena known as 'anaphylaxis'.

It should be mentioned that in all cases of diphtheria, means should be taken to prevent the spread of the disease in a household, by isolation of the patient, care in those matters to which reference has been made in describing the causes of the disease, and the use of disinfectants to purify at once all handkerchiefs, spoons, and similar articles used by the patient. The attendants ought to be scrupulously careful to avoid infection with the products of the disease, and should frequently use gargles. Injection of antitoxic serum is often used as a precautionary measure for other children of a household in which one has contracted diphtheria. A procedure very commonly followed is to take swabs in the manner already described from the throats of all persons who have come in contact with the patient in the two or three days preceding the onset of the diphtheria. These swabs are examined for the presence of the diphtheria bacillus, and persons, in whose throat the bacillus is found to be present, are specially watched and treated by antiseptic applications to the throat, until the period of incubation has passed, and until the throat is found on subsequent examination to be free from these bacilli.

DIPLEGIA (*δίς*, twice; *πλῆγή*, a blow) means extensive paralysis on both sides of the body. (*See* PARALYSIS.)

DIPLO- (*διπλόος*, double) is a prefix meaning twofold.

DIPLOCOCCUS (*διπλόος*, double; *κόκκος*, berry) is the term applied to a group of bacterial organisms which have a tendency to adhere in pairs.

DIPLOE (*διπλόη*, a doubling) is the layer of spongy bone which intervenes between the compact outer and inner tables of the skull.

DIPLOPIA (*διπλόος*, double; *ὄπτομαι*, I see) means double vision. It is due to some irregularity in action of the muscles which move the eyeball, in consequence of which the eyes are

placed so that rays of light from one object do not fall upon corresponding parts of the two retinæ, and two images are produced. It is a symptom of several nervous diseases, and often a temporary attack follows an injury to the eye, intoxication, or some febrile disease like diphtheria.

DIPROSOPUS is the term applied to a fœtus which has two faces instead of one.

DIPSOMANIA (*δίψα*, thirst; *μανία*, madness). (*See* ALCOHOLISM, CHRONIC.)

DIPYGUS is the term applied to a fœtus which has a double pelvis.

DISARTICULATION is the amputation of a bone by cutting through the joint of which the bone forms a part.

DISCHARGE FROM EAR, NOSE, etc. (*see* EAR, NOSE, etc., DISEASES OF).

DISCISSION is the term applied to an operation for destroying a structure by tearing it without removal, *e.g.* the operation of needling the lens of the eye for cataract.

DISCRETE (*discerno*, I separate) is a term applied to rashes, etc., in which the individual spots remain separate, and is the opposite of confluent. (*See* CONFLUENT.)

DISINFECTION is the process of rendering harmless any persons, articles, rooms, etc., which are liable to communicate disease. *Disinfectants* are procedures, or substances, used for this purpose. The word is sometimes confused with *antiseptics*, which denotes substances used to prevent or check putrefaction, and, though most antiseptics are disinfectants, this is not necessarily the case. For example, salt and boracic acid, though good antiseptics, are very feeble disinfectants. *Germicides* are measures directed towards killing bacterial life. *Deodorants* are substances which suppress foul smells, and, though most deodorants are disinfectants, they are so only on much more effective application than is necessary to subdue smell. Thus charcoal exposed in a sick-room clears away smell but does not disinfect the room, and eucalyptus sprinkled on the floor renders the air of a room sweet, but does not destroy all the germs of disease in the room.

FORMS OF DISINFECTANT.—**Light and fresh air** are too apt to be neglected. There can hardly be found a more powerful disinfectant than direct sunlight, for few bacteria can survive exposure to it in the open for an hour. This applies, for example, with special force to the tubercle bacillus.

Heat is of great importance. Exposure to moist heat at 212° Fahr. or 100° C. (*i.e.* boiling in water) kills bacteria in five to ten minutes, while for absolute purification Koch's method of boiling on three successive days (*see* BACTERIOLOGY) may be employed. Some articles which would spoil by boiling may be steamed in a closed, though not air-tight, vessel, steam being allowed to pass freely over them for twenty minutes after it has begun to rise; metal articles, for example, do not rust so quickly in steam as in boiling water, and cotton or linen materials do not become so wet as in water. In the expensive forms of steriliser the steam used is subjected to pressure, which, according to some authorities, renders its action much more effective. Articles which will not stand moisture at all may be subjected to dry heat at a temperature of 250° Fahr. for an hour, for example, in Ransom's apparatus; but this form of heat has little penetrating power, so that clothes, etc., subjected to it must not be made up into thick bundles.

Gaseous disinfectants.—SULPHUROUS ACID, produced by burning sulphur, is frequently used to disinfect close places. One pound of sulphur, which produces over 11 cubic feet of sulphurous acid gas, should be used for every 1000 cubic feet of air to be disinfected. The sulphur may be bought ready mixed with charcoal in the form of cones. These cones, in order to prevent risk of fire, are set on a plate, which in turn is placed in an iron basin containing water. The windows and chimney being carefully stopped up, the sulphur is ignited, and the door closed tightly. Six hours are allowed to elapse before the door is opened and fresh air admitted. Sulphurous acid gas may also be obtained compressed in iron cylinders, and, to be

used, is simply allowed to escape into the air in the above proportion, the room being similarly closed up.

FORMALIN vapour may be evolved from tablets containing it, placed upon a thin metal plate over the chimney of a lamp, or cones in which the formalin is driven off by charcoal may be burned like the sulphur cones. It is easily managed, harmless to furniture, and very effective. It is still more commonly used dissolved in water as a fine spray (*see below*).

CHLORINE is less manageable than sulphurous acid, but in the presence of moist air is a very powerful disinfectant.

OZONE is sometimes used, being given off when 3 parts of strong sulphuric acid are mixed slowly with 2 parts of permanganate of potash. It is a very weak disinfectant.

VOLATILE OILS, such as eucalyptus, terebene, etc., when diffused through the air, probably act as feeble disinfectants.

Fluid disinfectants. — PERCHLORIDE OF MERCURY in water (1 in 1000 to 10,000) is perhaps the strongest of these, but to check its coagulating action upon all animal fluids it should be mixed with dilute hydrochloric acid. The Ministry of Health of England recommends a *sublimate disinfectant* made up as follows: perchloride of mercury, half ounce; hydrochloric acid, 1 ounce; soluble aniline blue, 5 grains; water, 3 gallons. This forms a cheap disinfectant, deep blue in colour, which may be used for various purposes.

CARBOLIC ACID (1 in 20 of water) and CRESOL (in strength from 1 in 40 to 1 in 200 according to the purpose for which they are employed) are also used, and, as coagulation does not result to the same extent with them as with perchloride of mercury, their action is less impeded by the presence of albuminous fluids. These are much used for disinfecting pavements, floors, etc.

CHLORINATED LIME (1 lb. to 1 gallon water) gives off chlorine freely when sulphuric acid is added, and is a powerful disinfectant. It is much used for disinfecting drains.

FORMALIN in the strength of 2 to 10 per cent in water may be used as a spray for walls, air, curtains, etc., and is a powerful disinfectant, being also harmless to furniture and wall-paper. It is much used after a case of infectious disease has occurred in a private house.

BURNETT'S SOLUTION, containing chloride of zinc; CONDY'S FLUID, containing permanganate of sodium; SANITAS, containing oxidised turpentine; and IZAL, LYSOL, CYLLIN, MONSOL, and other coal-tar derivatives are much used and useful.

METHODS OF DISINFECTION.—**The person** requires disinfection after certain acute diseases, notably after scarlatina, and parts, such as the hands and mouth, after exposure to infection. Disinfectant soaps, such as carbolic, etc., may be used, but are not of great power. A disinfecting bath of potassium permanganate solution diluted to a pale pink colour is useful, or the body may preferably, when there is a rash or desquamation going on after scarlatina, be anointed with pure eucalyptus oil or ozonised lard (1 part ozonic ether to 8 parts lard). For the hands, the best and most efficient disinfectant is washing in a large amount of warm water with clean soap. The hands may then be sponged with ether, and steeped for five minutes in perchloride of mercury solution (1 in 2000), or pink potassium permanganate solution. For a mouth disinfectant, washing with the last-named is perhaps best, though rather irritating. For this purpose peroxide of hydrogen is much used in full strength as a mouth wash, gargle, etc.

Dressings and instruments used for surgical cases are usually sterilised by moist heat. The bandages, swabs, lint, etc., are made into the form in which they will be finally used, and are then made up in bundles which are placed in special boxes and treated in a steam steriliser. The bundles are not afterwards opened till the time of the operation or dressing for which their contents are required.

Rooms have to be disinfected after an infectious case has been treated, and certain precautions should be observed during the illness. The room should not be swept during the course of treatment nor till after disinfection, but furniture may be dusted with a damp cloth. A sheet damped with 1 in 20 carbolic acid solution may be hung outside the door of the sick-room for isolation, and may be redamped with the same solution as it becomes dry.

During the disease, all unnecessary ornaments, hangings, and the like should be removed. At the end, the carpet, if not previously removed, should be rolled up, any bright metal fittings removed or smeared with vaseline for protection, and then the room should be fumigated with sulphurous acid gas, or sprayed with formalin, as described above, to disinfect the atmosphere and walls. Next, the bedding, carpets, window curtains and similar objects, which require a more than superficial disinfection, should be removed for disinfection by heat. Thereafter the floor should be immediately mopped with cresol solution or perchloride of mercury, to destroy any organisms which may have fallen on it, and finally the windows widely opened to allow the fresh air and sunlight free access for twenty-four hours.

Clothes and bedding require careful handling, since mattresses and the like are damaged by moisture. All rags, cheap books, toys, and valueless clothing should simply be burned. Washable articles like sheets, cotton, and flannel garments should be steeped, before removal from the sick-room, in cold water containing 2 per cent lysol or similar substance, to remove excreta, discharges, etc., and then boiled for ten minutes before being sent to the laundry. Bedding, carpets, curtains, dresses, and outer garments may be sterilised by moist or dry heat as described. Usually the sanitary authorities of towns will do this, free of charge, on application. Valuable books may be sterilised by formalin vapour.

Stools, sputum, and other discharges may be removed from sheets and clothing as above. All stools, sputa, etc., from infectious cases should be mixed at once with an equal bulk of strong cresol solution (1 in 50), lysol solution (1 in 20), or disinfected with other antiseptic, such as perchloride of mercury, chloride of lime, chromic acid, perchloride of iron, etc., before being emptied down the drains.

Drains and streets should be kept in good repair and occasionally flushed. During an epidemic of plague, cholera, or the like, the streets should be kept constantly moist by watering-carts, and for disinfection may be irrigated with water containing one pound of chlorinated lime per gallon, and, after a few hours' interval, thoroughly flushed. Burnett's solution is also largely used for disinfecting bilge-water, cesspools, etc., and for pavements cresol has been recommended as several times stronger than carbolic acid.

DISINFESTATION means the destruction of insect pests, especially lice, whether on the person or in dwelling places.

DISLOCATIONS (*dis*, apart; *loco*, I place) are injuries to joints of such a nature that the ends of the opposed bones are forced more or less out of connection with one another. Besides displacement of the bones, there is more or less bruising of the tissues around them, and tearing of the ligaments which bind the bones together.

Varieties.—Dislocations, like fractures, are divided into simple and compound, the bone in the latter case being forced through the skin. This seldom occurs, since the round head of the bone has not the same power to wound as the sharp end of a broken bone. Dislocations are also divided according as they are (1) congenital, *i.e.* present at birth in consequence of some malformation, or (2) acquired at a later period in consequence of injury, the great majority falling into the latter class.

One important division includes those which are produced only by great violence, are difficult to reduce, and which, when reduced, do not readily slip out again. Another division comprises those which easily occur, are readily reduced, and are prone to take place again. As an example of the former class may be mentioned dislocation of the hip-joint, as an example of the latter class dislocation of the shoulder.

A very important distinction is drawn between recent and old-standing dislocations. In old-standing dislocations, the accident has occurred perhaps some weeks previously, and has either been unrecognised on account of surrounding swelling, or, at all events, untreated, so that not only has the dislocated bone formed adhesions in its new position, but the smooth, cartilage-covered surfaces have lost, to a great extent, their power of

moving evenly over one another if again properly brought in contact. In this connection, Sir Astley Cooper laid down as an axiom that no attempt should be made to reduce a dislocation at an interval longer than three or four months after the injury has taken place. Since the introduction of chloroform, however, successful attempts are often made after long intervals, and the decision, as to whether an attempt should be made or not, depends on several other factors than the mere lapse of time, for example, on the age of the person, the presence or absence of pain, the usefulness of the limb in its new position, etc.

Causes.—The causes of dislocation are similar to those of fracture, the fact as to whether a bone or a joint gives way depending upon the manner in which force is applied, and still more upon the relative strength of bones and joints. Thus in very young and very old persons dislocations are extremely rare, because the bones are relatively easily broken, and thus the joints are saved from damage. Congenital dislocations are mainly due to some defect in development of the bones.

Signs and symptoms.—The injured limb is useless, but, as a rule, there is little pain, unless the dislocated bone presses upon some nerve trunk. When the limb is compared with that of the opposite side, the joint is found to be unduly prominent in one place, and shows an abnormal hollow in another. Further, there is loss of movement at the joint in question, but no grating (crepitus) as in a case of fracture. Each joint shows further special symptoms dependent upon its conformation.

Treatment.—So far as temporary treatment is concerned, nothing is necessary but a splint, bandage, sling, or the like, to keep the injured part moderately quiet, because there is not the same danger of damage to nerves, vessels, etc., by the rounded head of the bone, as by the sharp fragments of a fracture. The greatest care is necessary in reduction, *i.e.* putting the dislocated bone back in place, for great damage may be done by an unskilled person in the way of breaking the bone, tearing nerves and vessels, or even leaving the bone dislocated in a new direction. After reduction to the natural position, the limb must be fixed for a time so as to prevent a recurrence, which will take place if it be used at once. The length of time depends upon the severity of the injury; as a rule, after about ten days, gentle movements are made to prevent the joint becoming stiff, and the bandages, etc., left off after about three weeks. But care in using the limb is necessary for long.

SHOULDER.—This may be reduced in one of two methods. (*a*) By *manipulation*, in which the bone is gently worked back into place by a method too complicated for description here. (*b*) By *extension*. The injured person lies on his back upon a couch or upon the floor. The operator then, sitting down by the injured side opposite the patient's hip and facing towards his

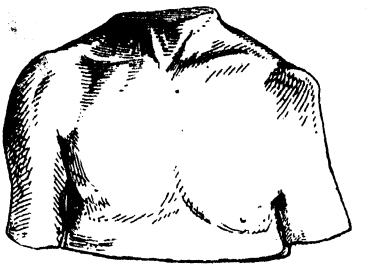

FIG. 146.—Dislocation of the left shoulder, showing the flattening on the outer side. The right shoulder is uninjured. (Miller's *Surgery*.)

shoulder, grasps the limb with one hand by the wrist, with the other above the elbow, while at the same time he places his foot, from which the boot has been removed, in the armpit, on the edge of the shoulder-blade, to steady it, and give him something against which to pull. He then pulls on the injured arm gently, steadily, and strongly, first in a direction parallel with the injured person's body, and, if this be unsuccessful, at right angles to it, pressing all the while with his foot against the edge of the shoulder-blade. The injured person must at the same time relax all his shoulder muscles. The bone goes into place generally with a snap, and the appearance of the joint is then like that of its fellow.

ELBOW.—This joint may be dislocated backwards by a fall on the hand,

or forwards by a fall on the point of the elbow. In both cases it is reduced by bending steadily across the knee of

FIG. 147.—Dislocation of the forearm bones backwards at the elbow. The prominence in front of the elbow is due to the lower end of the humerus. (Miller's *Surgery*.)

the operator, who at the same time pulls on the forearm.

WRIST.—This joint is seldom dislocated, and the dislocation is readily replaced by pressure, and is then kept in position by a well-padded splint on the palm and front of forearm. A fracture of the lower end of the radius (Colles's fracture) is sometimes mistaken for a dislocated wrist.

FINGERS AND TOES may be dislocated and are difficult to reduce, because the tight ligaments close round the displaced bone, and because of the difficulty in grasping the finger to pull on it. This may be overcome by winding strips of sticking-plaster round the finger, or by a device of interlacing tapes known as the 'Indian puzzle'. Dislocation of the thumb at its base is particularly hard to reduce, and may even require an operation to enlarge the opening through which the bone has passed.

HIP.—This joint, being extremely strong, is seldom dislocated, and, when dislocated, is very difficult to reduce. The head of the thigh bone usually passes backwards and upwards, so that the limb appears much shortened and the toes turned inward. Reduction is effected by a special form of manipulation, or, failing this, by extension. For the latter, the injured person lying on his back, the limb is pulled straight downwards, one assistant steadying the pelvis by pressing one of his hands upon each iliac spine, and another pulling the whole thigh outwards by means of a towel passed round it as high up as possible. A very steady, powerful pull is necessary if reduction is to be effected.

KNEE.—This joint is very seldom dislocated, and such an injury to it is specially severe, being accompanied by the tearing of strong ligaments.

ANKLE.—This joint is hardly ever dislocated, most severe injuries near it being fractures of the leg bones.

SPINE.—Dislocation of the spine is only produced by great violence, such as that of a horse rolling over a man, and is usually combined with fracture. Very often pressure on or tearing of the spinal cord takes place, which may produce paralysis of the lower limbs, or even death from shock.

JAW.—This joint is sometimes dislocated forwards when the mouth is very widely opened, as in yawning or singing. It can usually be replaced by a person pressing downwards with his thumbs upon the farthest back teeth and at the same time pressing up the chin. He should take care that his thumbs do not get bitten.

DISORIENTATION is a term applied to a symptom in mental disease or delirium in which the patient is confused as to sense of time or place.

DISPLACEMENT is a term used in psychological medicine to describe the mental process of attaching to one object painful emotions associated with another object.

DISSEMINATED SCLEROSIS (*disseminо*, I scatter about; *σκληρός*, hard), also called MULTIPLE and INSULAR SCLEROSIS, is a disease of the brain and spinal cord, which, though slow in its onset, produces marked symptoms, such as paralysis and tremors,

and renders persons suffering from it confirmed invalids in the course of a few years. It consists of hardened patches, from the size of a pin-head to that of a pea or larger, scattered here and there irregularly through the brain and cord, each patch being made up of a mass of the connective tissue (neuroglia), which should be present only in sufficient amount to bind the nerve-cells and fibres together. In the earliest stage, the insulating sheaths of the nerve fibres in the hardened patches break up, are absorbed, and leave the nerve-fibres bare, the connective tissue being later formed between these.

Causes.—These are very obscure, for the disease comes on in young people (being rare after the age of forty), apparently without previous illness; and though it occurs sometimes in persons with a heredity of nervous disorder, this is not always so. The actual changes in the nervous system appear to be due to the action of some substance which dissolves or breaks up the fatty matter of the nerve-sheaths.

Symptoms.—These depend greatly upon the part of the brain and cord affected by the sclerotic patches. Very often the disease is preceded by some 'hysterical' manifestations, and may show no other sign for several years. Temporary paralysis of a limb, or of an eye muscle, causing double vision, and tremors upon exertion, first in the affected parts, and later in all parts of the body, are early symptoms. Stiffness of the lower limbs causing the toes to catch on small irregularities in the ground and trip the person in walking, is frequently an annoying symptom and one of the first to be noticed. Great activity is shown in the reflex movements obtained by striking the tendons and by stroking the soles of the feet. The latter reflex shows a characteristic sign (Babinski sign) in which the great toe bends upwards and the other toes spread apart as the sole is stroked, instead of the toes collectively bending downwards as in the normal person. Tremor of the eye movements (nystagmus) is usually found. Trembling handwriting, interference with the functions of the bladder, giddiness, a peculiar 'staccato' or 'scanning' speech, and various peculiarities of sensation—*e.g.* numbness, prickly feelings, hot flushes—are common symptoms at a later stage. As the disease progresses, these become marked, epileptiform fits may appear, mental dullness, or more serious insanity sometimes comes on, and the paralyses, which were before transitory, now become confirmed, often with great rigidity in the limbs. Many cases progress very slowly and show little or no tendency to shortening of the duration of life.

Treatment is unsatisfactory, because the most that can be done is, by means of careful dieting, tonics, plenty of sleep, and especially by leading a life as free from strain as possible, to check the progress rather than to effect a cure of the disease. It is important to keep the nerves and muscles functioning and therefore the patient should remain at his work as long as he is capable of doing it, and in any case should regularly exercise the lower limbs by walking and the upper limbs by carrying out movements requiring co-ordination such as knitting or embroidery. In some cases protein shock by injections of peptone or anti-typhoid vaccine in doses sufficient to produce a moderate rise of temperature may help (*see* PROTEIN SHOCK). Injections of liver extract, arsenic, liver, and vitamin B1 have also been recommended.

DISTEMPER is the name applied to several infectious diseases of animals, especially a contagious catarrhal disease affecting young dogs caused by a filter-passing virus.

DISTICHIASIS is the term applied to the condition in which there are two complete rows of eyelashes in one eyelid (or in both).

DISTOMA (δίς, twice; στόμα, mouth) is a general term including various forms of trematodes or fluke worms parasitic in the intestine, lung, and other organs.

DIURETICS (διά, through; οὐρέω, I pass water) are substances which produce diuresis, that is, a copious excretion of urine by the kidneys.

Varieties.—Unirritating watery fluids —*e.g.* milk, lemonade—are rapidly excreted. Substances which dilate the kidney arteries, as alcohol, spirit of nitrous ether, and salts of the alkalies,

especially potassium salts, which disturb the composition of the blood and are accordingly quickly discharged from the body, have a diuretic action. Substances which irritate the kidneys act in small amount as stimulants to their function; for example, oil of turpentine, oil of juniper, cantharides, caffeine, diuretin. Substances which increase the force of the heart, and so the blood-pressure, act under certain conditions in this way also; for example, digitalis, strophanthus, squills, infusion of broomtops.

Uses.—Diuretics are given, as in dropsy, to diminish the amount of fluid in the blood and so in the body; and to remove waste solid matter in solution. In the former case, drugs of the digitalis group are given if the dropsy results from heart disease, while that from kidney trouble is treated according to circumstance. In febrile conditions, and when there is a tendency to the accumulation of uric acid or other waste products in the system, diuretics which render the urine more watery, particularly the saline diuretics, are administered.

DIURETIN is the salicylate of theobromine and soda, and, being a powerful diuretic, is much used for the treatment of dropsy due to kidney insufficiency.

DIVERTICULUM (*diverto*, I turn aside) means a pouch or pocket leading off a main cavity or tube. The term is especially applied to protrusions from the intestine, which may be either present at the time of birth as a developmental peculiarity, or which in some cases develop in numbers upon the large intestine during the course of life, leading to constipation and general symptoms arising from absorption of poisonous products. The process of formation of these pockets is known as diverticulosis, and inflammation of them as diverticulitis.

DIZZINESS (*see* VERTIGO).

DOLANTAL (*see* PETHIDINE).

DOLICHOCEPHALIC means long-headed and is a term applied to skulls the breadth of which is less than four-fifths of the length.

DONOR is the term applied in medicine to anyone who gives his blood for transfusion to another; also often known as blood-donor.

DORYL (*see* CARBACHOL).

DOSAGE.—The quantity of medicine given in one dose must vary considerably in different circumstances. Many drugs produce one effect when given in small amount, and quite another effect when administered in larger quantity; thus tartarated antimony in fractional doses of a grain causes merely profuse perspiration, while one or two grains act as an emetic.

Many factors, however, influence the activity with which drugs of very definite effect operate; and instead of having a fixed dose each drug varies in the amount given, according to circumstances, within certain recognised limits. Among the factors which affect the necessary quantity are age, weight, sex, idiosyncrasy, habitual use, disease, fasting, combination with other drugs, and the form in which the drug is given.

Age is perhaps the most important factor of all, for naturally a young child requires a smaller dose than an adult. Again, some of the most potent remedies, such as opium and strychnine, are borne by children very badly. On the other hand, children require nearly the full adult dose of some remedies like arsenic, calomel, belladonna, ipecacuanha, and most purgatives. Various devices have been introduced for calculating roughly and quickly the dose generally suitable for a child of any given age. Of these the simplest is *Cowling's Rule*, according to which one divides the child's age at next birthday by the number 24; the resulting fraction gives the portion of the adult dose required.

According to *Young's Rule* the fraction of the adult dose is measured by dividing the child's age by the age increased by 12.

Very few drugs are suitable for administration to infants before the age of one year; some, as already stated, should be avoided all through childhood; while in the case of others much larger doses than those indicated by the above table must be given to produce any effect.

Weight and Sex are of importance, for, as a rule, women require slightly smaller doses than men, while naturally

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Acacia mucilage	60-240 minims	4-16 mils
Acetic acid, diluted	30-60 minims	2-4 mils
Adrenalin (by injection)	$\frac{1}{600}$-$\frac{1}{120}$ grain	0·0001-0·0005 grm.
Adrenalin hydrochloride liquor (by injection)	2-8 minims	0·12-0·5 mil
Agar	60-240 grains	4-16 grm.
Almond oil	½-1 fluid ounce	15-30 mils
Aloes	2-5 grains	0·12-0·3 grm.
Aloes pill	4-8 grains	0·25-0·5 grm.
Aloes and asafœtida pill	4-8 grains	0·25-0·5 grm.
Aloes and iron pill	4-8 grains	0·25-0·5 grm.
Aloin	½-1 grain	0·015-0·06 grm.
Alum	5-10 grains	0·3-0·6 grm.
Amidopyrine (Pyramidon)	5-10 grains	0·3-0·6 grm.
Ammonia, aromatic spirit of	15-60 minims	1-4 mils
Ammonia liquor, diluted	10-20 minims	0·6-1·2 mils
Ammonium acetate liquor, diluted	½-1 fluid ounce	8-30 mils
Ammonium acetate liquor, strong	15-60 minims	1-4 mils
Ammonium bicarbonate	5-10 grains	0·3-0·6 grm.
Ammonium carbonate	5-10 grains	0·3-0·6 grm.
Ammonium chloride	5-60 grains	0·3-4 grm.
Amyl nitrite (by inhalation)	2-5 minims	0·12-0·3 mil
Amylocaine hydrochloride	½-¼ grain	0·02-0·05 grm.
Amylocaine hydrochloride (by spinal injection)	½-1½ grains	0·02-0·1 grm.
Anise oil	1-3 minims	0·06-0·2 mil
Antimony and potassium tartrate	$\frac{1}{32}$-⅛ grain	0·002-0·008 grm.
Antimony and potassium tartrate (as emetic)	½-1 grain	0·03-0·06 grm.
Antimony and potassium tartrate (by injection)	½-2 grains	0·03-0·12 grm.
Antimony and sodium tartrate	$\frac{1}{32}$-⅛ grain	0·002-0·008 grm.
Antimony and sodium tartrate (as emetic)	½-1 grain	0·03-0·06 grm.
Antimony and sodium tartrate (by injection)	½-2 grains	0·03-0·12 grm.
Antipyrin	5-10 grains	0·3-0·6 grm.
Apomorphine hydrochloride	$\frac{1}{64}$-$\frac{1}{32}$ grain	0·001-0·002 grm.
Apomorphine hydrochloride (as emetic)	$\frac{1}{32}$-⅛ grain	0·002-0·008 grm.
Arachis (pea-nut) oil	½-1 fluid ounce	15-30 mils
Arsenic liquor (Fowler's solution)	2-8 minims	0·12-0·5 mil
Arsenic and mercury iodide liquor	5-15 minims	0·3-1 mil
Arsenic triiodide	$\frac{1}{128}$-¼ grain	0·004-0·016 grm.
Arsenic trioxide	$\frac{1}{60}$-$\frac{1}{120}$ grain	0·001-0·005 grm.
Asafœtida	5-15 grains	0·3-1 grm.
Asafœtida tincture	30-60 minims	2-4 mils
Aspirin	5-15 grains	0·3-1 grm.
Atropine	$\frac{1}{240}$-$\frac{1}{60}$ grain	0·00025-0·001 grm.
Atropine sulphate	$\frac{1}{240}$-$\frac{1}{100}$ grain	0·00025-0·001 grm.
Balsam of Peru	5-15 minims	0·3-1 mil
Balsam of Tolu	5-15 grains	0·3-1 grm.
Barbitone	5-10 grains	0·3-0·6 grm.
Barbitone, soluble	5-10 grains	0·3-0·6 grm.
Belladonna dry extract	¼-1 grain	0·015-0·06 grm.
Belladonna liquid extract	¼-1 minim	0·015-0·06 mil
Belladonna, powdered	½-3 grains	0·03-0·2 grm.
Belladonna root	½-2 grains	0·03-0·12 grm.

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Belladonna tincture	5-30 minims	0·3-2 mils
Benzocaine	5-10 grains	0·3-0·6 grm.
Benzoic acid	5-15 grains	0·3-1 grm.
Benzoin	10-30 grains	0·6-2 grm.
Benzoin compound tincture	30-60 minims	2-4 mils
Betanaphthol	5-10 grains	0·3-0·6 grm.
Bile extract	5-15 grains	0·3-1 grm.
Bismuth carbonate	10-30 grains	0·6-2 grm.
Bismuth injection	8-15 minims	0·5-1 mil
Bismuth salicylate injection	10-20 minims	0·6-1·2 mils
Bismuth, precipitated (by injection)	1½-3 grains	0·1-0·2 grm.
Bismuth salicylate	10-30 grains	0·6-2 grm.
Bismuth salicylate (by injection)	1-2 grains	0·06-0·12 grm.
Blaud's pill	5-30 grains	0·3-2 grm.
Blue pill	4-8 grains	0·25-0·5 grm.
Borax	5-15 grains	0·3-1 grm.
Boric acid	5-15 grains	0·3-1 grm.
Buchu concentrated infusion	60-120 minims	4-8 mils
Buchu fresh infusion	1-2 fluid ounces	30-60 mils
Caffeine	2-5 grains	0·12-0·3 grm.
Caffeine and sodium benzoate	5-15 grains	0·3-1 grm.
Caffeine and sodium benzoate (by injection)	2-5 grains	0·12-0·3 grm.
Cajuput oil	1-3 minims	0·06-0·2 mil
Cajuput spirit	5-30 minims	0·3-2 mils
Calcium carbonate	15-60 grains	1·4 grm.
Calcium chloride	10-30 grains	0·6-2 grm.
Calcium chloride (by intramuscular injection)	½-1½ grains	0·03-0·1 grm.
Calcium chloride (by intravenous injection)	5-15 grains	0·3-1 grm.
Calcium hydroxide	5-15 grains	0·3-1 grm.
Calcium hydroxide liquor	1-4 fluid ounces	30-120 mils
Calcium lactate	15-60 grains	1-4 grm.
Calcium phosphate	10-30 grains	0·6-2 grm.
Calomel	½-3 grains	0·03-0·2 grm.
Calumba	10-30 grains	0·6-2 grm.
Calumba concentrated infusion	30-60 minims	2-4 mils
Calumba fresh infusion	½-1 fluid ounces	15-30 mils
Calumba tincture	30-60 minims	2-4 mils
Camphor	2-5 grains	0·12-0·3 grm.
Camphor (by injection)	1-3 grains	0·06-0·2 grm.
Camphor spirit	5-30 minims	0·3-2 mils
Camphor water	½-1 fluid ounce	·15-30 mils
Capsicum	½-2 grains	0·03-0·12 grm.
Capsicum tincture	5-15 minims	0·3-1 mil
Caraway	10-30 grains	0·6-2 grm.
Caraway oil	1-3 minims	0·06-0·2 mil
Carbolic acid	1-3 grains	0·06-0·2 grm.
Carbolic acid, liquefied	1-3 minims	0·06-0·2 mil
Carbon tetrachloride	30-60 minims	2-4 mils
Carbromal	5-15 grains	0·3-1 grm.
Cardamoms	10-30 grains	0·6-2 grm.
Cardamoms compound tincture	30-60 minims	2-4 mils
Cascara sagrada	20-60 grains	1·2-4 grm.
Cascara sagrada elixir	30-60 minims	2-4 mils
Cascara sagrada dry extract	2-8 grains	0·12-0·5 grm.

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Cascara sagrada liquid extract	30-60 minims	2-4 mils
Castor oil	60-240 minims	4-16 mils
Cassia	60-120 grains	4-8 grm.
Catechu	5-15 grains	0·3-1 grm.
Catechu tincture	30-60 minims	2-4 mils
Chalk	15-60 grains	1-4 grm.
Chalk aromatic powder	10-60 grains	0·6-4 grm.
Chalk aromatic powder with opium	10-60 grains	0·6-4 grm.
Chalk mixture	½-1 fluid ounce	15-30 mils
Chenopodium oil	3-15 minims	0·2-1 mil
Cherry, wild	15-30 grains	1-2 grm.
Cherry, wild, syrup	30-120 minims	2-8 mils
Chloral hydrate	5-20 grains	0·3-1·2 grm.
Chlorbutol (Chloretone)	5-20 grains	0·3-1·2 grm.
Chloroform	1-5 minims	0·06-0·3 mil
Chloroform spirit	5-30 minims	0·3-2 mils
Chloroform water	½-1 fluid ounce	15-30 mils
Cinchona	5-15 grains	0·3-1 grm.
Cinchona extract	2-8 grains	0·12-0·5 grm.
Cinchona liquid extract	5-15 minims	0·3-1 mil
Cinchona compound tincture	30-60 minims	2-4 mils
Cinchona tincture	30-60 minims	2-4 mils
Cinchophenum (Atophan)	5-10 grains	0·3-0·6 grm.
Cinnamon	5-20 grains	0·3-1·2 grm.
Cinnamon concentrated water	5-15 minims	0·3-1 mil
Cinnamon distilled water	½-1 fluid ounce	15-30 mils
Cinnamon oil	1-3 minims	0·06-0·2 mil
Citric acid	5-30 grains	0·3-2 grm.
Clove	2-5 grains	0·12-0·3 grm.
Clove concentrated infusion	30-60 minims	2-4 mils
Clove fresh infusion	½-1 fluid ounce	15-30 mils
Clove oil	1-3 minims	0·06-0·02 mils
Coal-tar, liquid	2-10 grains	0·12-0·6 grm.
Cocaine	⅛-¼ grain	0·008-0·016 grm.
Cocaine hydrochloride	⅛-¼ grain	0·008-0·016 grm.
Cochineal tincture	5-15 minims	0·3-1 mil
Cod liver oil	30-120 minims	2-8 mils
Codeine	¼-1 grain	0·016-0·06 grm.
Codeine phosphate	¼-1 grain	0·016-0·06 grm.
Colchicum bulb	2-5 grains	0·12-0·3 grm.
Colchicum dry extract	¼-1 grain	0·015-0·06 grm.
Colchicum liquid extract	2-5 minims	0·12-0·3 mil
Colchicum seed	2-5 grains	0·12-0·3 grm.
Colchicum tincture	5-15 minims	0·3-1 mil
Colocynth	2-5 grains	0·12-0·3 grm.
Colocynth compound extract	2-8 grains	0·12-0·5 grm.
Colocynth and hyoscyamus pill	4-8 grains	0·25-0·5 grm.
Copaiba	10-30 minims	0·6-2 mils
Copper sulphate	¼-2 grains	0·016-0·12 grm.
Copper sulphate (as emetic)	5-10 grains	0·3-0·6 grm.
Coriander	5-15 grains	0·3-1 grm.
Coriander oil	1-3 minims	0·06-0·2 mil
Cottonseed oil	½-1 fluid ounce	15-30 mils
Creosote	2-10 minims	0·12-0·6 mil
Cresol	1-3 minims	0·06-0·2 mil
Croton oil	½-1 minim	0·03-0·06 mil
Diamorphine hydrochloride	1/24-⅛ grain	0·0025-0·008 grm.

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Digitalis fresh infusion	90-300 minims	6-20 mils
Digitalis fresh infusion (as single dose)	1-4 fluid ounces	30-120 mils
Digitalis, powdered	½-1½ grains	0·03-0·1 grm.
Digitalis, powdered (as single dose)	3-10 grains	0·2-0·6 grm.
Digitalis tincture	5-15 minims	0·3-1 mil
Digitalis tincture (as single dose)	30-90 minims	2-6 mils
Dill concentrated water	5-15 minims	0·3-1 mil
Dill distilled water	½-1 fluid ounce	15-30 mils
Dill oil	1-3 minims	0·06-0·2 mil
Dover's powder	5-10 grains	0·3-0·6 grm.
Emetine and bismuth iodide	1-3 grains	0·06-0·2 grm.
Emetine hydrochloride (by injection)	½-1 grain	0·03-0·06 grm.
Ephedrine hydrochloride	¼-1½ grains	0·016-0·1 grm.
Epsom salts	30-240 grains	2-16 grm.
Ergosterol irradiated liquor (preventive)	5-15 minims	0·3-1 mil
Ergosterol irradiated liquor (curative)	25-50 minims	1·5-3 mils
Ergot liquid extract	10-20 minims	0·6-1·2 mils
Ergot, prepared	5-15 grains	0 3-1 grm.
Ergotoxine ethanesulphonate	$\frac{1}{120}$-$\frac{1}{60}$ grain	0·0005-0·001 grm.
Erythrityl tetranitrate, diluted	½-2 grains	0·03-0·12 grm.
Ether	15-60 minims	1-4 mils
Ether nitrous spirit	15-60 minims	1-4 mils
Ether spirit	15-60 minims	1-4 mils
Eucalyptol	1-3 minims	0·06-0·2 mil
Eucalyptus oil	1-3 minims	0·06-0·2 mil
Fennel	5-10 grains	0·3-0·6 grm.
Fern, male	60-180 grains	4-12 grm.
Fern, male, extract	45-90 minims	3-6 mils
Gentian	10-30 grains	0·6-2 grm.
Gentian extract	2-8 grains	0·12-0·5 grm.
Gentian concentrated compound infusion	30-60 minims	2 4 mils
Gentian fresh compound infusion	½-1 fluid ounce	15-30 mils
Gentian compound tincture	30-60 minims	2-4 mils
Ginger	5-15 grains	0·3-1 grm.
Ginger syrup	30-120 minims	2-8 mils
Ginger tincture, strong	5-10 minims	0·3-0·6 mil
Ginger tincture, weak	30-60 minims	2-4 mils
Glauber's salt	30-240 grains	2-16 grm.
Glycerin	60-120 minims	4-8 mils
Glycerin of alum	30-60 minims	2-4 mils
Glycerin of borax	30-60 minims	2-4 mils
Glycerin of boric acid	10-30 minims	0·6-2 mils
Glycerin of phenol	5-15 minims	0·3-1 mil
Glycerin of tannic acid	10-30 minims	0·6-2 mils
Glyceryl trinitrate liquor	½-2 minims	0·03-0·12 mil
Gregory's powder	10-60 grains	0·6-4 grm.
Grey powder	1-5 grains	0·06-0·3 grm.
Guaiacol	5-10 minims	0·3-0·6 mil
Hamamelis liquid extract	30-60 minims	2-4 mils
Hexamine	10-30 grains	0·6-2 grm
Homatropine hydrobromide	$\frac{1}{60}$-$\frac{1}{30}$ grain	0·001-0·002 grm.
Hydnocarpus oil	5-15-60 minims	0·3-1-4 mils
Hydnocarpus oil (by injection)	30-75 minims	2-5 mils

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Hydrobromic acid, diluted	15-60 minims	1-4 mils
Hydrochloric acid, diluted	5-60 minims	0·3-4 mils
Hydrocyanic acid, diluted	2-5 minims	0·12-0·3 mil
Hydrogen peroxide liquor	30-120 minims	2-8 mils
Hyoscine hydrobromide	$\frac{1}{100}$-$\frac{1}{100}$ grain	0·0003-0·0006 grm.
Hyoscyamus	3-6 grains	0·2-0·4 grm.
Hyoscyamus dry extract	¼-1 grain	0·016-0·06 grm.
Hyoscyamus liquid extract	3-6 minims	0·2-0·4 mil
Hyoscyamus tincture	30-60 minims	2-4 mils
Hypophosphorous acid, diluted	5-15 minims	0·3-1 mil
Ichthammol	5-10 grains	0·3-0·6 grm.
Indigo carmine (by intramuscular injection)	½-1½ grains	0·05-0·1 grm.
Indigo carmine (by intravenous injection)	¼-½ grain	0·008-0·016 grm.
Insulin (by injection)	5-100 units	
Iodide of iron syrup	30-120 minims	2-8 mils
Iodine liquor, weak	5-30 minims	0·3-2 mils
Iodine liquor, simple	3-15 minims	0·2-1 mil
Iodoform	½-3 grains	0·03-0·2 grm.
Iodophthalein	Up to 75 grains	Up to 5 grm.
Iodophthalein (by intravenous injection)	Up to 45 grains	Up to 3 grm.
Ipecacuanha liquid extract	½-2 minims	0·03-0·12 mil
Ipecacuanha liquid extract (as emetic)	10-30 minims	0·6-2 mils
Ipecacuanha, powdered	½-2 grains	0·03-0·12 grm.
Ipecacuanha, powdered (as emetic)	15-30 grains	1-2 grm.
Ipecacuanha and opium powder	5-10 grains	0·3-0·6 grm.
Ipecacuanha tincture	10-30 minims	0·6-2 mils
Ipecacuanha tincture (as emetic)	½-1 fluid ounce	15-30 mils
Ipecacuanha wine (as expectorant)	10-30 minims	0·6-2 mils
Ipecacuanha wine (as emetic)	½-1 fluid ounce	15-30 mils
Ipomœa	5-20 grains	0·3-1·2 grm.
Iron carbonate, saccharated	10-30 grains	0·6-2 grm.
Iron and ammonium citrate	5-15 grains	0·3-1 grm.
Iron and quinine citrate	5-15 grains	0·3-1 grm.
Iron injection	15-30 minims	1-2 mils
Iron perchloride liquor	5-15 minims	0·3-1 mil
Iron reduced	1-10 grains	0·06-0·6 grm.
Iron sulphate	1-5 grains	0·06-0·3 grm.
Iron sulphate, dried	½-3 grains	0·03-0·2 grm.
Iron iodide syrup	30-120 minims	2-8 mils
Jalap, powdered	5-20 grains	0·3-1·2 grm.
Jalap compound powder	10-60 grains	0·6-4 grm.
Kaolin	½-2 ounces	15-60 grm.
Krameria	10-30 grains	0·6-2 grm.
Krameria dry extract	5-15 grains	0·3-1 grm.
Krameria tincture	30-60 minims	2-4 mils
Lactic acid	5-20 minims	0·3-1·2 mils
Laudanum	5-30 minims	0·3-2 mils
Lavender oil	1-3 minims	0·06-0·2 mil
Lead acetate	½-2 grains	0·03-0·12 grm.
Lemon oil	1-3 minims	0·06-0·2 mil

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Lemon syrup	30-120 minims	2-8 mils
Lemon tincture	30-60 minims	2-4 mils
Lime water	1-4 fluid ounces	30-120 mils
Linseed oil	½-1 fluid ounce	15-30 mils
Liquorice	15-60 grains	1-4 grm.
Liquorice extract	10-30 grains	0·6-2 grm.
Liquorice liquid extract	30-60 minims	2-4 mils
Liquorice compound powder	60-120 grains	4-8 grm.
Liver extract, dry	Equivalent of ½ lb. liver	Equivalent of 225 grm. liver
Liver extract, liquid	1 fluid ounce	30 mils
Lobelia	1-3 grains	0·06-0·2 grm.
Lobelia ethereal tincture	5-15 minims	0·3-1 mil
Luminal	½-2 grains	0·03-0·12 grm.
Magnesium bicarbonate liquor	1-2 fluid ounces	30-60 mils
Magnesium carbonate, light	10-60 grains	0·6-4 grm.
Magnesium carbonate, heavy	10-60 grains	0·6-4 grm.
Magnesium hydroxide mixture	60-240 minims	4-16 mils
Magnesium oxide, light	10-60 grains	0·6-4 grm.
Magnesium oxide, heavy	10-60 grains	0·6-4 grm.
Magnesium sulphate	30-240 grains	2-16 grm.
Malt extract	60-240 minims	4-16 mils
Malt extract with cod liver oil	60-240 minims	4-16 mils
Menthol	½-2 grains	0·03-0·12 grm.
Mercury	½-3 grains	0·03-0·2 grm.
Mercury (by injection)	½-1 grain	0·03-0·06 grm.
Mercury with chalk	1-5 grains	0·06-0·3 grm.
Mercury injection	5-10 minims	0·3-0·6 mil
Mercury subchloride injection	10-20 minims	0·6-1·2 mils
Mercury oxycyanide (by intramuscular injectiou)	$\frac{1}{12}$-¼ grain	0·005-0·01 grm.
Mercury oxycyanide (by intravenous injection)	¼ grain	0·01 grm.
Mercury perchloride	$\frac{1}{120}$-$\frac{1}{15}$ grain	0·002-0·004 grm.
Mercury perchloride liquor	30-60 minims	2-4 mils
Mercury pill	4-8 grains	0·25-0·5 grm.
Mercury red iodide	$\frac{1}{120}$-$\frac{1}{10}$ grain	0·002-0·004 grm.
Mercury subchloride	½-3 grains	0·03-0·2 grm.
Mercury subchloride (by injection)	½-1 grain	0·03-0·06 grm.
Methyl salicylate	5-15 minims	0·3-1 mil
Methylsulphonal	5-20 grains	0·3-1·2 grm.
Methylthionin chloride	1-5 grains	0·06-0·3 grm.
Morphine hydrochloride	⅛-¼ grain	0·008-0·02 grm.
Morphine hydrochloride liquor	5-30 minims	0·3-2 mils
Morphine tartrate	⅛-¼ grain	0·008-0·02 grm.
Myrrh	5-15 grains	0·3-1 grm.
Myrrh tincture	30-60 minims	2-4 mils
Neoarsphenamine (by injection)	2½-14 grains	0·15-0·9 grm.
Nitroglycerin tablets, 1-2 tablets	$\frac{1}{120}$ grain	0·0005 grm.
Nitrous ether spirit	15-60 minims	1-4 mils
Nutmeg	5-10 grains	0·3-0·6 grm.
Nutmeg oil	1-3 minims	0·06-0·2 mil
Nux vomica dry extract	½-1 grain	0·015-0·06 grm.
Nux vomica liquid extract	1-3 minims	0·06-0·2 mil
Nux vomica, powdered	1-4 grains	0·06-0·25 grm.
Nux vomica tincture	10-30 minims	0·6-2 mils

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Oleic acid	5-15 minims	0·3-1 mil
Olive oil	½-1 fluid ounce	15-30 mils
Opium dry extract	¼-1 grain	0·015-0·06 grm.
Opium, powdered	½-3 grains	0·03-0·2 grm.
Opium tincture	5-30 minims	0·3-2 mils
Opium tincture, camphorated	30-60 minims	2-4 mils
Orange concentrated infusion	30-60 minims	2-4 mils
Orange fresh infusion	½-1 fluid ounce	15-30 mils
Orange syrup	30-120 minims	2-8 mils
Orange tincture	30-60 minims	2-4 mils
Orthocaine	1½-3 grains	0·1-0·2 grm.
Oxymel	30-120 minims	2-8 mils
Oxymel of squill	30-60 minims	2-4 mils
Pancreatin	3-10 grains	0·2-0·6 grm.
Paraffin, liquid	½-1 fluid ounce	7·5-30 mils
Paraldehyde	30-120 minims	2-8 mils
Paregoric	30-60 minims	2-4 mils
Pelletierine tannate	2-8 grains	0·12-0·5 grm.
Peppermint oil	1-3 minims	0·06-0·2 mil
Peppermint spirit	5-30 minims	0·3-2 mils
Peppermint concentrated water	5-15 minims	0·3-1 mil
Peppermint distilled water	½-1 fluid ounce	15-30 mils
Pepsin	5-10 grains	0·3-0·6 grm.
Perchloride of iron liquor	5-15 minims	0·3-1 mil
Permanganate of potassium	1-3 grains	0·06-0·2 grm.
Peroxide of hydrogen liquor	30-120 minims	2-8 mils
Phenacetin	5-10 grains	0·3-0·6 grm.
Phenazone	5-10 grains	0·3-0·6 grm.
Phenobarbitone (Luminal)	½-2 grains	0·03-0·12 grm.
Phenobarbitone, soluble	½-2 grains	0·03-0·12 grm.
Phenolphthalein	1-5 grains	0·06-0·3 grm.
Phosphoric acid, diluted	5-60 minims	0·3-4 mils
Physostigmine salicylate	$\frac{1}{100}$-$\frac{1}{60}$ grain	0 0006-0·0012 grm.
Pilocarpine nitrate	$\frac{1}{120}$-$\frac{1}{8}$ grain	0·003-0·012 grm.
Pituitary liquid extract	2-5 units	0·2-0·5 mil
Podophyllum	2-10 grains	0·12-0·6 grm.
Podophyllum indicum	2-10 grains	0·12-0·6 grm.
Podophyllum resin	¼-1 grain	0·015-0·06 grm.
Potassium bicarbonate	15-60 grains	1-4 grm.
Potassium bromide	5-30 grains	0·3-2 grm.
Potassium acetate	15-60 grains	1-4 grm.
Potassium acid tartrate	15-60 grains	1-4 grm.
Potassium carbonate	2-5 grains	0·12-0·3 grm.
Potassium chlorate	5-10 grains	0·3-0·6 grm.
Potassium citrate	15-60 grains	1-4 grm.
Potassium iodide	5-30 grains	0·3-2 grm.
Potassium nitrate	5-15 grains	0·3-1 grm.
Potassium permanganate	1-3 grains	0·06-0·2 grm.
Procaine hydrochloride (Novocain)	½-2 grains	0·03-0 12 grm.
Procaine hydrochloridr (by subcutaneous injection)	Up to 15 grains	Up to 1 grm.
Procaine hydrochloride (by spinal injection)	Up to 2½ grains	Up to 0·15 grm.
Quassia	2-8 grains	0·12-0·5 grm.
Quassia concentrated infusion	30-60 minims	2-4 mils
Quassia fresh infusion	½-1 fluid ounce	15-30 mils

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Quassia tincture	30-60 minims	2-4 mils
Quillaia	1-3 grains	0·06-0·2 grm.
Quillaia tincture	30-60 minims	2-4 mils
Quinidine sulphate	3-10 grains	0·2-0·6 grm.
Quinine bisulphate	1-10 grains	0·06-0·6 grm.
Quinine dihydrochloride	1-10 grains	0·06-0·6 grm.
Quinine dihydrochloride (by injection)	5-10 grains	0·3-0·6 grm.
Quinine ethyl carbonate	1½-15 grains	0·1-1 grm.
Quinine hydrochloride	1-10 grains	0·06-0·6 grm.
Quinine ammoniated liquor	30-60 minims	2-4 mils
Quinine sulphate	1-10 grains	0·06-0·6 grm.
Quinine tannate	1½-15 grains	0·1-1 grm.
Resorcinol	1-5 grains	0·06-0·3 grm.
Rhubarb	3-15 grains	0·2-1 grm.
Rhubarb compound pill	4-8 grains	0·25-0·5 grm.
Rhubarb compound powder	10-60 grains	0·6-4 grm.
Rhubarb compound tincture	30-60 minims	2-4 mils
Rosemary oil	1-3 minims	0·06-0·2 mil
Saccharin, soluble	½-2 grains	0·03-0·12 grm.
Salicin	5-15 grains	0·3-1 grm.
Salicylate of sodium	10-30 grains	0·6-2 grm.
Salicylic acid	5-10 grains	0·3-0·6 grm.
Sal volatile spirit	15-60 minims	1-4 mils
Sandalwood oil	5-15 minims	0·3-1 mil
Sandalwood oil, Australian	5-15 minims	0·3-1 mil
Santonin	1-3 grains	0·06-0·2 grm.
Scammony resin	½-3 grains	0·03-0·2 grm.
Senega	6-12 grains	0·4-0·8 grm.
Senega liquid extract	5-15 minims	0·3-1 mil
Senega concentrated infusion	30-60 minims	2-4 mils
Senega fresh infusion	½-1 fluid ounce	15-30 mils
Senega tincture	30-60 minims	2-4 mils
Senna confection	60-120 grains	4-8 grm.
Senna liquid extract	10-30 minims	0·6-2 mils
Senna fruit	10-30 grains	0·6-2 grm.
Senna concentrated infusion	30-60 minims	2-4 mils
Senna fresh infusion	½-2 fluid ounces	15-60 mils
Senna leaf	10-30 grains	0·6-2 grm.
Senna compound mixture	1-2 fluid ounces	30-60 mils
Senna syrup	30-120 minims	2-8 mils
Serpentaria	½-1½ grains	0·05-0·1 grm.
Sesame oil	½-1 fluid ounce	15-30 mils
Silver nitrate	¼-½ grain	0·008-0·016 grm.
Sodium benzoate	5-30 grains	0·3-2 grm.
Sodium bicarbonate	15-60 grains	1-4 grm.
Sodium bromide	5-30 grains	0·3-2 grm.
Sodium carbonate	5-15 grains	0·3-1 grm.
Sodium carbonate, dried	2-5 grains	0·12-0·3 grm.
Sodium citrate	15-60 grains	1-4 grm.
Sodium iodide	5-30 grains	0·3-2 grm.
Sodium nitrite	½-2 grains	0·03-0·12 grm.
Sodium phosphate	30-240 grains	2-16 grm.
Sodium acid phosphate	30-60 grains	2-4 grm.
Sodium effervescent phosphate	60-240 grains	4-16 grm.

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Sodium and potassium tartrate	120-240 grains	8-16 grm.
Sodium salicylate	10-30 grains	0·6-2 grm.
Sodium sulphate	30-240 grains	2-16 grm.
Sodium effervescent sulphate	60-240 grains	4-16 grm.
Squill	1-3 grains	0·06-0·2 grm.
Squill oxymel	30-60 minims	2-4 mils
Squill syrup	30-60 minims	2-4 mils
Squill tincture	5-30 minims	0·3-2 mils
Squill vinegar	10-30 minims	0·6-2 mils
Storax	10-30 grains	0·6-2 grm.
Stramonium	½-3 grains	0·03-0·2 grm.
Stramonium tincture	5-30 minims	0·3-2 mils
Strophanthin (by injection)	$\frac{1}{240}$-$\frac{1}{60}$ grain	0·00025-0·001 grm.
Strophanthus tincture	2-5 minims	0·12-0·3 mil
Strychnine hydrochloride	$\frac{1}{30}$-$\frac{1}{15}$ grain	0·002-0·008 grm.
Strychnine hydrochloride liquor	3-12 minims	0·2-0·8 mil
Sulpharsphenamine (by injection)	1½-10 grains	0·1-0·6 grm.
Sulphonal	5-20 grains	0·3-1·2 grm.
Sulphur confection	60-120 grains	4-8 grm.
Sulphur, precipitated	15-60 grains	1-4 grm.
Sulphur, sublimed	15-60 grains	1-4 grm.
Sulphuric acid, diluted	5-60 minims	0·3-4 mils
Syrup compound of iron phosphate (Parrish)	30-120 minims	2-8 mils
Syrup of iron phosphate with quinine and strychnine (Easton)	30-60 minims	2-4 mils
Tannic acid	5-10 grains	0·3-0·6 grm.
Tar, liquid	2-10 grains	0·12-0·6 grm.
Tartaric acid	5-30 grains	0·3-2 grm.
Terebene	5-15 minims	0·3-1 mil
Theobromine and sodium salicylate	10-20 grains	0·6-1·2 grm.
Theophylline and sodium acetate	2-5 grains	0·12-0·3 grm.
Thymol	½-2 grains	0·03-0·12 grm.
Thymol (as anthelmintic)	15-30 grains	1-2 grm.
Thyroid	½-5 grains	0·03-0·3 grm.
Thyroxinsodium	$\frac{1}{240}$-$\frac{1}{24}$ grain	0·0001-0·001 grm.
Tolu syrup	30-120 minims	2-8 mils
Tolu tincture	30-60 minims	2-4 mils
Totaquina	1-10 grains	0·06-0·6 grm.
Trinitrophenol	1-5 grains	0·06-0·3 grm.
Tragacanth mucilage	60-240 minims	4-16 mils
Tragacanth compound powder	10-60 grains	0·6-4 grm.
Tuberculin, old (diagnostic)	$\frac{1}{60}$-$\frac{1}{12}$ minim	0·001-0·005 mil
Tuberculin, old (therapeutic)	$\frac{1}{60.000}$ minim	0·000001 mil
Turpentine oil	3-10 minims	0·2-0·6 mil
Turpentine oil (as anthelmintic)	120-240 minims	8-16 mils
Urea	15-240 grains	1-16 grm.
Vaccine lymph (by scarification)	1 minim	0·06 mil
Valerian	5-15 grains	0·3-1 grm.
Valerian ammoniated tincture	30-60 minims	2-4 mils
Veronal	5-10 grains	0·3-0·6 grm.
Vitamin B1 adsorbate	15-90 grains	1-6 grm.

Drug.	Dose in Imperial Measure.	Dose in Metric Measure.
Witch-hazel liquid extract . . .	30-60 minims	2-4 mils
Yeast	½-1 ounce	16-30 grm.
Zinc oxide	5-10 grains	0·3-0·6 grm.
Zinc sulphate	1-3 grains	0·06-0·2 grm.
Zinc sulphate (as emetic) . . .	10-30 grains	0·6-2 grm.

an individual weighing 100 pounds would require much less than a person of double that size.

Idiosyncrasy occasionally causes drugs administered in the ordinary dose to produce unexpected effects. Thus some people are but little affected by even powerful drugs, while in others certain drugs, such as iodide of potassium, calomel, or belladonna, produce excessive symptoms in minute doses. Similar facts are noticed in persons of one family or race.

Habitual use of a drug is perhaps the influence that causes the greatest increase in the dose necessary to produce its effect. The most notable examples are found in the large quantities of opium and arsenic that can be tolerated by habitués of these drugs. The contrary holds with regard to some of the most active alkaloidal principles like digitalin and strychnine, which, after being taken without an interval over a prolonged period, are liable to accumulate in the system and suddenly to produce an extreme or even dangerous effect.

Disease modifies very greatly the dose of many medicines, for their tendency to produce poisonous effects diminishes in circumstances that urgently require their administration.

Fasting aids the rapidity of absorption of, and also makes the system much more susceptible than otherwise to, the action of most remedies. For this reason, as well as to avoid irritation of the stomach, it is usual to prescribe medicines to be taken after meals, and diluted with water.

Combination of different drugs possessing a similar action is generally practised in the writing of prescriptions, and frequently this enables the total dose to be more effective with fewer of the undesirable subsidiary symptoms that would accompany the use of one of the drugs given by itself. This is noticeably the case with purgatives, and with powerful drugs such as morphia and atropine in combination.

Form of Administration is also highly important, for active principles when separated and given by themselves in solution produce more rapid and intense effects than a corresponding amount of the crude drug. Further, it must be noted that the doses given in the above table are those for administration by the mouth to adults; when given by the bowel, the doses require in general to be about twice as large; and, of those drugs suitable for hypodermic injection, about one-half the amount will produce the same effect when given by the hypodermic syringe.

DOUCHE (French word) is an application of water to the body, directly, through a pipe.

Action. — Douches fall into two divisions: (*a*) those which act by virtue of some substance which they contain, such as astringent douches, cleansing douches, etc.; (*b*) those which act by virtue of their temperature, producing the effects which have been described under BATHS, and COLD, USES OF, with the distinction that douches act locally and so produce an action, upon one part only, greater than if the application were made to the whole body at one time.

Uses.—(*a*) MEDICATED AND CLEANSING DOUCHES are applied when it is inconvenient to use a general bath. For example, *warm douches* of boric lotion

may be used to irrigate wounds or ulcers, either in order to remove dressings which are adherent, or in order to maintain a steady trickle over the broken surface, and prevent accumulation of putrefactive material. *Bladder douches* are often used in inflammation of this cavity, containing, for example, boric acid solution (1 in 80), or weak potassium permanganate solution. Such a douche is administered by means of a douche-can holding one quart or more, connected by india-rubber piping with a three-way or T-shaped tube of glass,

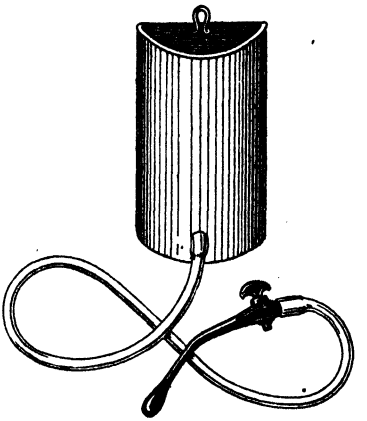

FIG. 148.—Douche-can, tube, and nozzle.

which, on its other two ends, has an outflow tube, and a tube leading to a catheter introduced into the bladder. The douche-can being suspended at a height of 3 feet or so above the bed on which the patient lies, is filled with fluid, which runs into the bladder as soon as the outflow tube is pinched. When sufficient has entered it can be at once drawn off by pinching the inflow tube and releasing the outflow. This is repeated several times. *Vaginal douches* of sulphate of zinc (2 grains per ounce), Condy's fluid of a pink tinge, perchloride of mercury (1 in 4000), etc., are used in cases of leucorrhœa or 'whites'. A quart or larger douche-can is used at a height of 5 or 6 feet. It leads by an india-rubber tube to a large nozzle, which should be made of glass for ready disinfection. Very often such a douche is used at a temperature of 115° Fahr., or as hot as the hand can bear, in order to obtain also the soothing and constricting action of a hot douche on the blood-vessels of the surrounding parts.

(*b*) TEMPERATURE DOUCHES may be hot or cold, or in general the two alternated. The action upon the circulation has been explained under the heading of BATHS, with the exception that the douche acts strongly upon a single part. Douching, combined with massage, is a useful procedure for rheumatism, neuralgia, and other pains. The Scotch douche consists of an alternate hot water or steam douche and a cold douche. It is used for similar purposes, and it is important that the hot stream should be given first, and that it should last four or five times as long as the cold stream. Such a douche acts powerfully upon the skin and nerves, and can be continued for a few minutes only.

DOVER'S POWDER, also known as COMPOUND IPECACUANHA POWDER, is made from 10 per cent each of powdered opium and ipecacuanha, with 80 per cent of sulphate of potassium. (*See* OPIUM.)

Uses.—It is used in some conditions to which opium is applicable, one of its main uses being to check diarrhœa, another to increase the action of the skin, and so benefit a cold in its early stages. The dose is 5 to 10 grains.

DRAINS (*see* WATER-CLOSETS, etc.).

DRASTICS (δράω, I act) are substances which have a violent purgative action, such as croton oil, jalap, scammony. (*See* PURGATIVES.)

DRAUGHT, or DRAFT, is a small mixture intended to be taken at one dose. It consists generally of two or four tablespoonfuls of fluid. The best-known is black draft, whose chief constituents are sulphate of magnesium and tincture of senna.

DRAW SHEET (*see* BED).

DREAMS (*see* SLEEP).

DRENCH is an old term still used in parts of England for a draft of medicine.

DREPANOCYTOSIS is another term for sickle-cell anæmia, which is characterized by the presence in the blood of red blood corpuscles sickle-like in shape. The anæmia is a severe one and afflicts the negro race.

DRESSINGS (*see* WOUNDS).

DROP-FOOT is a condition in which there is difficulty in raising the front part of the foot from the ground, or in which, when the condition is severe, the foot hangs limp.

Causes.—The commonest form is that due to neuritis of the nerve (anterior tibial) supplying the muscles on the front of the leg. It may be caused by alcohol, lead poisoning, or severe chill to the leg, or it may follow some infection such as typhoid fever or diphtheria. In drop-foot from these causes, there are apt to be disturbances of sensation on the leg also. Drop-foot may occur in children who have had infantile paralysis, but in this condition there is no sensory disturbance. Occasionally drop-foot results from a wound on the front of the leg involving the nerve. If the condition is not so bad as to prevent the patient from going about, he walks by lifting the foot high so as to prevent the toes from catching on objects on the ground.

Treatment.—If the condition is due to neuritis, it tends gradually to become better as the neuritis passes off. (*See* NEURITIS.) While the condition lasts, it is usual for the patient to wear a shoe of which the front part is supported by an elastic band attached to the front of the leg in order to prevent the weak muscles from being over-stretched and the toes from dropping.

DROPPED BEAT means the missing out of a regular beat of the heart. It can be detected either by listening to the heart or by feeling the pulse. It may be due to HEART BLOCK or to an EXTRASYSTOLE. Dropped beat due to extrasystole is of no great significance.

DROPSY, or HYDROPS (*ὕδρωψ*), means an abnormal accumulation of fluid beneath the skin, or in one or more of the cavities of the body. The term is a general one, the accumulation in special localities having special names, *e.g.* dropsy beneath the skin is known, when limited, as *œdema*, when widespread, as *anasarca*; dropsy in the abdomen as *ascites*, in the chest as *hydrothorax*, and in the head as *hydrocephalus*.

Causes.—Dropsy is not a disease, although this is a popular idea, supported by the fact that many deaths are recorded as due to 'dropsy' without a further statement of the cause. Dropsy may be due to one of three conditions: (1) weakening of the walls of the capillary vessels, by injury of the part in which dropsy occurs, by ill-health of the body generally, by poverty of the blood circulating through and nourishing the vessels, or by poisonous materials in the blood; (2) obstruction to the blood-flow through the veins; (3) a watery condition of the blood, allowing fluid to escape through the capillary walls. Dropsy may also result from obstruction to the flow of lymph in the lymph channels.

Heart disease, which produces increased pressure in the veins, and also an impure condition of the blood, in consequence of the defective pumping action of the heart, and *Bright's disease*, in which the kidneys fail in their functions of excreting poisonous substances and a certain amount of water from the blood, are the main causes of general dropsy. In heart disease the dropsy is more marked after exertion, in kidney disease it is found chiefly after resting. Thus one of the chief characters of dropsy due to Bright's disease is that it appears in the morning, affects loose tissues like the skin beneath the eyes, and passes off as the day advances. Dropsy due to heart disease, on the other hand, tends to appear towards evening, affects dependent parts like the feet, and vanishes during the night. When the two diseases are combined, the state of dropsy may become very grave.

In *general debility* due to overwork, bloodlessness, and the like, dropsy of the feet and legs frequently appears towards evening. The swelling which sometimes follows serpent-bites, bee-stings, or the eating of poisonous shell-fish, and constitutes an extreme and rapidly ensuing form of *nettle-rash*, is a peculiar variety of dropsy. *White-leg*, which may appear after some acute disease like typhoid fever or pneumonia, or after the birth of a child, due to a thrombosis or plugging up of the main vein in the affected limb, is one of the localised forms of dropsy. A similar condition may be caused by a *tumor* pressing upon a large vein of the arm or leg. *Cirrhosis*, tumors, and other diseases of the liver may, by inter

ference with the circulation through it, cause dropsy first of the abdomen and later of the lower limbs.

Treatment. — There is no general treatment which will meet every case. The particular cause has in each case to be removed. Cases due simply to ill-health pass off as the health improves under tonics, rest, and good food. Dropsy due to heart or kidney disease yields as the disease producing it is alleviated. In cases of localised dropsy, elevation of the dropsical part is of great importance, and the person should adopt the recumbent position. In the case of heart disease, digitalis, strophanthus, squills, and infusion of broom-tops, which improve the action of the heart, form the chief means employed. Often when the dropsy has become so great as to distend the abdomen tightly, it is necessary to begin the treatment by a purgative such as blue-pill or elaterium, which relieves the distension and allows the circulation in the kidneys, impeded by the distension, to proceed. Further, the sick person must rest quietly in bed, lying preferably on one or other side. In acute kidney disease, the treatment of the dropsy consists in the hot-air baths, aperients, and drugs to act upon the skin, which form the routine treatment of Bright's disease. In dropsy due to liver conditions, occasional purges with blue-pill, or calomel, help the condition. When the dropsy will not yield to drugs, some of the fluid may have to be drawn off (*see* ASPIRATION), and very frequently when this is done partially, the kidneys are enabled to cope with the remainder of the fluid.

DROP-WRIST is a condition in which, owing to partial or complete paralysis of the muscles which extend the hand, the latter droops at the wrist.

Causes. — Perhaps the commonest form is that known as crutch-palsy, in which, owing to the constant pressure of a crutch in the armpit, the large nerve (musculo-spiral) that controls the extensor muscles of the forearm becomes damaged, and hence the muscles in question are paralysed. The same effect may be produced when a person sleeps with his head resting on the upper arm, or with the arm over the back of a chair. A blow on the back of the arm may produce a similar condition. Poisoning by alcohol or by lead may also cause the condition, which may also be brought about by a chill.

Treatment.—The forms due to pressure on the nerve or to chill require only rest, and application of massage and electricity to the muscles to prevent their wasting, for recovery takes place in general gradually and surely. In the cases due to lead, the appropriate treatment for lead poisoning is necessary.

DROWNING, RECOVERY FROM. —The number of deaths from drowning registered yearly in Great Britain is roughly about 2800. In drowning, death as a rule ensues from asphyxia (*see* ASPHYXIA), though, in falls from a height upon water, or in cases where the body in falling has encountered blows upon the head or abdomen, death may be due to 'shock'. In the latter case, instead of the signs of asphyxia, the skin is pale, face placid, the lungs are empty of water, because no attempts at breathing have taken place. In slight cases of shock the chances of resuscitation are rather more hopeful than in cases of asphyxia, because little water has been drawn into the lungs, and because there has been no struggling. It must be remembered that recovery from drowning may take place even after submersion for as long as half an hour. Artificial respiration must therefore be persisted in until the signs of death are unmistakeable. Speed and immediate treatment on withdrawal from the water are of paramount importance.

The specific gravity of the body being slightly greater than that of water, it sinks at first; then if the person is able to struggle, his efforts bring him to the surface, only to sink again as he becomes exhausted. This may be repeated several times. In these struggles, water mixed with air is drawn into the air-passages, and the two are churned up with mucus into a froth which forms a great obstacle to the entrance of air into the lungs during subsequent attempts at resuscitation. The first

step in this process should be commenced *on the instant the body is drawn from the water*, without delay for any examination, removal of clothing, or the like, and consists in the attempt to restore breathing by *artificial respiration*. Before beginning the actual movements of artificial respiration a few seconds may be spent in getting rid of as much water as possible from the lungs and air-passages: for example, a child may be held up by its heels, and the water will run out of its mouth; when an adult is lying prone on the ground, as in the illustration, the operator's arms can be linked round the patient's middle, which is then raised, and water will flow out of the mouth. Any seaweeds or other matter in the mouth should be quickly removed by the finger. The same methods of artificial respiration are applicable whatever the cause of asphyxia. Four methods are available:

1. **Schäfer's prone-posture method.**—Immediately on removal from the water, place the patient face downwards on the ground, with a folded coat under the lower part of the chest,

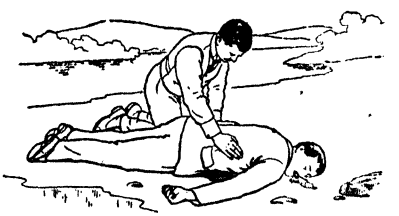

FIG. 149.—Artificial respiration by Schäfer's method.

and lose no time by removing clothing. Turn the patient's face a little to one side, so that the mouth and nose are not obstructed. Let the operator *kneel astride* of or to one side of the patient, facing his head, and let him place his hands over the lower part of the patient's back, one on each side (on the lowest ribs). Let him throw the weight of his body forward upon his hands, so as to press the air (and water if there is any) out of the patient's lungs. Then let him immediately raise his body to take the pressure off and allow the patient's chest to expand. Repeat these movements twelve or fifteen times per minute.

This method has the advantages of extreme simplicity and great effectiveness. Further, no time is lost in freeing the air passages of water and mucus, which may drain from the mouth during the whole procedure; there is no trouble caused by the tongue falling backwards into the throat, as in the face-up methods; the patient is not so liable to bruising as in the Marshall Hall method, nor to injury of the ribs or liver, which may be occasioned by the Howard method. The introducer of the method also claimed that while the amount of air taken into the lungs of an average-sized healthy person is about 5850 cubic centimetres per minute, the amount that can be drawn in by this method is about 6760 cubic centimetres, an amount far in excess of that possible by the Silvester or Marshall Hall method. While in the Silvester method force is employed to produce inspiration as well as expiration, in Schäfer's method, as in Howard's method, the force is used only to compress the chest, and the chest is allowed to expand by its own elasticity, and draw air into the lungs.

2. **Marshall Hall's ready method** is valuable for two reasons: firstly, because it frees one lung thoroughly from its frothy water; and, secondly, because it is a very easy and simple method. A roll about 6 to 8 inches thick is made, for example, out of a rolled-up coat and vest, or a large stone or spar of wood may be used for the purpose. With this under his chest, the patient is placed face downwards, and firm pressure made with both hands upon the back to expel air and water. Then the body, grasped by the shoulders, is turned steadily upon one side, still lying upon the bundle or stone, so that one lung is expanded. Then the body is turned again upon the face so that the air is expelled from the chest, and so forth, each movement being repeated about fifteen times per minute. It is important always to turn the body upon the same side, otherwise water is apt to run from the lung which was previously the lower one, and again choke up the air passages of the one which has been cleared.

3. **Howard's method** is a much more effective method, but requires consider-

able skill, and is therefore not suitable for an untrained person. It is the method in which lifeboat-men, firemen, etc., are trained in the United States. It is performed in two stages.

(*a*) To free the air passages of water. Place the body face downwards, with forehead on forearm so as to keep the mouth off the ground, and with a *large* tight roll of clothing beneath the pit of the stomach. Let the operator lean for a few seconds heavily upon the back of the patient with his left hand placed over the lower ribs on the patient's left side, and his right hand over the spine lower down, and let him end this pressure with a push. Repeat this two or three times according to the probable amount of water and froth to be expelled.

(*b*) To re-establish breathing. Place the body face upwards with the large roll of clothing beneath the chest, so that the shoulders incline slightly downwards, but do not touch the ground; bend the head and neck as far back as possible, and place the hands above the head, where the wrists may, if necessary, be fastened together. The waist and chest must be free of clothing. Let the operator now kneel astride of the patient at the level of the latter's hips, and place his hands with the thumb-tips together, the ball of each thumb just beneath the margin of the ribs, and the fingers each in a space between two ribs. Now let him swing forwards from his knees, pressing the drowned person's ribs upwards and inwards with his hands, till his face almost touches that of the patient, remaining so for two or three seconds to press the air out of the lungs. Let him recover himself with a final sharp push, at the same time taking his hands off the chest, and then remain kneeling upright for two or three seconds, so as to let the chest expand. Repeat this ten times per minute.

4. **Silvester's method** is fairly efficient and quite simple. Its drawbacks are, that in addition to the operator there should be some one to hold the feet of the patient—though this is not absolutely necessary—and that there may be difficulty in keeping the entrance to the larynx open. To effect the latter, the tongue must be drawn forward, and if necessary held forwards either by means of a cloth or forceps. The patient after his air passages have been cleared, as in Howard's method, is placed on a flat surface inclined a little from the feet upwards, with a roll of clothing under his shoulders. The mouth and nose are carefully wiped. Then to produce inspiration the operator, placing himself at the head of the patient, grasps his arms just above the elbows, and draws them upward by the side of the head for two seconds. (Note that in Bain's modification of Silvester's method the operator grasps the pectoral muscles and collar-bone in front of the armpit.) Next, to produce expiration, he turns down the arms and presses them against the

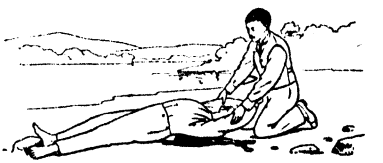

FIG. 150.—Artificial respiration by Silvester's method—Inspiration.

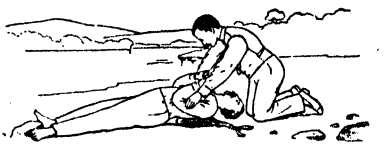

FIG. 151.—Artificial respiration by Silvester's method—Expiration.

patient's chest for two seconds. This is repeated fifteen times a minute. A caution is necessary that the downward movements must not be made too forcibly; for serious damage is apt to be done to the internal organs of an unconscious person by violent pressure.

After-treatment for drowning.—As soon as the patient makes efforts at breathing, these measures are stopped. But no such effort may be made for twenty minutes, an hour, or even in some recorded cases for several hours, and still the person may recover, so that artificial respiration should be persevered with so long as there is the slightest sign of life. Efforts must next be made to restore the feeble circulation, and, in cases where the body has been long in water or much exposed during artificial respiration, to regain

the body warmth. To this end the patient should be wrapped in hot blankets, with hot bottles to the sides and feet, and the arms and legs should be energetically rubbed upwards towards the body. So soon as the power of swallowing returns, sips of hot water, and teaspoonfuls of hot brandy and water, or hot coffee, may be administered. When the heart continues feeble, and indeed during the performance of artificial respiration, but not in such a way as to impede the latter, which is of paramount importance, hot sponges may be applied to the front of the chest over the heart, or a galvanic current passed through the chest. Ammonia, nitrite of amyl, or smelling salts may for the same purpose be now and then held to the nose. Finally, if the patient shows a tendency to sleep this should be encouraged.

DRUG (*see* DANGEROUS DRUGS *and* DOSAGE).

DRUG HABITS.—Drugs, which have been administered for the relief of pain, for sleeplessness, or as a temporary stimulant, or which have been taken out of curiosity, are sometimes continued for their pleasurable effects or for the temporary sense of increased well-being which they confer, until their use becomes a habit. This habit may be continued either because the habitué has not sufficient will-power to resign the pleasure derived from the use of his drug, or, very often, because any attempt to break off the habit leads to severe mental and bodily distress. All such habits lead to a mental and moral deterioration, and, under proper precautions, they may in every case be broken off.

Alcohol habit (*see* ALCOHOLISM, CHRONIC).

Ether habit.—This is by no means common, but comes into vogue now and then. Several teaspoonfuls are taken with water, and produce quickly a state of excited intoxication, which goes through all the stages of alcoholic intoxication in an hour or thereabout. The treatment is similar to that for alcoholism.

Cocaine habit.—The action of this drug is described under coca. It is generally taken hypodermically by its habitués, or the leaves may be chewed. A hypodermic dose of one grain or thereabout may produce after a few minutes a feeling of suffocation, anxiety, and faintness, but this rapidly passes off, and is followed by mental exhilaration, rapidity of thought, and a feeling of buoyancy. After a short time, however, this passes off, and as dose after dose is taken, a reaction of deeper and deeper depression ensues upon each. The drug begins to lose its effect, and larger and larger doses have to be taken; while, at the same time, dyspepsia, loss of appetite, restlessness, sleeplessness, forgetfulness, and failure of the power to apply the mind to any task appear. Finally, the person may pass into a state of melancholy or mania. Marked physical deterioration in the form of emaciation and digestive disorders is also found. The treatment is similar to that for the morphia habit, but the cocaine habit is the harder to renounce.

Morphia habit, or opium habit, is perhaps the commonest one indulged in. Although the ordinary dose of morphia is about ¼ grain, and of laudanum about 30 drops, habitués of the drug become so inured to it that 100 grains of the former are said to be sometimes taken daily, and the latter has been drunk as if it were wine. It must be borne in mind, however, that by some Oriental peoples opium is widely used, not in an excessive and pernicious manner, but in the same sense as tobacco is used in Europe and America. The confirmed morphia-eater, who takes excessive doses or uses the drug constantly, speedily degenerates. His face becomes sallow, his appearance prematurely aged, and his muscles wasted. The memory becomes bad, sleep is lost, and conditions resembling neuralgia or ague come on, from which the only relief is given by larger doses. The character changes also, and a person, who previously was honest and truthful, becomes in everything utterly untrustworthy. Delusions of various sorts may present themselves, and under their influence criminal acts may be performed. If the drug be suddenly stopped, there is always much suffering. Restlessness and sleeplessness become extreme, neuralgic pains come on, and dyspepsia, diarrhœa, and vomiting appear. Within one day of complete deprivation of the

drug a condition of delirium or even serious collapse may ensue.

Treatment. — The longer the habit has lasted, the less hope is there for permanent abandonment of the drug, and persons who have long lost self-control may relinquish one habit only to fall into another, like that of alcohol. There are three modes of treatment. The first consists in abandoning the drug entirely and at once, and this is the best thing for cases in which only moderate doses are taken. A certain amount of suffering is inevitable, but it is minimised by temporarily replacing the morphia by large doses of bromide of sodium. The second mode is by rapidly withdrawing the drug, beginning with one-third of the habitual dose and reducing this to nil in the course of a week or ten days. These diminishing doses should be given by the mouth, and the syringe abandoned. Bromide of sodium is given in doses which increase as the morphia is diminished. This is perhaps the best method in most cases where large doses are taken, and should be combined with a milk diet, rhubarb and soda if there be indigestion, caffeine or kola if stimulants be needed, and massage or hot fomentations for the pains, if these be severe. The third method consists of slow reduction, lasting over weeks or months, and is sometimes necessary in the case of very weak people, who might collapse on a sudden removal of their drug. Tonics, change of scene, and, above all, careful watching of the patient are necessary for long after the habit is shaken off.

Chloral-hydrate, Sulphonal, Trional, Bromides, and Paraldehyde have also their devotees, the habit having been contracted through taking the drug for insomnia. Confusion of mind, digestive troubles, and inability to transact business are the symptoms, but these habits are out of comparison more easily abandoned than those of cocaine or morphia. The drug should simply be stopped once and for all, the patient resting quietly in bed for some time and being massaged or placed in a wet-pack to induce sleep.

DRUNKENNESS (*see* ALCOHOLISM, ACUTE, *and* CHRONIC).

DUBINI'S DISEASE is another name for ELECTRIC CHOREA, a nervous disease acute in onset and characterized by involuntary shock-like movements of the muscles and severe pain.

DUCT is the name applied to a passage leading from a gland into some hollow organ, or on to the surface of the body, by which the secretion of the gland is discharged, *e.g.* pancreatic duct and bile duct opening into duodenum and the sweat duct opening on the skin surface.

DUCTLESS GLAND is the term applied to any one of certain glands in the body the secretion of which goes directly into the blood stream and so is carried to different parts of the body. These glands—the pituitary, thyroid, parathyroid, adrenal, and reproductive —are also known as the ENDOCRINE GLANDS. Some glands may be both duct glands and ductless glands. For example, the pancreas manufactures a digestive juice which passes by a duct into the small intestine. It also manufactures, by means of special cells, a substance called insulin which passes straight into the blood and not by way of any duct.

DUMBNESS means an inability to pronounce the elementary sounds which make up words, and is present in the proportion of about 1 to every 1000 of population.

Varieties. — The important classification of cases of deficient power of speech is into (*a*) those associated with deafness, and (*b*) those in which hearing is good. In a case associated with deafness, the person may be dumb merely because he has been born deaf, and, having no knowledge of sound cannot understand or make intelligible sounds, although provided with good voice mechanism; or a person who has lost his hearing by some disease in childhood may be unable to speak otherwise than as a child for the same reason. When hearing is good, on the other hand, dumbness is due generally to some mental defect or sometimes to some failure in the organs of voice production.

Causes.—Deafness is the most important cause, because the one most capable of treatment. Of those due to some congenital brain-deficiency

some arise in children of persons who were themselves deaf-mutes. Another class of cases, in which there is also mental deficiency, arises from brain disease, such as that due to syphilis. Those children who are mentally bright and whose hearing is good have occasionally some structural defect, such as tongue-tie or enlarged tonsils and adenoids in the throat, which allow of attempts at speaking but prevent proper formation of words. Lisping and lalling speech are slight forms of dumbness due to inefficient control of the voice mechanism, but can generally be cured by careful training. (*See* STAMMERING *and* VOICE.)

Treatment.—A dumb child is cut off from other people and so cannot develop normally, unless carefully treated; a careful examination should be made of any child who does not speak by four years of age. Deafness is easily discovered by finding that the child pays no attention to noises made behind its back. Mental ability can be measured by special tests. Physical obstructions, like tongue-tie or large tonsils, should be removed if present.

Deaf-mutes may be trained to read the lips and throat movements of others by sight, and to use their powers of voice through a complicated process, which should begin about the age of six or seven. It is hard for adults to pick this up, and persons who are to be instructed in this method should not learn the finger language first.

The training required for this 'oral' method is long, and, if the deaf person is to gain a modulated voice and a fair command of language, the constant attention of an expert tutor is necessary all through childhood and youth. Institutions which undertake the education of deaf-mutes who have to begin a trade about the age of sixteen, find that only a slight acquaintance with the oral method, sufficient to guess everyday expressions on the lips of others, together with careful training by the finger alphabet, suits these children best.

Dumbness is sometimes a hysterical manifestation.

DUODENAL ILEUS is the term applied to chronic obstruction of the duodenum, caused by an abnormal position of arteries in the region of the duodenum, pressing on it.

DUODENAL ULCER is a condition in which an ulcer similar to an ulcer of the stomach forms in the duodenum usually just beyond the exit from the stomach. The chief symptoms of duodenal ulcer are pain of a spasmodic character commencing from two to three hours after food is taken and sometimes relieved by taking more food; also tenderness below the ribs slightly to the right of the middle line; and frequently the passage of dark, tarry material derived from blood, in the stools. There are also general symptoms of failing health and anæmia caused by interference with digestion and by the loss of blood in cases where this is considerable. The treatment of duodenal ulcer is similar to that of gastric ulcer. (*See* STOMACH DISEASES.)

DUODENUM (*duodenum*) is the first part of the intestine immediately beyond the stomach, so named because its length is about twelve finger-breadths. (*See* INTESTINE.)

DUPUYTREN'S CONTRACTION is a thickening and drawing together of the skin and tissues beneath it in the palm of the hand, which causes gradual and permanent bending of the fingers. It is brought on by the constant pressure of a tool, or as the result of a strain in gouty and rheumatic people, and the ring and little fingers are most often affected. It is treated in early cases by massage and the occasional wearing of a splint, and in advanced cases by dividing the fibrous bands beneath the skin.

DURA MATER (*durus*, dense; *mater*, mother) is the outermost and strongest of the three membranes or meninges which envelop brain and spinal cord. In it run vessels which nourish the inner surface of the skull. (*See* BRAIN.)

DWARF, or DWARFISM, is a term applied to under-development of the body. The causes are either developmental or due to food insufficient in quantity or unsuitable in quality or to defects in some of the body secretions which can be corrected. The first-named group includes 'pituitary' dwarfism, the subjects being very

small persons with normally proportioned parts, also achondroplastic dwarfs with large globular head and shortened limbs and stumpy fingers. In the class of dwarfism which is partly curable, there are included cretins, whose want of growth in mind and body is attributable to a primary defect of the thyroid gland (*see* CRETINISM). In this class are also included various forms of defective growth associated with defects in the secretions of the digestive organs, especially the pancreas; this type of defect, often known as pancreatic infantilism, is mainly confined to a retardation of physical development, while the mental changes are little marked. Another form of dwarfism, associated with a deformity of the bones, is produced by rickets in early life, such persons showing high forehead, great bending of the leg bones, and deformity of the chest. (*See* RICKETS.)

DYES, POISONOUS (*see* ARSENIC *and* ANILINE).

DYNAMOMETER (δύναμις, power; μέτρον, a measure) is an elliptical ring of steel to which is attached a dial and moving index. It is used to test the strength of the muscles of the forearm, being squeezed in the hand, and registering the pressure in pounds or kilogrammes.

DYS- (δυσ-, badly) is a prefix meaning difficult or painful.

DYSCHEZIA is the term applied to constipation due to retention of fæces in the rectum. This retention is the outcome of irregular habits, which damp down the normal reflex causing defæcation.

DYSCRASIA (the prefix δυσ-, badly; κρᾶσις, a mixture) means a diseased constitution. (*See* CONSTITUTION.)

DYSDIADOKOKINESIA means loss of the ability to perform rapid alternate movements, such as winding up a watch. It is a sign of a lesion in the cerebellum.

DYSENTERY (from the prefix δυσ-, and ἔντερον, the intestine), also called bloody flux, is an infectious disease with a local lesion in the form of inflammation and ulceration of the lower portion of the bowels.

Causes.—Dysentery in a scattered form may occur anywhere, but such occasional cases are of a different nature as regards cause from those which occur endemically in certain localities or break out as an epidemic; for, while isolated cases are capable of being produced by any agencies which have a strongly irritating action on the intestinal canal, and may develop out of an ordinary catarrh of the bowels, the dysentery of the tropics is a serious infectious disease.

The epidemic forms of dysentery are due to two main causes. One of these, known as 'amœbic dysentery', is produced by infection with a microscopic animal parasite, the *Entamœba histolytica*, which develops in the wall of the large intestine, where it sets up inflammation and later ulceration as it burrows under the lining mucous membrane. The other main cause is a group of bacteria, called after their discoverers the Bacillus of Shiga, of Flexner, etc. In any case the infection is carried from the excreta of the sick to the healthy in contaminated water, or in food soiled by flies, or by dust carried on the wind. Other forms of dysentery are due to special development of the bacilli ordinarily inhabiting the intestine, others are associated with the parasite 'Bilharzia mansoni', and still others develop in association with malaria, or in former times when scurvy was rife in association with that disease. On the Gallipoli Peninsula the dust in the food and water caused by storms was believed by its irritation to have rendered men more liable to become infected.

Long-continued high temperature of the air and ground, such as exists in the tropics, together with a soil of swampy character, are the conditions generally present where dysentery prevails endemically. Persons who are the subjects of chronic constipation appear also to contract dysentery more readily than those whose bowels are healthy, and indeed previous trouble of any kind connected with the bowels is a predisposing factor.

Varieties.—The two principal types of dysentery, *amœbic* and *bacillary*, have been already mentioned. There is a tendency for dysentery to occur along with other diseases, and thus *malarial* and *scorbutic* dysentery are sometimes spoken of, the disease being benefited

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also by treatment suitable for these conditions.

Dysenteric attacks may be *mild* with little sign of illness except some discomfort and looseness of the bowels. On the other hand there may be a *malignant* form with symptoms resembling those of severe cholera, in which gangrenous sloughs of the mucous membrane are passed and the patient quickly dies.

The organisms of dysentery exert their effects especially upon the large intestine. In the milder forms of the disease there is simply a congested or inflamed condition of the mucous membrane, with perhaps some inflammatory exudation on its surface, which is passed off by the discharges from the bowels. But in the more severe forms ulceration of the mucous membrane takes place. These ulcers, small at first, enlarge and run into each other, till a large portion of the bowel may be implicated in the ulcerative process. Should the disease be arrested, these ulcers may heal entirely, but occasionally they remain, causing disorganisation of the coats of the intestines, as is often found in chronic dysentery. Sometimes, though rarely, the ulcers perforate the intestines, causing rapidly fatal inflammation of the peritoneum, or they may erode a blood-vessel and produce violent hæmorrhage. Even where they undergo healing, they may cause so much narrowing of the intestinal canal as to give rise to symptoms of obstruction of the bowels later on. The occurrence of abscess of the liver in connection with dysentery is frequently observed. It comes on sometimes a considerable time after the attack of dysentery, even when the affected person has left the tropics and returned to a temperate clime, and it occurs only in connection with the amœbic, not with the bacillary form.

Symptoms.—The attack is commonly preceded by certain premonitory indications in the form of general illness, loss of appetite, and some amount of diarrhœa, which gradually increases in severity and is accompanied with griping pains in the abdomen (tormina). The discharges from the bowels succeed each other with great frequency, and the painful feeling of downward pressure (tenesmus) becomes so intense that the patient is constantly desiring to go to stool. The matters passed from the bowels, which at first resemble those of ordinary diarrhœa, soon change their character, becoming scanty, mucous, or slimy, and subsequently mixed with, or consisting wholly of blood, along with shreds of exudation thrown off from the mucous membrane of the intestine. Generally speaking, the bacillary type tends to come on more suddenly and to be more severe than the amœbic type.

Although the constitutional disturbance is at first comparatively slight, it increases with the advance of the disease, and febrile symptoms come on, attended with thirst and scanty and painful flow of urine. Along with this, the nervous depression becomes very marked. Should no improvement occur, death may take place in from one to three weeks, either from repeated losses of blood or from gradual exhaustion consequent on the continuance of the symptoms, in which case the discharges from the bowels become more offensive and are passed involuntarily.

When, on the other hand, the disease is checked, the signs of improvement are shown in the cessation of pain, in the evacuations being less frequent and more natural, and in relief from the state of extreme depression. Convalescence is, however, generally slow, and recovery may be imperfect—the disease continuing in a chronic form, which may exist for a variable length of time, giving rise to much suffering, and occasionally leading to an ultimately fatal result.

Treatment. — PREVENTIVE TREATMENT is of the utmost importance in localities and circumstances where dysentery is likely to be contracted. Sanitary measures involve the proper protection of the water supply and care in disinfecting the excreta of persons suffering from or convalescent from the disease. Flies must be destroyed or at least prevented by nettings, etc., from having access either to food or to latrines. Persons liable to bowel complaint should avoid constipation, eating unripe fruit and the like; should practise the strictest temperance in eating and drinking, and should wear a binder or cholera belt.

CURATIVE TREATMENT.—A restriction of the diet to albumin-water, rice-

water, or light meat broth for a day, together with rest in bed and a dose of castor oil to which laudanum may be added to relieve griping, is often sufficient to arrest a mild attack. Other remedies which alleviate the symptoms are carbonate of bismuth in large doses and astringent or soothing enemata.

In *amœbic dysentery* the drug which is specially used is ipecacuanha or its active principle emetine. This drug was originally introduced into England from Peru as the *radix antidysenterica*, and has proved of signal value in the treatment of the disease in India, and has diminished the mortality to a remarkable extent.

Emetine hydrochloride is administered by hypodermic injection of one-half grain night and morning for several days, the dose being lessened as the evacuations become more natural; it has a special destructive effect upon the parasites. Another method in which emetine is given is the administration by the mouth of emetine-bismuth-iodide in doses of 3 grs. each night for 12 days.

In *bacillary dysentery*, a serum is used; and the injection of hypertonic salt solution into the veins is of great value in severe cases. Yatren, a disinfectant remedy, is also sometimes used. Another form of treatment which has been used with success consists in the administration of small doses of Epsom salts very frequently repeated, and continued for a day or more. Since the introduction of the sulphonamide drugs into medical practice in 1935, they have been applied in the treatment of intestinal infections. Only those drugs which are slowly absorbed from the intestine can be expected to be of any use: if they are absorbed quickly into the blood they will not come into close enough contact with bacteria in the gut. Sulphaguanidine (sulphanilylguanidine) and succinylsulphathiazole (sulphasuxidine) are both absorbed only slowly; and both have been given successfully in the treatment of bacillary dysentery. Starch enemata containing laudanum are of use in relieving the tenesmus. Ice may be freely taken to allay thirst. The diet should be light, consisting of soups and farinaceous food.

In chronic dysentery the chief points to which attention should be given are the proper nourishing of the patient, and the observance of judicious hygienic measures, such as the due clothing of the body, the use of tonics, baths, etc. A method of treatment, which has often resulted in cure, consists in the administration every day or two of purgative doses of castor oil combined with opium in order to relieve pain. Another procedure, which is almost always attended with benefit, is the daily washing out of the lower bowel with warm salt water or some mild astringent in large quantities. Still another method of treatment, which is often followed quickly by good results, is the administration of a substance which forms a soothing coating to the bowel and at the same time absorbs and carries off the bacilli in the motions. For this purpose large doses of a teaspoonful or more of carbonate of bismuth or of kaolin are administered in water after every meal. A change to a cooler climate, such as a year's furlough in England for persons employed in India, will sometimes banish the disease when other means fail.

DYSIDROSIS, or CHEIROPOMPHOLYX, is a skin eruption in which minute vesicles of clear fluid form in the cuticle.

DYSMENORRHŒA (δυσ-, with difficulty, μήν, a month; ῥέω, I flow) means painful menstruation. (*See* MENSTRUATION.)

DYSPAREUNIA means painful or difficult coitus.

DYSPEPSIA (δυσ-, with difficulty; πέπτω, I digest) means pain, or any uncomfortable symptom associated with the function of digestion. The term dyspepsia should not be limited to the occurrence of pain while the food remains in the stomach, for (*see* DIGESTION) this period represents only a small part of the digestive process, and interference with this process, in its wider sense, may produce various symptoms, such as appendicitis, constipation, diarrhœa, upon which information will be found elsewhere. Vagaries of digestion produce symptoms of many sorts, often not at all directly connected with the taking of food, and the whole subject

is a most recondite one. The condition of the teeth is of the utmost importance in regard to dyspepsia, particularly those forms grouped below as Nervous Dyspepsia, and proper chewing of the food, together with leisurely eating of meals by those accustomed to hurry, frequently suffices to cure indigestion of long standing. Success in treatment of obstinate cases is greatly aided by the administration of test meals, their withdrawal after some time by the stomach tube, and chemical and microscopic examination of the digestive products.

We shall consider here only the broadly marked forms of dyspepsia affecting the stomach, and recognisable by every one as such. *See also* STOMACH, DISEASES OF.

ACUTE DYSPEPSIA sometimes occurs in people who ordinarily digest food with comfort, and, still more frequently, in persons of weak digestive powers. It results from a single serious error in diet, or the irritation of poisonous substances acting upon the interior of the stomach. For the treatment see Acute Gastritis under STOMACH, DISEASES OF.

ACID DYSPEPSIA (ACID GASTRITIS) is one of the commonest forms. It is of several types, but as a rule affects young persons or those in the prime of life, and is due to the presence of an excessive amount of hydrochloric acid, or of acid salts, in the gastric juice. One type affects young persons of sedentary occupation, who eat irregularly as to time and amount of food, and who are in the habit of 'bolting' their meals. Another type of sufferer is a girl the subject of anæmia, in whom the acid dyspepsia is very frequently a forerunner of gastric ulcer. Still another type of sufferer is that of a nervous, highly strung individual, in whom nervous dyspepsia may take this form.

Symptoms.—As a rule, the dyspeptic is conscious of irregularity in taking his meals, and, having a good appetite, eats at times more food than is good for him. There is no discomfort for perhaps an hour, indeed relief is often gained by eating, and then a sense of heaviness and heat about the pit of the stomach and left side set in and grow gradually worse. There is often a feeling as of strangling in the throat, and a vague sense of constriction in the left side which grows now more and now less intense in conformity with the muscular action of the stomach. Relief is got for a few seconds by swallowing saliva, and by gulping mouthfuls of air, but these lead later only to distension and greater pain. After perhaps an hour of this discomfort, a burning feeling (heart-burn) is experienced about the centre of the chest, and mouthfuls of intensely sour material are brought up into the mouth, leaving a raw feeling in the throat. Now and then vomiting occurs, and this gives temporary relief. The vomit is intensely sour, and may contain streaks of blood in cases where the pain is great, the blood and pain being due to minute 'erosions' in the mucous membrane of the stomach. If blood comes in any quantity, however, and if sharp pain be experienced immediately upon partaking of solid food, the case is probably one of ulcer. (*See* STOMACH, DISEASES OF.)

Treatment. — Regularity in mealtimes, and in the amount of food taken at each meal, are essential, and regular exercise in the open air, cold baths in the morning, and early rising all play an important part. The food should be chewed deliberately, and small meals, frequently taken, suit this and the following form of dyspepsia better than large meals with long intervals. It is important to avoid condiments, such as vinegar, mustard, pickles, and particularly salt. The food should be of a simple form, which does not stimulate the walls of the stomach to secrete much gastric juice, such as eggs, fish, thick soups, puddings made from tapioca, cornflour, rice, and the like. Above all, milk and cream are well borne, and, in any case where there is bleeding, should form the staple of the diet. Meat, meat essences, and strong (stock) soups should be avoided. The symptoms may be much abated by powders containing rhubarb (2 grains), soda (6 grains) and carbonate of bismuth (20 grains), taken half an hour after meals, or by a soothing mixture before meals. When the pain is very acute, it may be alleviated by small doses of Dover's powder after meals. Con-

stipation should be treated by mild remedies. (*See* CONSTIPATION.)

CHRONIC CATARRH OF THE STOMACH (MUCOUS GASTRITIS) may come on as a late stage of the above. Perhaps its commonest cause is the chronic abuse of alcohol. It is also associated with heart disease, and disorders of the liver, which cause congestion of the stomach, and it is not infrequently produced by gout.

Symptoms.—The appetite is poor, or is capricious with an inclination for sharp, sour, or salt articles of diet like pickles, pepper, vinegar, salt herrings. The tongue is covered with a thick yellow or brownish fur, especially in the mornings, and, in consequence, the taste of ordinary food is dull and papery. The usual symptoms are discomfort, eructations, and choking sensations after a meal, with occasional vomiting, particularly in the morning. The vomit consists of fragments of half-digested food mixed with strings and lumps of tough mucus, with which the interior of the stomach is coated. Most discomfort is felt after the chief meal of the day, and soup seems specially prone to cause this. Constipation is generally present, but not to such an extreme extent as in gastric ulcer or dilatation.

Treatment.—Attention to the diet is here also the most important point. Alcohol and tobacco, which maintain and even cause the condition, must be stopped, and daily exercise should be taken. Salted foods, pickles, and the like may in this case be taken, and are beneficial when a meal contains a considerable amount of meat, because the secretion of gastric juice is feeble and is stimulated by these means. The meat taken should all be scraped down, because the gastric juice has to a large extent lost its power to dissolve fibrous tissue. The following diet is one which is readily digested and unirritating. The lunch and supper might be interchanged.

7 A.M. *Breakfast.*—Breakfast cup of cocoa made with milk and sugar; 2 oz. of toast or rusks.

10 A.M. *Lunch.*—3 oz. white fish; 3 oz. sweetbread or chicken; 2 oz. bread and 1 oz. butter.

1 P.M. *Dinner.*—Plate of soup made of 1 oz. tapioca-meal, a pat of butter, and an egg; 3 oz. of chicken-breast, or veal, or fish, or pigeon; 3 oz. macaroni, or vermicelli, or purée of potatoes, spinach, or beans; 3 oz. of milk-pudding or omelette.

4 P.M. *Afternoon tea.*—One teacupful of milk or milk-tea with sugar; 1 oz. of toast or biscuits.

8 P.M. *Supper.*—A sandwich consisting of 2 oz. bread, 1 oz. butter, and 2 oz. finely scraped meat.

Medicinal treatment is not generally necessary if these rules be attended to, except for the loss of appetite, the pain, and the irregularity of the bowels. Appetite may be gained by taking bitters half an hour before dinner, such as condurango, or calumba with nux vomica. Before breakfast, the patient may take a tumblerful of warm water, to which has been added a small teaspoonful of common salt. This has the effect of dissolving the mucus on the stomach and also of helping the action of the bowels. For the discomfort after meals, ten drops of dilute hydrochloric acid, in water, or added to the bitter, may be taken after meals and repeated every half-hour while digestion is proceeding. For constipation, if present, a glass of an aperient water in the morning may be sufficient, and for diarrhœa, if present, lime-water or chalk mixture.

Treatment at watering-places often does much good. In the early stages, the aperient waters of Carlsbad and Marienbad or the alkaline waters of Vichy and Ems are recommended. In long-standing cases, the milder waters of Kissingen, Homburg, or Wiesbaden are suitable.

NERVOUS DYSPEPSIA includes many forms, the cases being due, not to an actual organic deficiency in or injury to the stomach, but to an exaggerated influence of the nervous system in increasing or diminishing the natural movements of the digestive organs, or altering the character of their secretions. There may be no apparent cause for the dyspepsia beyond the fact that the person is of a nervous temperament, or there may be trouble in other organs, and particularly in women in the womb or ovaries, or the nervous system may be temporarily excited or worn out. These forms of dyspepsia occur also in alcoholics, in great brain-workers, and

in people subject to constant exhaustion, and are very liable to be associated with mental depression and the moody critical state known as 'hypochondriasis'. To this class belong the following, among other groups of symptoms: *Acute dilatation* arises readily in some people when food is taken during exhaustion, such as that caused by a long walk or climbing a mountain, or too soon after a severe surgical operation. The stomach distends, and can neither digest nor expel its contents. Ineffectual attempts are made at vomiting, and unless the stomach be relieved of its contents by a smart emetic or by the stomach tube, the result may sometimes be dangerous even to life. *Periodic vomiting* is a similar but slighter condition which comes on now and then in people with irritable stomach, prone at other times to suffer from acid dyspepsia. It is known also as 'acute catarrh', and as 'bilious attack'. Digestion ceases for the time being, and the stomach contents, often followed by bile from the intestine, are vomited up. It is due usually to an indiscretion in diet, and in women is sometimes associated with irregularity of the menstrual function. *Atonic dyspepsia* is a chronic condition which is practically the reverse of acid dyspepsia. The secretion of juice may fail, or the stomach walls may lose their activity and lapse into a weak, flabby condition of partial dilatation. It occurs especially in people of feeble general health, for example, in consumptives, or is sometimes the result of long-continued abuse of the stomach by over-feeding. *Spasm* is an acute condition of the opposite nature. It comes on from time to time, often associated with acid dyspepsia, and causes severe griping pains very similar to colic. *Flatulence* is a condition which may be due either to fermentation in the intestine or to nervous influences. Persons subject to it are troubled by noisy action of the stomach and bowels, particularly when the limbs are at rest, and are liable to suffer from cold hands and feet, warm and cold flushes, and other signs of bad circulation.

Treatment.—For the conditions associated with vomiting see VOMITING. Atonic dyspepsia requires tonics, nutritious food of little bulk, change of air and scene, and cold baths. Spasm is relieved by hot compresses, mustard leaves to the pit of the stomach, and internally by belladonna, peppermint water, or tincture of valerian. Flatulence requires simple food, an avoidance of certain articles of diet, such as green vegetables, and general tonic treatment. (*See* FLATULENCE.) It is important to bear in mind that flatulence is often due to a habit of swallowing air, and can be relieved by breaking this habit.

FERMENTATIVE DYSPEPSIA is a very definite condition, which, however, is far less common than those already stated. It arises in connection with dilatation of the stomach due to some obstruction at its exit, in consequence of which food is retained, ferments, and distends the organ. In the majority of cases the gastric juice is not deficient. The most common cause is narrowing of the outlet by the scar of a previous and healed ulcer, while other causes are found in various displacements of the organ, pressure by other organs such as a floating kidney, and even tumors in the stomach wall.

Symptoms.—Great loss of appetite, a feeling of constant fullness and weight increased by food, belching up of foul-smelling gases, repeated vomiting of large quantities of fermenting, frothy, and half-digested food, great thirst, headache, and obstinate constipation are the main symptoms of this form of dyspepsia.

Treatment.—The washing out of the stomach, regularly, for a period of some weeks, either at night or in the morning, is the treatment *par excellence* of this condition. After having been shown a few times how to pass the stomach tube, the patient can do this for himself, and thereby obtain great relief.

The apparatus required for washing out the stomach is: a soft india-rubber stomach tube about 2 feet long; a glass tube 3 inches long to connect it with 4 feet of rubber tubing; and a glass or metal funnel to fit into the other end of the long piece of tubing. The method of use is as follows: the stomach tube is dipped in warm water and the end is then passed back into the throat; swallowing motions are at once made by the patient while the tube is pushed steadily onwards for a distance of 18 or

20 inches, by which time its end will have reached the stomach. If an inclination to retch be present, it is obviated by drawing deep breaths. Fluid is then poured into the funnel, and this being raised, the fluid runs down into the patient's stomach. Before the tube is quite empty the funnel is depressed into a pail or other receptacle standing on the floor, and the fluid, and other contents of the stomach, run off by siphon action. This is repeated till several quarts of fluid have been run into and out of the stomach, thoroughly cleansing its walls. The fluid used is generally warm water tinted pink with permanganate of potassium.

Further, a special diet is necessary. The dyspeptic should avoid fats and starchy foods, take all his nourishment in as dry a form as possible, eat only three meals daily, with no food between them, and limit the fluid he drinks to a quart or less each day. Lying upon the right side for half an hour some 2 or 3 hours after a meal enables the stomach to empty itself and so brings relief. The wearing of a supporting belt also helps to counteract the dilatation. (*See* BELTS AND BINDERS.) When the condition of dilatation is great and does not yield to simple treatment, the operation of gastro-enterostomy—by which an opening is made out of the lowest part of the stomach into a neighbouring loop of the small intestine—is sometimes helpful in cases of dilatation caused by narrowing of the scar following an ulcer

DYSPHAGIA is the medical term for difficulty in swallowing.

DYSPITUITARISM means disordered function of the pituitary body. (*See* PITUITARY BODY.)

DYSPNŒA (δύσπνοια) means difficulty in breathing. Orthopnœa means breathing possible only when sitting up.

DYSTOCIA means slow or painful birth of a child.

DYSTROPHY (δυσ-, badly; τρέφω, I nourish) means defective or faulty nutrition, and is a term generally applied to some developmental change in the muscles occurring independently of the nervous system. The best-known forms are those known as *progressive muscular dystrophy*, in which the groups of muscles, especially those of the calves and buttocks, undergo a fatty degeneration associated with increase in size but weakness in power; and *adiposo-genital dystrophy* associated with defect of the pituitary gland.

DYSURIA means difficulty or pain in urination.

E

EAR.—The ear is concerned with two functions. The more evident is that of the sense of hearing, the other, with which the ear has more or less to do, is the sense of equilibration and

FIG. 154.—The auricle, with its various parts named.

of motion. The organ is divided into three parts: (*a*) the external ear, consisting of the auricle on the surface of the head, and the tube which leads inwards to the drum; (*b*) the middle ear, or 'drum', separated from the former by the tympanic membrane, and from the internal ear by two other membranes, but communicating with the throat by the Eustachian tube; and (*c*) the internal ear, comprising the complicated labyrinth from which runs the auditory nerve into the brain.

External ear.—The auricle or pinna, shaped in man something like a crumpled-up funnel, is not essential to the sense of hearing, though in animals it appears to play an important part. It consists of a framework of elastic cartilage covered by skin, the lobule at the lower end being a small mass of fat. The various parts of the auricle are named as in Fig. 131. From the bottom of the concha the external auditory meatus runs inwards for an inch or an inch and a half, to end blindly at the drum. This passage is short in young children, in whom the drum is almost at the surface, and it lengthens as the skull bones develop. The outer half of the passage is surrounded by cartilage, lined by skin, on which are placed fine hairs pointing outwards, and glands secreting a small amount of wax. In the inner half, the skin is smooth and lies directly upon the temporal bone, in the substance of which the whole hearing apparatus is enclosed. The two parts meet at a slight angle, so as to give the whole passage a curve which can be straightened by pulling the auricle upwards and backwards, when the drum can often be clearly seen by a good light.

Middle ear.—The tympanic membrane, forming the drum, is stretched completely across the end of the passage, being placed rather obliquely, so that it makes an angle of about 60° with the floor. It is about one-third of an inch across, as thick as a piece of gold-beater's skin, and white or pale pink in colour, so that it is partly transparent, and some of the contents of the middle ear shine through it.

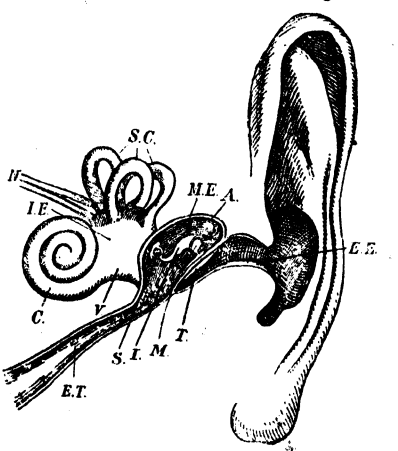

FIG. 155.—Diagram of section through the ear, *EE*, External, *ME*, middle, *IE*, internal, ear; *T*, tympanic membrane; *M*, malleus; *I*, incus; *S*, stapes; *A*, opening to mastoid antrum; *ET*, Eustachian tube; *C*, cochlea; *SC*, semicircular canals; *V*, utricle; *N*, auditory nerve. (Schmeil's *Zoology*.)

From this description it can be readily understood how easily it is torn, and how dangerous to it are blows on the side of the head, and rough manipulations to remove wax, etc. The cavity of the middle ear is about one-third of

an inch wide and one-sixth of an inch in depth from the tympanic membrane to the inner wall of bone. Although important structures, like the facial nerve, which runs down behind it, lie close around, its only important contents are three small bones, the malleus (hammer), incus (anvil), and stapes (stirrup), collectively known as the 'auditory ossicles', with two minute muscles which regulate their movements, and the chorda tympani nerve which runs across the cavity. The auditory ossicles are of great importance. The malleus has a long spicule of bone, the 'handle', embedded in the substance of the drum, while its 'head' is in contact with the incus. The incus, suspended by one process of bone, has another affixed to the stapes, and the latter fits, by what would in a real stirrup be the footpiece, into one (fenestra ovalis) of the two openings which lead through the inner wall of the middle ear into the internal ear. Accordingly these three bones form a chain across the middle ear, connecting the drum with the internal ear. Their function is to convert the air-waves, which strike upon the drum, into mechanical movements, which can affect the fluid in the inner ear, because air-waves produce little effect upon fluid directly.

The middle ear has two connections which are of great importance as regards disease; in front, it communicates by a passage 1½ inches long, the Eustachian tube, with the upper part of the throat, which lies behind the nose; behind and above, it opens into a cavity known as the 'mastoid antrum'. The Eustachian tube admits air from the throat, and so keeps the pressure on both sides of the drum fairly equal. Serious deafness is produced by its closure, and it also, unfortunately, forms a channel by which acute inflammation in measles, scarlatina, etc., spreads to the ear. The antrum occupies the interior of the projecting mass of bone, the mastoid process, which is felt on the surface of the head behind the ear, and this cavity, along with the middle ear, is separated from the interior of the skull only by a thin plate of bone about the thickness of a calling card.

Internal ear.—This consists of a complex system of hollows in the substance of the temporal bone enclosing a membranous duplicate. Between the membrane and the bone is a fluid known as perilymph, while the membrane is distended by another collection of fluid known as endolymph. This membranous labyrinth, as it is called, consists of two parts. The hinder part, comprising a sac, called the utricle, and three short semicircular canals opening at each end into it, is the part probably concerned with the balancing sense; the forward part consists of another small bag, the saccule, and of a still more important part, the cochlea, and is the part concerned in hearing. In the cochlea three tubes, known as the scala tympani, scala media, and scala vestibuli, placed side by side (the middle one

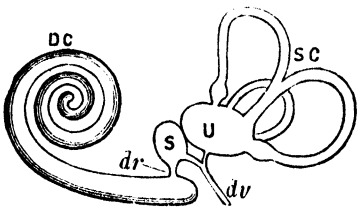

FIG. 156.—Diagram of the membranous labyrinth. *DC*, Ductus cochlearis; *dr*, ductus reuniens; *S*, sacculus; *U*, utriculus; *dv*, ductus vestibuli; *SC*, semicircular canals. (Turner's *Anatomy*.)

being part of the membranous labyrinth), take two and a half spiral turns round a central stem, after the manner of a snail's shell. In the central one (scala media) is placed the apparatus (organ of Corti) on which the sound-waves are finally received and by which the sounds are communicated to the auditory nerve, which ends in filaments to this organ of Corti. The essential parts in the organ of Corti are a double row of rods and several rows of cells furnished with fine hairs of varying length. This organ runs the whole length of the scala media. Different musical notes are perhaps appreciated by different rods and hair cells.

The act of hearing.—When sound-waves in the air reach the ear, the drum is alternately pressed in and pulled out, in consequence of which a to-and-fro movement is communicated to the chain of ossicles. The foot of the stapes communicates these move-

ments to the perilymph in the scala tympani, by which in turn the fluid of the scala media is set in motion. Finally these motions reach the delicate filaments placed in the organ of Corti, and so affect the nerve of hearing, which conveys impressions to the centre in the brain. There are two theories of hearing. The first is that of Helmholtz, who compared the organ of Corti to a piano and presumed that each sound caused a vibration of a corresponding part of Corti's organ. The second and later theory of Keith and Wrightson assumes that the entire organ of Corti is thrown into vibration by sounds and that the nature of the sound is analysed and perceived by the hearing-centre in the brain. The vibrations in the fluid of the internal ear are prevented from doing damage by the fact that the scala vestibuli, which communicates with the scala tympani at the apex of the cochlea, is separated at its other end from the middle ear only by a membrane in the fenestra rotunda, and this bulges out as the stapes is driven in, and *vice versa*.

EAR, DISEASES OF. — Troubles connected with the ear should, when possible, be treated early, both on account of this organ's importance, and because, owing to its delicacy and inaccessibility, little can be done for unpleasant symptoms like deafness and ringing due to advanced disease. Mention has been made of the importance of the connection between throat and middle ear by way of the Eustachian tube, both as regards the maintenance of good hearing, and as regards the spread of inflammation. There are several simple procedures connected with the management of the ear which demand explanation.

Examination of the external ear is carried out by placing the person's head in a good light near a window, inclining the head away from the window a little, pulling the auricle upwards and backwards, and if a conical speculum be at hand introducing this with a gentle screwing movement. The drum and deeper part of the external ear may then be viewed. It is often more convenient to use the light reflected from a concave mirror, through a hole in the centre of which the physician looks, or the light of a forehead lamp.

Syringing is done with a large-sized glass or metal syringe provided with a short point (not longer than 1 inch, so that no damage to the drum can result). The auricle is pulled gently up

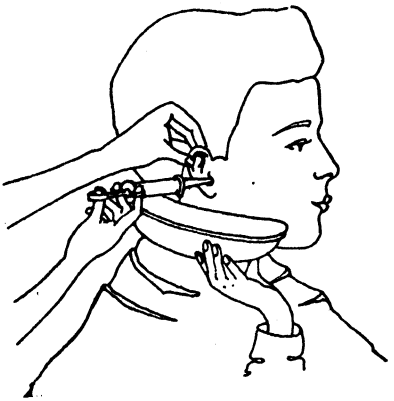

FIG. 157.—Method of syringing ear.

and back while a steady stream from the syringe is directed along the upper wall, and flows out along the lower one. In syringing the ear of a child the point of the syringe should not be inserted within the shallow passage at all.

Inflation of the middle ear is performed for cases in which the Eustachian tube is partly blocked, and the drum indrawn. A catheter is passed along the floor of the nose into the opening of the Eustachian tube in the throat, and forcible inflation made through this by means of an india-rubber bag (Politzer's bag). Or the bag is used to blow up one nostril, the other being closed, while the Eustachian tube is kept open by one of the following devices. The person swallows a mouthful of water, or pronounces some guttural, such as 'Huck', so as to raise the soft palate and close the opening between the nose and throat; and at this moment the bag is suddenly squeezed. The middle ear may also be inflated by forcibly expelling air from the chest while the mouth and nose are closed. The fact of whether air enters the middle ear becomes plain to the person himself by a click

followed by a slight ringing in the ear, and often by improved hearing, and to the surgeon by means of an india-

FIG. 158.—Method of using Politzer bag.

rubber tube, a couple of feet long, connecting his ear with the patient's ear, through which he hears the click of the distended drum.

Tuning-fork test is used to test the internal ear. When a vibrating fork is placed on the centre of the forehead it is heard equally in both ears, the sound being conducted through the bones of the head. If one ear be closed, it is heard better in that ear. Accordingly, if one ear be deaf, and the sound of the fork placed on the forehead is heard better in that ear, the deafness is due to middle ear disease. While, if the ear be deaf to the fork when placed on the forehead, as well as when held near the ear, the internal ear or nerve mechanism is at fault.

General symptoms.—The following are some of the chief symptoms of ear disease :

DEAFNESS (*see* DEAFNESS).

EARACHE is in general due to acute inflammation in the middle ear, but may also be due to chronic inflammation, or to boils, eczema, wax, or neuralgia, affecting the outer ear. Pain in this region may also be caused by carious teeth. The treatment varies, of course, with the cause, but the pain may generally be relieved to some extent by applying hot flannel or a hot-water bag to the side of the head. Ear drops consisting of carbolic acid (10 grains) in glycerin

(2 drams) have a soothing and antiseptic effect when one or two drops are instilled into the ear. A few drops of laudanum have a similar effect when dropped from a warm teaspoon. Warm salt solution (a teaspoonful to every tumblerful of water) may also be gently run into the ear for two hours with soothing effect. A small blister applied to the skin behind the ear often gives relief in prolonged cases. The ear should not be syringed, which is very painful in a case of inflammation, nor should oil be dropped in, as is often done. When inflammation is very acute, it is sometimes necessary for the surgeon to puncture the drum in its lower part.

RINGING in the ear, or ' tinnitus ', is sometimes a very annoying symptom It may take various forms, but is in general accompanied by catarrh of some part of the ear. Clicking similar to the noise made by winding up a watch, and caused by spasm of small muscles about the throat and ear, is relieved by general tonic treatment. Pulsating or throbbing in the ear is sometimes due to bloodlessness, or to large doses of quinine or salicylate of soda, and passes off as the bloodlessness is treated or the drugs producing it discontinued. Blowing, hissing, and whistling noises, like those made by an escape of steam, or by a boiling kettle, are the most common and most annoying forms. Usually they are associated with middle-ear catarrh, but they are very often due to gout or rheumatism or associated with high blood-pressure and diminish as the general disease is treated. Accompanied by deafness, ringing is not infrequently due to wax. Blisters behind the ear, the passage of a galvanic current through the head, and inflation of the middle ear generally give only temporary relief from ringing. Bromide of potassium or dilute hydrobromic acid is the drug which is most often successful by internal administration. Musical tinnitus sometimes occurs, in which the sound of bells, or of short passages of music, is repeated constantly. It is due to similar causes. A high crescendo musical note, followed by giddiness, is one of the symptoms of Ménière's disease.

DISCHARGE from the ear may arise

EAR, DISEASES OF

in the external ear as the result of eczema, boils, or the irritation caused by a plug of wax or foreign body, but, in the absence of these, comes in the great majority of cases from a chronic suppuration in the middle ear through a perforation in the drum. The suppuration may begin in an acute inflammation of the middle ear arising in the course of a 'cold in the head', or may result from scarlet fever, or measles, or may be due to disease of the bone in or around the ear, or may simply have a slow onset, without apparent cause, in weakly persons, especially in children. The discharge may be thick and yellowish, in cases which are fairly acute, or thin and watery in cases which are improving, or brownish and evil-smelling in cases which have been neglected, or in which the bone is diseased. There are two common fallacies regarding this condition. One is that a discharge from the ear is a trifling thing, and that, on the whole, it is undesirable to take means to cure it. In reality the presence of suppuration is accompanied usually by increasing deafness, and is attended always by the risk of an abscess in the mastoid antrum, or even within the skull. The other fallacy is that a perforation in the drum necessarily entails great deafness. As a matter of fact, unless the perforation be so large as to interfere with the tension of the drum, it causes little interference with hearing, the real cause of deafness in suppurative middle-ear disease being adhesions which bind down the ossicles and prevent their movements. In the treatment of a case of suppuration, the most important point is to keep the outer ear clean by syringing, which is done, as a rule, with boracic acid solution. For the reduction of the discharge, three methods are in vogue, according to the circumstances of the case: (1) the use of instillations is carried out by dropping into and holding in the ear for fifteen to twenty minutes some astringent and antiseptic fluid, such as a mixture of hydrogen peroxide and rectified spirit in equal parts, or a solution of picric acid (1 grain) in rectified spirit (2 drams). This is repeated every day or every few days, and is most successful in cases where the discharge is thin and small in amount. (2) The dry method is performed by syringing, and then carefully mopping out the outer ear with a piece of wool. Next, powdered boracic acid is blown in by a quill, and gently pressed down under cotton-wool. This is repeated next day or after a few days, so soon in fact as the discharge has soaked through the powder. (3) The absorbent method is simplest, and is most easily borne by a tender ear. It consists, as in the others, in cleansing the ear by syringing and then gently pushing in a wick-shaped strip of gauze. The latter must be changed two or three times each day. If these methods fail, it may be necessary for a surgeon, in bad cases, to remove the ossicles and remains of the drum, and so to convert the middle ear into a simple cavity, which can be easily kept clean. Removal of the malleus and incus does not necessarily produce great deafness; indeed the hearing may be improved after this operation.

WAX in the ear is the commonest cause of deafness, sometimes even of several years' standing. It is to be removed by syringing with warm water containing two teaspoonfuls of baking soda to a tumblerful of water, or a weak solution of lysol. If the wax be very hard it should be softened by making the person lie down on his side for half an hour with the affected ear upwards, into which is poured some of this solution, or a few drops of sweet oil. At the end of half an hour the syringing is repeated.

FOREIGN BODIES, such as peas, gravel, or slate pencils are often pushed by children into the ear, and are extremely difficult to remove. An attempt should first of all be made by syringing as for wax. In the case of peas, however, it is better to syringe with warm oil, because water causes the dried pea to swell and block the passage still more. If syringing be ineffectual, no attempt should be made by unskilful persons with hair-pins, bent wires, or the like, to remove the object, which is apt by such means to be pushed through the drum.

BOILS in the skin lining the outer ear give rise to intense pain. This pain is much relieved by running gently into

the ear a quantity of warm carbolic lotion (1 in 40), or by packing the ear lightly with a piece of gauze dipped in a 10 per cent solution of ichthyol in water or glycerin. Relief is also gained when the boil is incised.

ECZEMA, consisting of a cracked condition of the skin in the ear, with watery discharge and intense irritation, is common, as an acute affection, in infants, and as a chronic one in gouty and rheumatic adults. In children, syringing with Goulard's water and application of vaseline, with care not to bring soap in contact with the ear for a time, affords relief. In adults, weak nitrate of mercury ointment, or tar ointment mixed with vaseline, applied with a brush several times daily, does good.

TUMORS in the ear are mostly either outgrowths from the surrounding bone or soft polypi. The former may block the passage and interfere with hearing, but have often a narrow neck, so that they can be easily removed. Polypi usually develop as a result of the irritation set up by a chronic discharge, and shrivel up as the discharge is cured, though a large one may have to be removed in order to get to the drum.

ACUTE INFLAMMATION (otitis) is already referred to under earache.

CHRONIC INFLAMMATION is referred to above, under Discharge from the ear. There is a form of inflammation (catarrh) in which no true suppuration takes place, and, if the drum is not perforated, there is no discharge outwards. This condition, which leads to adhesions about the ossicles and thickening of the drum, interferes greatly with hearing, and causes a slowly advancing and most intractable form of deafness. It often runs in families, and is frequently preceded by adenoid growths in the post-nasal space during childhood.

MASTOID DISEASE is a serious complication of inflammation in the ear. The mastoid antrum and its connection with the middle ear have been mentioned under EAR. As a rule, inflammation in this cavity arises by direct spread of a long-standing suppuration from the middle ear, sometimes in consequence of neglect to keep the ear clean and prevent discharge from accumulating, though in influenza and some other conditions the mastoid antrum has been known to become primarily affected. The signs of this condition are rather vague, but include swelling and tenderness of the skin behind the ear, redness and swelling inside the ear, pain in the side of the head, feverishness, and discharge of foul-smelling, brownish material from the ear. If the condition be left to itself it may, after a period of inflammation, resolve itself without the formation of an abscess, but the dangers are great. More usually an abscess forms, and the pus, if unrelieved, bursts, according to the nature of the surrounding bone, upwards or backwards into the skull at the base of the brain, or outwards through the skin, or downwards among the muscles of the neck. Accordingly, in early cases, the surgeon cuts through the skin behind the ear to relieve congestion, but once an abscess has formed, he chisels down through the bone of the mastoid process till he can clear out the pus, and completes his operation by making a free communication between the antrum and the ear, so that pus cannot collect again when the outside wound heals.

EBURNATION (*ebur*, ivory) is a process of hardening and polishing which takes place at the ends of bones, giving them an ivory-like appearance. It is caused by the wearing away of the smooth plates of cartilage which in health cover the ends of the bones, in consequence of osteo-arthritis.

ECBOLICS (ἐκβάλλω, I throw out) are drugs which cause contraction of the womb, such as ergot.

ECCHYMOSIS (ἐκ, out of; χυμός, juice) means the discoloured patch resulting from escape of blood into the tissues just under the skin, often from bruising.

ECCYESIS is the term applied to the condition in which the egg is impregnated, and the resulting fœtus develops, outside the uterus, the normal place for these events.

ECGONINE is another name for cocaine.

ECHINOCOCCUS (ἐχῖνος, hedgehog; κόκκος, berry) is the immature form of a small tapeworm *Taenia echinococcus* found in dogs, wolves, and jackals, from

which human beings become infected, so that they harbour the immature parasite in the form known as hydatid cyst. (*See* PARASITES.)

ECHOLALIA is a term applied to the meaningless repetition, by a person suffering from mental degeneration, of words and phrases addressed to him.

ECLAMPSIA (ἐκλάμπω, I explode) is a general name for convulsive seizures of sudden onset. (*See* CONVULSIONS, EPILEPSY, URÆMIA.) The name is especially applied to convulsions arising in connection with pregnancy, which are of a very dangerous type. This condition is said to occur in one out of every 500 cases of pregnancy. It occurs especially in the later months and at the time of delivery, but a certain proportion of cases are manifest only after delivery has taken place. The cause of the condition is not definitely known, but it appears to be of the nature of a poisoning process from products derived either from the after-birth or from defective chemical changes in the blood. In some cases the kidneys are profoundly affected, and in this way the condition is much aggravated.

Symptoms.—There are several warning symptoms, such as dizziness, headache, vomiting, and secretion of urine, which is found to contain albumin. These symptoms may be present for some days or weeks before the seizure takes place. The seizure consists of rigidity of the body with unconsciousness, followed by twitching in the face and limbs lasting for one or two minutes and then passing into a state of deep unconsciousness with stertorous breathing. In mild cases there are a few fits at long intervals and the patient recovers consciousness between them, but in severer cases the fits succeed one another so rapidly that there is no appreciable interval. In cases which progress to a fatal termination, the pulse and temperature rise, and cerebral hæmorrhage or pneumonia may supervene, or the breathing may gradually cease. About one-quarter of the cases end in this way.

Treatment.—The treatment of the seizures is that generally applicable to convulsions of any kind, morphia and chloral being especially used as sedatives. Another substance frequently used by hypodermic injection is veratrone, which has the effect of lowering blood-pressure and producing profuse perspiration. Bleeding from a vein in the arm is another remedy to which recourse is frequently had, and, in some cases, the administration of thyroid extract appears to have a very salutary effect. Some authorities recommend that the birth of the child should be hastened, but at the present day the tendency is to leave this part of the treatment to nature.

ECSTASY (ἔκστασις, from ἐξίστημι, I put out of its place, I alter) is a term applied to a morbid mental condition in which the mind is entirely absorbed in the contemplation of one dominant idea or object, and loses for the time its normal self-control. This condition usually presents itself as a kind of temporary religious insanity, and has frequently appeared as an epidemic.

ECTHYMA (ἔκθυμα, a pustule) is the term applied to a pustular eruption accompanied by surrounding inflammation. The pustules burst and discharge, leaving pigmental scars. It is associated with a filthy condition of the skin and the presence of parasites.

ECTO- (ἐκτός, without) is a prefix meaning on the outside.

ECTOPIC (ἐκ, out of; τόπος, place) means out of the usual place. For example, in congenital displacement of the heart outside the thoracic cavity it is said to be ectopic, while an 'ectopic gestation' means a pregnancy in some organ outside of the womb.

ECTROMELIA means the absence of a limb or limbs from congenital causes.

ECTROPION (ἐκ, out of; τρέπω, I turn) is a condition of the eyelid, usually the lower, in which the skin is contracted so as to turn the inside of the lid outwards. It is caused usually by scars due to burns and the like, and is remedied by operation.

ECZEMA (ἐκζέω, I bubble up) is a superficial disease of the skin of inflammatory nature, characterised by a scaly and fissured condition of the

cuticle, and a sticky watery discharge, and associated with itching or even pain. The condition is very important, because it is said to embrace about one-half of all the cases of skin disease. It is often called by the more general term of 'dermatitis' or inflammation of the skin. (*See* SKIN, DISEASES OF.)

EDEMA is the U.S.A. spelling of œdema. (*See* DROPSY.)

EFFERENT (*efferens*, carrying out) is the term applied to vessels which convey away blood or a secretion from a part, or of nerves which carry nerve impulses outwards from the nerve-centres.

EFFERVESCING DRAUGHTS (*see* CITRIC ACID).

EFFLEURAGE is a form of massage by gentle stroking movements.

EFFORT SYNDROME, or D.A.H. (Disordered Action of the Heart), is a condition in which symptoms of a weak heart and circulation occur after exercise. There is no evidence of heart disease and psychological factors are thought to be of importance. The condition was common in the armies after the four years' war of 1914-1918.

EFFUSION (*effundo*, I pour out) means a pouring out of fluid from the vessels in which it is naturally enclosed into the substance of the organs, or into cavities of the body, as a result of inflammation or of injury: for example, pleurisy with effusion, effusions into joints, and effusion of blood.

EGG is a term applied to any animal ovum. The hen's egg forms an easily digestible article of food, and weighs on an average 2 oz. One egg consists of 6 grams of protein and 6 grams of fat, providing energy equivalent to 80 calories. The yolk of the egg is of special value as a food. The best test for a stale egg is to dissolve 2 oz. of salt in a pint of water; fresh eggs placed in the solution sink and stale eggs float.

ELATERIUM is the sediment obtained from the juice of *Ecballium elaterium*, the squirting cucumber. It is dried to form thin, greenish-grey flakes, and an active principle elaterin is also extracted from it. It has a powerful irritant action upon the skin and mucous membranes, and is used as a purgative to produce copious watery motions in cases of pleurisy, dropsy, and apoplexy.

ELBOW is the joint formed between the humerus above and the radius and ulna below. The humerus has at its lower end a rounded surface, against which the head of the radius moves, and a deep groove to which a saddle-shaped surface at the upper end of the ulna fits. The head of the radius rests upon a projection of the ulna and is bound to it by a stout annular ligament, within which it can rotate. Two important movements take place at this joint, a flail-like backward and forward movement of the radius and ulna moving together upon the humerus, and a rotary movement of the radius on the ulna, by which the lower end of the radius is crossed over the ulna and again brought side by side with it, according as the hand is turned palm downwards and palm upwards. The joint is secured at the sides by strong lateral ligaments, and at the back and front is covered by powerful muscles. The ulnar nerve as it passes down to the forearm has an exposed position behind the inner edge of the humerus at its lower end, and is popularly known as the 'funny-bone'. The elbow is seldom dislocated, but a not uncommon accident consists in the chipping off, through a fall on the elbow, of the olecranon process which forms the point behind the joint. *Miner's Elbow* or *Beat Elbow* is the term applied to an inflammatory condition of the bursa over the point of the elbow, caused by resting the weight of the body on the elbow in hewing coal. The condition corresponds to housemaid's knee in the lower limb, and occurs not only in miners but sometimes in school children and other persons who lean upon or bruise the point of the elbow. (*See* BURSITIS.) *Tennis Elbow* is a term applied to a pain over the lower end of the humerus due to mild inflammation in the bone caused by strains

and jars in playing tennis and similar games. *Pulled Elbow* is the name applied to a painful condition of the elbow in young children, constituting a slight dislocation of the head of the radius from beneath the ligament which should bind it to the ulna, caused by a jerk of the hand.

ELECTRICAL INJURIES are becoming more frequent owing to the increasing use of electricity. Such injuries are usually caused by the passage through the body of an electric current of high voltage owing to accidental contact with a live wire or to a discharge of lightning. The general effects produced are included under the term electric shock, but vary greatly in degree. The local effects include spasmodic contraction of muscles, fracture of bones, and in severe cases more or less widespread destruction of tissues which may amount simply to burns of the skin or may include necrosis of masses of muscle and internal organs. Fright due to unexpectedness of the shock and pain due to the sudden cramp of muscles are the commonest symptoms and in most cases pass off in a few minutes or less. In more severe cases, especially when the person has remained in contact with a live wire for some time or has been unable to let go of the electrical contact owing to spasmodic contraction of his muscles, the effects are more pronounced and may be those of concussion of the brain or of compression of the brain (*see* BRAIN, DISEASES OF). In still severer cases, death may ensue either from paralysis of the respiration or stoppage of the heart's action. In either instance, the condition may be at first one of suspended animation and death may not ensue if prompt measures are taken for treatment.

With regard to the after-effects of an electric shock, recovery in slighter cases is almost immediate, but in cases where the discharge of current has been prolonged, the person is sometimes left nervous and debilitated for some months. The more permanent effects depend upon the extent to which tissues have been destroyed. Fractures and splitting of bones are frequently caused by very powerful currents, but these usually mend rapidly and thoroughly. Dislocation of a joint is sometimes produced by violent muscular spasm. Masses of muscle and areas of skin may be destroyed, and if these injuries are extensive, a long time may be required for the absorption or sloughing away of the dead tissues and for healing. A remarkable fact, however, is that electrical injuries show little tendency to become septic as compared with similar injuries due to other causes, and while loss of a part of the body may take place, healing is in the end usually very satisfactory.

With regard to the amount of current necessary to produce serious results, this varies enormously according to circumstances. It has been found by experiment that a current at 100 volts and of $\frac{1}{10}$ ampere invariably kills an animal such as a dog. On the other hand, instances are frequent in human beings of brief contact with a live wire at 250 or more volts which produces merely an unpleasant momentary cramp and a small burn. The amperage of the current appears to be of more importance than the voltage, and the direct current is more injurious than an alternating current of the same voltage. Physical factors are probably the most important in regard to the effects produced by a given strength of current, and after a shock is received through dry shoes or dry clothing, the effect may be negligible as compared with that of contact made with a bare part of the body, especially when the skin is damp or perspiring, or of contact through wet feet. Mental conditions are also of considerable importance, for if a shock is expected the general effect is not so severe as when it is quite unforeseen, especially in the case of a nervous type of person. For this reason, electricians, who are constantly in the course of their work accustomed to electric discharges, may be unaffected by an amount of current which would produce dangerous results in a nervous person.

Treatment.—No electrical apparatus or switch should be touched by anyone who is in metallic contact with the ground, such as through a metal pipe, especially, for example, from a bath. The first necessity in regard to a person through whose body a powerful electric current is passing is to break

the current. This can sometimes be done by turning off a switch. If the victim is grasping or in contact with a live wire, the contact may be severed with safety only by someone wearing rubber gloves or rubber boots, but as these are not likely to be immediately available, his hands may be protected by a thick wrapping of dry cloth, or the live wire may be hooked or pushed out of the way with a long wooden stick. If the injured person is unconscious, and especially if breathing has stopped, *artificial respiration should be applied and continued even for hours.* Schäfer's method is the best, as described under DROWNING, RECOVERY FROM. When the patient begins to breathe again he must be treated for shock, *i.e.* put to bed and given hot water bottles and hot drinks. Electrical burns are treated on the same lines as ordinary burns. If the patient shows undue excitement and restlessness, sedatives may later be necessary. The local destructive effects of a powerful current, including burns, fractures, and sloughing of large masses of tissue, are treated later by ordinary surgical means, but strong and irritating antiseptics should be avoided. Bleeding from damaged vessels is liable to occur a few days after a severe injury, and is treated by the ordinary means for arrest of hæmorrhage.

ELECTRICITY IN MEDICINE.—As electricity has proved to be a form of energy, very wide in usefulness and extremely convenient in application, it has become greatly employed in medicine. Several forms of electricity are of great importance also in regard to diagnosis, especially in conditions of the nervous system. Electricity is also of great indirect importance in the use of various instruments and forms of apparatus, for example, in lighting small lamps for examination of the eye, throat, etc., in heating cauteries, and in the production of X-rays and ultra-violet rays. It has, however, been credited with powers of healing far beyond those that it is capable of achieving. Electricity is generally spoken of as existing in different forms, but these differ in pressure, in amount, and in duration, rather than in any essential quality. They are named as follows:

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(*a*) Static, or Frictional, or Franklinic; (*b*) Galvanic or Voltaic; (*c*) Faradic or Induced; (*d*) Alternating or Sinusoidal; (*e*) High Frequency or D'Arsonvalism.

Static electricity has been recognised, by some of its simplest phenomena, from the earliest times. The name electricity is derived from the Greek word ἤλεκτρον, meaning 'amber', because it is said that Thales of Miletus first discovered this force by noticing that a piece of amber, rubbed with a dry cloth, had the power of attracting other small bodies to itself. Subsequently it was found that other bodies, such as sulphur, wax, and glass, have similar properties, and a treatise, *De Magnete*, was published on the subject by Gilbert, physician to Queen Elizabeth, in 1600. This form of electricity is often called 'Franklinic', after Benjamin Franklin, who, in the middle of the eighteenth century, experimented much with it in the United States. It is also interesting to note that Wesley, the famous preacher, concerned himself much with the subject of electricity, and about the same time published a treatise on its medical applications known as *The Desideratum, or Electricity made Plain and Useful, by a Lover of Mankind and Common Sense.*

When a glass rod is rubbed with a piece of dry flannel, the two gain certain properties. If the glass rod be brought near a light pith-ball or piece of paper hanging by a dry silk thread, the pith-ball is attracted towards the rod, but if the two be allowed to touch for a moment, the pith-ball is now as energetically repelled when the rod is brought near it. If, however, the piece of flannel be brought near the ball, the latter is attracted to it. To express these facts conveniently it is said that there are two 'kinds' of electricity, 'positive' and 'negative', the glass rod becoming positively electrified by the rubbing, the flannel negatively electrified, and further, that like electricities repel one another. Accordingly, when the positively electrified glass rod is brought near the pith-ball, the negative electricity in the latter is supposed to separate from the positive (the ball having till now been uniformly charged with the two) and to collect on that side of the

ball nearest to the rod, while the positive electricity is repelled to the point farthest off. When the rod and ball touch, the negative electricity escapes to the rod, leaving the ball positively electrified, so that it is now repelled by the positive electricity of the rod and attracted by the negative electricity of the flannel. Positive electricity is designated shortly by the sign +, and negative by the sign −, while the power possessed by the electricity of passing from pith-ball to glass rod, carrying the ball with it, is known as ' potential ', or pressure, or electro-motive force (E.M.F.). All bodies have these properties, developing, when suddenly separated or broken, this ' difference of potential ', the amount and nature of the force produced depending on the nature of the bodies in question. But while in the case of certain bodies called ' non-conductors ', such as glass, porcelain, sealing-wax, india-rubber, gutta-percha, dry wool, silk, and amber, the electricity remains upon the surface where it is produced, in the case of others, known as ' conductors ', such as metals, salt solutions, and the bodies of animals and plants, it flows away through the body so soon as formed, and therefore does not show its presence. Static electricity is closely related to magnetism, a set of properties possessed only by iron, steel, nickel, cobalt, and an iron-ore called ' lodestone '.

Static electricity may be stored up in large amount by means of the ' Leyden jar '. This consists of two conducting surfaces, such as tinfoil, placed one outside, the other inside of a glass jar, so that they are everywhere separated by a thin plate of glass. The outer one simply rests in contact with the earth, the inner is connected to a metal rod ending in a knob. Electrified bodies, like a rubbed glass rod, may be brought up to the knob time after time till the inner sheet of tinfoil becomes highly charged with positive electricity, which attracts negative electricity from the earth into the outside sheet. If the knob of a charged Leyden-jar be connected with the outside sheet of foil the two electricities combine suddenly, and if this contact be made through the human body, a severe momentary shock is felt.

For practical medical purposes, static electricity is produced by an influence machine consisting of several pairs of circular glass or vulcanite plates, which are driven in opposite directions. Each plate carries at starting a small amount of electricity ; and, as they revolve, the alternate plates generate increasing quantities of + and − electricity, which are drawn off to opposite sides of the machine by fine metal brushes. The electricity can be stored in Leyden jars, or used directly to electrify the body. For the latter purpose, the person sits upon a chair or couch, carefully insulated from the earth by glass legs, india-rubber mats, or other non-conductors, and becomes charged positively or negatively according to the manner in which he is connected with the machine. During the process of charging, a peculiar tingling over the skin is felt and the hair stands upright ; the breathing becomes more rapid, and during a séance of fifteen to twenty minutes the chemical changes which accompany bodily activity are markedly increased. The electricity is discharged by bringing a metal point or ball gradually towards the charged person, when, in the former case, a spray of air or ' souffle ' passes towards the point as the charge passes off, in the latter case sparks are drawn. Either form of discharge, especially the latter, has a very stimulating effect. Electropathic belts may produce static electricity in small amount, but any benefit derived from them is probably a merely mental one. The atmosphere, both upon high wooded mountains and in the neighbourhood of breaking waves, has, as Lord Kelvin demonstrated, a different electric state from the quiet air of inland plains, so that it is quite possible that some of the advantage derived from summer change to mountain and seaside resorts may be due to stimulation from this cause.

Galvanic electricity is so named after Galvani, professor at Bologna, who published researches upon what he called ' animal electricity ' in 1791. It also received the name ' voltaic ', after Volta, professor at Pavia, who in 1799 published researches showing that this type of electricity is really due to chemical action. He found that dis-

similar metals, moistened and brought in contact, became electrified, so that, when parts of these metals not in contact are connected by a conductor, such as copper wire, a constant current passes through the wire. As chemical action proceeds almost continuously, this current is also continuous; and for this reason, added to the facts that it is of moderate 'potential' or pressure and is easily produced, it is the most convenient for general medical use.

The choice of metals depends upon the fact that one must be very liable to chemical action, the other as little affected as possible by an oxidising agent. The principal metals may be arranged in a series, thus:

+ Sodium	Iron
Magnesium	Copper
Zinc	Silver
Lead	Gold
Tin	Platinum
	– Carbon

of which each one is more oxidisable than that following it, and becomes positively electrified when brought into contact with one of those lower down in the series. Zinc and carbon, or zinc and copper, on account of their distance apart in this scale, and their comparative cheapness, are the metals usually selected. A vessel containing two metal plates, for example, zinc and copper, immersed in a fluid which maintains chemical action, for example, sulphuric acid in water, is known as a 'galvanic cell'. A collection of such cells is called a 'battery'. When the plates are joined by a conducting wire an electric current passes along it from the copper (+ pole) to the zinc (– pole). At the same time there is set free, on the surface of the zinc plate, oxygen, which acts upon the zinc, and also produces sulphuric acid; while hydrogen is set free at the surface of the copper plate and escapes.

It is important to bear in mind also that if the current passing along the wire be passed for some distance through a moist decomposable substance, such as the tissues of the human body, a similar chemical action is produced at the points where the wire enters and leaves the substance, which are called the 'electrodes'. Thus oxygen is set free and acids formed at the electrode connected to the + pole (the anode), while hydrogen is set free and alkalies developed at the other, or – electrode (the cathode). This action, known as 'electrolysis', is much used in medicine for removing hairs, destroying nævi or birth-marks, and reducing the size of certain tumors, unsuitable for removal by the knife. There is a great difference between the action of the two electrodes, because the substances formed at the anode are caustic and germicidal in action, while those produced at the cathode have no such action. Accordingly, the anode (+ pole) is generally applied to the structure which it is desirable to destroy.

Another important property of electric currents, viz. the fact that a powerful current passing through a circuit heats any part which is of feeble conducting power, is utilised to heat cauteries for delicate surgical work, especially about the nose and throat, and also to light small incandescent lamps for internal examinations. The cautery consists of a piece of platinum (low conducting power), joining the ends of two large copper wires (high conducting power), so that, when the current passes, the former immediately becomes red or white hot, according to the intensity of the current.

Another method in which the galvanic current is employed is in order to carry drugs through the unbroken skin by the process known as 'ionisation'. (*See* IONIC MEDICATION.)

For medical purposes, a battery of ten to forty Leclanché cells is generally employed, or, in towns where the continuous current is used for lighting purposes, the current from the electric main, modified to suit the comparatively small pressure required, and yield 10 to 20 milliamperes.

Faradic electricity dates only from 1831, when it was discovered by Faraday that if two coils of wire be placed near one another, and if a galvanic current be suddenly passed through one of them and again stopped, a current is 'induced' in the second coil at the moments of 'closing' and of 'opening' the first circuit. This secondary current differs from the continuous galvanic current in two important particulars: (1) it is only

momentary in duration; (2) it has a much higher potential or pressure, and is therefore much more capable of traversing poor conductors like the human body. The currents induced in the secondary coil at opening and closing the primary coil run in opposite directions, and accordingly, if the primary current be very rapidly closed and opened, as, for example, by the vibration of a steel spring, an almost continuous series of 'alternating' currents is obtained in the secondary circuit.

A faradic current sufficient for medical purposes can be obtained from an apparatus consisting of the

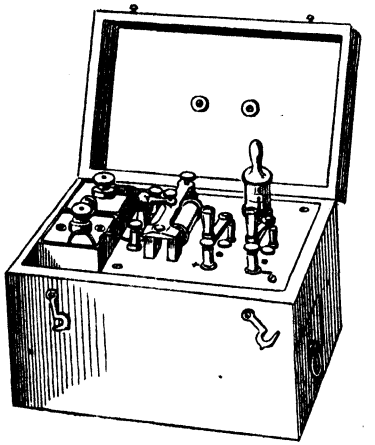

FIG. 159.—Small electric battery with two cells for faradisation.

following: a single galvanic cell connected to a primary coil, with an appliance to make and break the circuit; a secondary coil, which is connected by wires with two electrodes provided with handles, by which the electrodes can be applied to the surface of the body; and a core of iron which fits inside the primary coil, and which, becoming magnetised as the current passes through this coil, increases the effect upon the secondary coil. Such an apparatus can be obtained in the small compass of a box 4 or 5 inches each way.

The faradic current can be administered to the surface of the body generally by immersion of the patient in a warm bath into which two electrodes dip. (*See under* NEURASTHENIA.)

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For certain purposes, such as X-ray work, secondary coils with an enormous length of wire (even 40 miles) are used, the potential or pressure of the faradic current increasing with the number of turns taken by the wire in the secondary coil. By such coils a spark from 1 to 2 feet in length may be obtained.

The potential of faradic currents is high, in medical coils it may reach 20,000 or 100,000 volts, or about five hundred times as high as that of the powerful current which supplies a town, but the amount of electricity is very small. The difference between faradic and galvanic electricity presents some resemblance to the difference between a shower of swiftly falling raindrops, in which the total amount of water is small, and a large, sluggish river.

Alternating or sinusoidal currents.—An alternating current differs from the faradic current in the fact that the latter consists of a rapid series of sudden impulses or shocks, while with the sinusoidal or alternating current the strength gradually rises from nothing to a maximum, and falls away again to be followed immediately by a current in the reverse direction, which also grows to a maximum and wanes in the same manner. These currents rapidly succeed one another, so that the effect on the body is very much the same as that produced by the faradic current. Most systems of public distribution of electrical energy are carried out by alternating currents of this type, and by means of transformers they can be very readily converted into forms of electricity more suitable for medical use. The sinusoidal current, suitably reduced by apparatus, may be used for the electric bath; or may be used for stimulating nerves or muscles, especially when the current is rhythmically cut off and restored by an instrument known as a rhythmic interrupter. Sinusoidal currents on a small scale can be produced by bringing a magnet rapidly up to and away from a secondary coil, or making the coil move while the magnet remains fixed. Upon this principle are constructed box electric machines driven by hand which were formerly much used for medical purposes. The sinusoidal form of current

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generally has a very stinging effect on sensory nerves, and in this way is somewhat unpleasant for use.

High-frequency currents. — Of late years D'Arsonval, Tesla, and Elihu Thomson have, by apparatus constructed on the principle of the induction coil, but with other complicated arrangements designed to make and break the primary current several hundred thousand times a second, succeeded in producing currents of very peculiar properties. The effect upon the human body of these currents, huge in pressure but minute as regards duration, is something similar to that of a discharge of static electricity. The sensation is merely one of slight tingling when sparks are drawn, and there is no stimulation of muscles or nerves. This may possibly be explained by the currents being confined to the surface, and not passing through the substance of the body at all, or more probably by the theory of D'Arsonval, that the nerve endings are incapable of perceiving such extremely short vibrations. These 'high-frequency' currents formed at one time a very popular mode of stimulating treatment.

The apparatus by which these currents are produced consists essentially of Leyden jars, whose outer coats are united through a 'solenoid' or spiral of thick copper wire. The jars are rapidly charged and discharged by some source of high potential electricity; and, since the discharges from a Leyden jar have the property of taking place in an oscillatory manner, they induce in the solenoid corresponding secondary currents, which are of immensely rapid frequency. A second coil of thick wire, known as a 'resonator', is in general connected to the solenoid with the purpose of allowing of variations in the potential of the high-frequency discharges.

The currents are applied to the patient in various ways. (*a*) He may be connected to the two ends of the solenoid by thin wires provided with ordinary flat electrodes, from which the currents are simply passed through his body (direct application). (*b*) He may lie upon a couch connected with one end of the solenoid, while the cushion of the couch isolates him from a metal plate connected with the other end; he then becomes rapidly charged and discharged (condensation). (*c*) He may stand or lie within a wide secondary coil, and have currents induced in his body (auto-conduction) (*d*) One end of the solenoid may be connected to earth, while to the other end is attached an electrode which is cautiously approached to any desired part (local application). (*e*) The method of diathermy or thermo-penetration may be used to produce heat within the body. (*See* DIATHERMY.)

As already stated, the passage of high-frequency currents through the body produces no stimulation of muscles and no sensation, apart from that of heat caused by the resistance. There is a powerful effect, lasting many minutes, in diminishing the sensitiveness of the skin; the fullness of the blood-vessels in the skin, the output of body heat and of carbonic acid gas by the lungs are increased, and the quantity of urine passed becomes much greater.

Applications of electricity.— Specialists in medical electricity claim that they can, by this means, treat with advantage a great variety of diseases. There are certain, however, in which electricity is specially advantageous, and these only are mentioned below. The galvanic and faradic currents are of great value as a means of *diagnosis* in many conditions affecting nerves and muscles. In their natural condition nerves react to faradic or to interrupted galvanic currents, muscles to the latter. When excitability by faradisation is lost, it shows that the nerves in question are degenerating. The sudden commencement of a weak galvanic current should produce a contraction of muscles to which the cathode is applied, but, if a much stronger current be required, or if a contraction be obtained more readily with the anode, it shows that the muscles in question are also in process of degeneration. This is expressed by the statement that when the anodal closing contraction is stronger than the cathodal closing contraction the reaction of degeneration is present, or, put briefly, A.C.C.>K.C.C.=R.D.

PAIN, whether headache, neuralgia, sciatica, a chronic rheumatic condition,

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or due to several other causes, is almost always relieved temporarily, and sometimes, after a protracted course of treatment, severe pain is entirely removed by one of the following. The static breeze may be tried, applied to the seat of pain for some minutes every day. In painful nerve conditions like neuralgia, greater benefit is often derived from the galvanic current, a strong current of 20-30 milliamperes being used, and the anode (+ electrode) being placed over the course of the affected nerve. In most cases of vague but severe pain the faradic current is the simplest of application, and very effective. A small button electrode or wire-brush is applied to the seat of pain, the other electrode, moistened with common salt solution, to the neck, back, or other convenient part. The séance lasts, perhaps, a quarter of an hour, and is repeated several times daily. The bulk of the faradic apparatus is small, its cost trifling, and it may quite suitably be employed for such conditions as neuralgia or rheumatism by the sufferer himself. Diathermy is also very useful.

SPASMODIC CONDITIONS of all sorts, such as writer's cramp, are relieved or lessened by the static breeze, and still more by a strong galvanic current arranged so that the anode is close to the nerve or nerves connected with the spasmodically acting muscles. The anode decreases the conducting power of nerves for motor impulses as well as for painful sensations.

NEURASTHENIA, DEBILITY, and similar conditions of weakness, such as those which follow overwork, influenza, and typhoid fever, are immensely benefited by electrical applications. The static bath administered every day or every few days is often of great help. In other cases the faradic water bath is attended by greater stimulation, and, taken in the evening, is followed by refreshing sleep, which is often difficult for persons in this condition to obtain. Usually two cells and a small induction coil are employed, with a wooden bath containing water to which a handful of common salt or a little vinegar has been added. (*See* BATHS.) Two electrodes, which may be simply plates of zinc, hang in the water, protected by wood or wickerwork in such a way that they cannot touch the bather's body; or one electrode may be a rod grasped in his hand, in which case a much stronger stimulation is obtained. The bath should last only ten to twenty minutes. This bath is quite safe and suitable for home use. In such conditions the high-frequency applications are also of especial value.

SLEEPLESSNESS is often successfully treated by the static breeze applied to the head, often, also, by the faradic water bath, and by high-frequency currents.

PARALYSIS, such as infantile paralysis, or that following a stroke of apoplexy, or injury to a nerve, calls specially for the application of interrupted galvanic currents. The muscles in these and similar cases, where the nervous control usually exerted over them is lost, tend to waste. The application of interrupted galvanic currents of about 10 milliamperes' strength, or of these combined with faradisation, and assisted in every case by massage, and movements of the neighbouring joints, not only keeps up the nourishment of the paralysed muscles and prevents stiffness and wasting, but actually assists recovery. Treatment should be as far as possible daily, and must extend over very long periods.

CORPULENCE.—The faradic current has been applied by Professor Bergonié in the treatment of corpulence by means of a coil operated by a continuous current and an interrupter resembling a metronome. The patient sits in a chair and upon his limbs are laid bags filled with sand. When the current is passed through the patient, painless contractions of the muscles are produced which raise the heavy bags of sand, and in this way the patient performs physical work without any mental or physical effort, and thus reduces his store of fatty tissue without increasing his appetite too much or straining the heart or lungs.

CONSTIPATION, which is often due to irregular muscular action in the wall of the bowel, may sometimes be alleviated in very bad cases by interrupted galvanic or combined galvanic and faradic currents. A special electrode, consisting of an india-rubber tube perforated by small holes, through which salt water flows, is introduced

into the bowel, and the current passed for some minutes every morning.

DESTRUCTION OF HAIRS is almost painlessly accomplished by electrolysis.

BIRTH-MARKS, consisting of masses of blood-vessels beneath the skin (nævi), are very successfully destroyed, without leaving a scar, by electrolysis. The electrodes consist of two needles which are pushed through the skin into the mass, and an anæsthetic is usually given during the process.

STRICTURES of the gullet, bowel, and urethra may, it is claimed, also be painlessly dilated by electrolysis, though the process must be repeated several times at intervals of a fortnight or thereabout, in séances of fifteen minutes.

REMOVAL OF STEEL PARTICLES which have penetrated the eye may often be effected by a powerful electro-magnet consisting of a soft iron core round which is wound an electric coil, through which a heavy current can be passed.

X-RAYS AND ULTRA-VIOLET RAYS are produced by the aid of electricity, and used in the treatment of many skin and other diseases. (*See under* LIGHT TREATMENT *and* X-RAYS.)

ELECTROCARDIOGRAM is the term applied to a record of the variations in electric potential which occur in the heart as it contracts and relaxes. This record is obtained by placing the two hands of a patient, or one hand and one foot, in insulated vessels containing salt solution, which are then connected with one another through an instrument known as the electro-cardiograph, so that electric currents produced by the beating heart are shown by a galvanometer contained in the instrument. The galvanometer is one of great delicacy, consisting essentially of a silvered wire which vibrates in a magnetic field in response to these currents. While it is vibrating an electrographic record is obtained upon a moving photographic plate, and this, being subsequently developed, can be studied by the physician at his convenience. The normal electrogram of each heart-beat shows one wave corresponding to the activity of the auricle and four waves corresponding to the phases of each ventricular beat. Various readily recognisable changes are seen in cases in which the heart is acting in an abnormal manner, or in which one or other side of the heart is hypertrophied. This record, therefore, forms a useful aid in many cases of cardiac disease.

ELECTRO-ENCEPHALOGRAPHY. It has been found that in the brain there is a regular, rhythmical change of electric potential, due to the rhythmic discharge of energy by nerve cells. These changes can be recorded graphically and the 'brain waves' examined. These records—electro-encephalograms—are useful in diagnosis. For example, the abnormal electro-encephalogram occurring in epilepsy is characteristic of this disease. The normal waves, known as alpha waves, occur with a frequency of 10 per second. Abnormal waves, with a frequency of 7 or less per second, are known as delta waves and occur in the region of cerebral tumors and in the brains of epileptics.

ELECTUARY, or CONFECTION, is a soft paste containing drugs mixed with sugar or honey. (*See* CONFECTION.)

ELEPHANTIASIS (synonyms, *Elephantiasis Arabum, Barbados Leg, Boucnemia*) is a term applied to a disease which is characterised by a peculiar overgrowth of the skin and subjacent textures. This condition arises from repeated attacks of inflammation of the skin and subcutaneous tissue, and concurrent obstruction of the lymphatic vessels. A common cause is infection with certain parasitic worms (filariæ) which invade the lymphatic vessels. These worms are conveyed to man by mosquitoes. They may attack any portion of the body, but most commonly one of the legs, which becomes so enlarged and disfigured by the great thickening of its textures as to resemble the leg of an elephant, whence the name of the disease is derived. The thickening is due to excessive increase in the connective tissue, which results from the inflammatory process, and which by pressure on the muscles of the limb causes them to undergo atrophy or degeneration. Hence the limb becomes weak. This disease is most

frequently seen in tropical climates. When affecting the scrotum it frequently produces a tumor of enormous dimensions. The health, however, ultimately suffers, and serious constitutional disturbance is apt to arise. In the earlier stages of this disease great relief or even a cure may be effected by the persistent employment of wet bandages applied tightly to the limb from the toes upward, as recommended by Hebra. Amputation, which was formerly the only remedy employed, may occasionally be called for, but in many cases the condition can be completely removed as if it were a tumor. Prevention must be carried out by destruction of mosquitoes. This disease is totally different from the so-called *Elephantiasis Græcorum*, or true leprosy. (*See* LEPROSY.)

ELIXIR (*elixo*, I boil) is a diluted tincture made pleasant to the taste by the addition of aromatic substances and sugar. Compound elixir of kola, and elixir roborans, containing cinchona, are valuable tonics in debility. The name was specially applied to several preparations greatly used in the Middle Ages, which had the effect of acting as a tonic to the stomach and relieving constipation, and which were known as the elixir of Paracelsus, elixir of long life, etc. The main constituent of all of these was tincture of aloes.

EMACIATION (*emacio*, I make lean) means pronounced wasting, and is a common symptom of many diseases, particularly of those which are associated with a prolonged or repeated rise of temperature, such as typhoid fever and consumption. It is also associated with diseases of the alimentary system in which digestion is inefficient, or in which the food is not fully absorbed, for example, in diarrhœa, whatever be its cause, and in cases where a tapeworm is present. A type of emaciation known as cachexia is produced by the presence of malignant tumors, especially of cancer. (*See* CACHEXIA.) Perhaps the commonest cause of wasting without an evident reason is early consumption. (*See also* ATROPHY.)

EMBOLISM (ἔμβολον, a plug) means the plugging of a small blood-vessel by some material which has been carried through the larger vessels by the blood stream. It is due usually to fragments of a clot which has formed in some vessel, or to small portions carried off from the edge of a heart-valve when this organ is diseased; but the plug may also be a small mass of bacteria, or a fragment of a tumor, or even a mass of air bubbles sucked into the veins during operations on the neck. The result is usually more or less destruction of the organ or part of an organ supplied by the obstructed vessel. This is particularly the case

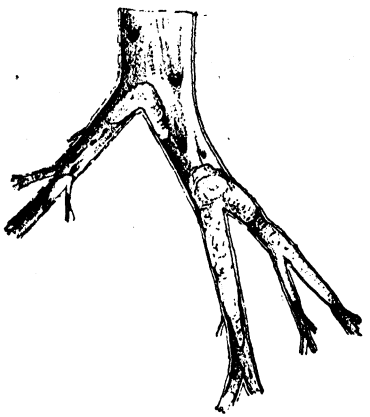

FIG. 160.—Artery from the lung, which has become plugged by emboli, opened lengthwise. (Thoma's *Pathology*.)

in the brain, where softening of the brain, with aphasia or apoplexy, may be the result. If the plug be a fragment of malignant tumor, a new growth develops at the spot; and if it be a mass of bacteria, an abscess forms there. Air-embolism occasionally causes sudden death in the case of wounds in the neck, the air bubbles completely stopping the flow of blood. Fat-embolism is a condition which has been known to cause death, masses of fat, in consequence of such an injury as a fractured bone, finding their way into the circulation and stopping the blood in its passage through the lungs.

EMBROCATIONS (ἐμβρέχω, I soak in) are mixtures, usually of an oily nature,

intended for external application in cases of rheumatism, sprains, and other painful conditions. Their action is due partly to the massage employed in rubbing in the embrocations, partly to a counter-irritant action which the drugs contained in them may exert. (*See* LINIMENTS.)

EMBRYO (ἔμβρυον) means the fœtus in the womb prior to the middle of the second month. (*See* FŒTUS.)

EMESIS (ἔμεσις) means vomiting. (*See* VOMITING.)

EMETICS (ἐμετικός, provoking sickness) are drugs or other means which produce vomiting.

Varieties. — Emetics are divided into two important classes: (1) direct emetics, which, being taken by the mouth, irritate the stomach and so cause vomiting, and (2) indirect emetics, which will cause vomiting, even when injected into the blood, by action upon the nervous centre in the brain controlling the act of vomiting. Examples of the first type are sulphate of zinc, mustard in water, alum, sal volatile, sulphate of copper, and even copious draughts of warm salt water. In the second class we have apomorphine, ipecacuanha, and tartar emetic; to this class also belong such means as tickling the throat, or presenting evil-smelling substances to the nose.

Uses.—Emetics are used when some article of diet is proving indigestible, and setting up pain, headache, etc. For this purpose large draughts of warm salt water, or a heaped dessert-spoonful of mustard in a tumblerful of cold water, are simple emetics. In cases of poisoning, a rapidly acting and more certain emetic is required. Sulphate of zinc (20 grains, repeated if necessary) and sulphate of copper (10 grains) are rapid and effective. When secretions are accumulating in the air passages and not properly removed by coughing, an emetic is often given to clear these passages, with good results. For this purpose ipecacuanha wine is generally chosen and administered in doses of a teaspoonful to a child, and a tablespoonful or more to an adult. When the heart is feeble, sal volatile (2 drams or more in water) is one of the best emetics, because it also stimulates the heart.

EMETINE is one of the active principles of ipecacuanha. (*See* IPECACUANHA *and* DYSENTERY.)

EMICTORY is a drug which provokes the excretion of urine.

EMMENAGOGUES (ἐμμήνια, the menses; ἄγω I move) are drugs which restore the flow at the menstrual periods, when this is scanty or absent. Certain substances, which are mainly dangerous irritant poisons, are credited with the power of producing this effect. Other substances act indirectly by removing the state of ill-health to which the failure is due, such as iron in anæmia, salicin for rheumatism, etc. (*See* MENSTRUATION.)

EMMETROPIA (ἔμμετρος, regular; ὄψις, vision) is a term applied to the normal condition of the eye as regards refraction of light rays. In this state when the muscles in the eyeball are completely relaxed the focusing power is accurately adjusted for parallel rays, so that vision is perfect for distant objects.

EMOLLIENTS (*emollio*, I soften) are substances which have a softening and soothing effect upon the tissues of the body. A combination of warmth and moisture, such as that presented by poultices of oatmeal, starch, bread, or linseed, has the greatest softening effect upon skin surfaces. Ointments, soap, and glycerin also act in this way, as do also albuminous and gummy substances like white of egg, isinglass, and mucilage of acacia.

Uses.—They are used in various inflammatory conditions such as eczema, when the surface becomes hard, cracked, and painful; to protect abraded mucous membranes, *e.g.* glycerin to the mouth, isinglass in milk for the stomach or bowels in inflammation of these organs; also in conditions where it is desired to hurry on inflammatory or absorptive changes, for example, by poultices to the skin over an abscess which is slow to burst.

EMPHYSEMA (ἐμφύσημα) means an abnormal presence of air in certain

parts of the body. In its restricted sense, however, it is generally employed to designate a peculiar affection of the lungs, of which there are two forms. In one of these there is over-distension of the air-cells of these organs, and in parts destruction of their walls, giving rise to the formation of large sacs, from the rupture and running together of a number of contiguous air-vesicles. This is termed *vesicular emphysema*. In the other form the air is infiltrated into the connective tissue beneath the pleura and between the pulmonary air-cells, constituting what is known as *interlobular emphysema*.

VESICULAR EMPHYSEMA is by far the more common.

Causes.—It appears to be capable of being produced by various causes, the chief of which are the following:

1. Where a portion of the lung has become wasted, or its vesicular structure permanently obliterated by disease, without corresponding falling-in of the chest wall, the neighbouring air-vesicles, or some of them, undergo dilatation to fill the vacuum.

2. In cases of bronchitis, and especially of bronchial asthma, where numbers of the smaller bronchial tubes become obstructed, the air in the pulmonary vesicles remains imprisoned, the force of expiration being insufficient to expel it; while, on the other hand, the stronger force of inspiration being adequate to overcome the resistance, the air-cells tend to become more and more distended, and permanent alterations in their structure, including emphysema, are the result.

3. Emphysema also arises from exertion involving expiratory efforts, during which the glottis is constricted, as in paroxysms of coughing, in straining, and in lifting heavy weights. Whooping-cough is well known as the exciting cause of emphysema in many persons.

Symptoms.—In the affected portions of the lungs there are the loss of the natural elasticity of the air-cells and the destruction of many of the pulmonary capillary blood-vessels, and the diminution of ærating surface for the blood. As a consequence there is a strain on the heart and the venous system generally, leading to dilatation of the right side of the heart, and so to dropsy. The chief symptom in this complaint is shortness of breathing, more or less constant but greatly aggravated by exertion, and by attacks of bronchitis, to which persons suffering from emphysema are specially liable. The respiration is of a wheezy character. In severe forms of the disease the patient comes to acquire a peculiar bluish and bloated appearance, and the configuration of the chest is altered, assuming the character known as the *barrel-shaped* chest.

Treatment.—The main element in the treatment of emphysema consists in attention to the general condition of the health, and in the avoidance of all causes likely to aggravate the disease or induce its complications. The same general plan of treatment as that recommended in asthma and bronchitis is applicable in emphysema. During attacks of urgent breathlessness antispasmodic remedies should be given, while dry cupping back and front over the lungs, together with inhalation of oxygen, will often afford marked and speedy relief.

INTERLOBULAR EMPHYSEMA, arising from the rupture of air-cells, may occur as a complication of the vesicular form, or separately as the result of some sudden expulsive effort, such as a fit of coughing, or, as has frequently happened, in parturition. Occasionally the air infiltrates the cellular tissue of the mediastinum, and thence comes to distend the integument of the neck and even the whole surface of the body. This air is, however, rapidly absorbed, and the condition soon subsides.

SURGICAL EMPHYSEMA is the term applied when air is present under the skin. It may get there, for example, if the lungs are wounded through the chest wall, or if the wind-pipe is pierced at any point in its path.

EMPIRICAL (ἐμπειρία, experience) treatment is that school of treatment which is founded simply on experience. Because a given remedy has been successful in the treatment of a certain group of symptoms, it is assumed, by those who uphold this principle, that it will be successful in the treatment of other cases presenting similar groups

of symptoms, without any inquiry as to the cause of the symptoms or reason underlying the action of the remedy. It is the contrary of 'rational' or 'scientific' treatment. Sometimes a course of treatment must perforce be empirical, for want of knowledge.

EMPLASTRUM is the Latin term for a plaster.

EMPROSTHOTONOS is the term applied to the spasm of the belly muscles that occurs in tetanus, making the body arch forwards.

EMPYEMA (ἐμπύημα, an internal abscess) is a term applied to an accumulation of pus within a cavity, the term being generally reserved for collections of pus within one of the pleural cavities. The condition is virtually an abscess, and therefore gives rise to the general symptoms accompanying that condition; but, on account of the thick unyielding wall of the chest, it has very little tendency to burst through the surface, and therefore it is of particular importance that the condition should be recognised early, and, as a rule, treated by surgical means.

Causes.—The condition most commonly follows an attack of pneumonia. It may also occur in the advanced stage of consumption. Empyema also occurs at times through infection from some serious disease in neighbouring organs, such as cancer of the gullet, or follows upon wounds penetrating the chest wall.

Symptoms.—In empyema following a case of pneumonia, symptoms of the former generally appear as the pneumonia is subsiding, and when an ordinary attack of pneumonia does not come satisfactorily to an end after the lapse of eight to ten days, it is usual for the physician to suspect and search for the signs of empyema. A certain amount of inflammation in the membrane lining the pleural cavity always accompanies pneumonia, and the fluid which is thus produced may show any stage between that of clear yellow serous fluid and thick pus of the consistence of cream. When the fluid is clear or merely turbid, absorption generally takes place naturally in course of time, and the mild type of infection which is present is readily overcome by the ordinary powers of the tissues. When, however, a severe infection, due usually either to a virulent pneumococcus or streptococcus, is present, the fluid is of the thicker purulent variety, and active measures of treatment are required. In any case, the temperature of the patient, which should revert to normal at the end of the attack of pneumonia, tends to show a daily rise to 102° or 103°; there is profuse sweating and the patient presents a flushed appearance. The severity of these symptoms is proportional to the degree of virulence in the infection of the pleural membrane, the symptoms generally being less marked the clearer the fluid. On examination of the chest a dull percussion-note, obscuration of the breath sounds, and other characteristic signs of the presence of fluid are found. It is usual for the physician to complete the diagnosis by puncturing the chest by means of a fine needle attached to a small aspiration syringe. A sample of the fluid is thus obtained, and its characteristics as regards the bacteria present, etc., are investigated. The collection of fluid may be very small in size and limited by adhesions to a small portion of the chest, especially in those cases due to the pneumococcus, and it may be necessary in such cases to insert the needle at various points before the purulent fluid is definitely located.

Treatment.—In those cases where the fluid is clear or only slightly turbid, the measures commonly employed for pleurisy (*see* PLEURISY) are very often sufficient to bring about absorption. In cases where the fluid is thick and purulent, and especially those following acute pneumonia, it is usually necessary to perform an operation for the drainage of the cavity, an incision being made through the skin and a portion of rib removed. The fluid is thus evacuated, and the lung can then expand naturally against the chest wall, a drainage tube being left in the wound so that the cavity can be irrigated and any fresh fluid which tends to collect can escape freely until the natural closure of the cavity is completed. For some months or years after such an operation the entrance of

air into the part of the lung round the wound is usually somewhat restricted, but in the great majority of cases the lung ultimately reverts completely to a normal state.

EMULSIONS (*emulgeo*, I milk out) are mixtures containing oily substances, in a state of very fine division. The division is effected and the oil kept suspended in the fluid by means of alkalies and sticky ingredients such as albumin, glycerin, or mucilage. Milk is an example of a very perfect emulsion of fat globules each surrounded by an envelope of albumin. The various preparations of cod-liver oil are usually emulsified by the aid of glycerin. The oil is not only rendered more devoid of taste, but digestion and absorption are also rendered easier by emulsification.

EMUNCTORY (*emungo*, I cleanse) is a term applied generally to excretory organs, such as the kidneys and bowels.

ENAMEL is a thin, hard, transparent layer which covers the surface of the teeth, at least that part of them which projects above the gums. It is composed almost entirely of the earthy salts found in bone, and is the hardest tissue in the body. It is arranged in the form of long six-sided prisms, each about $\frac{1}{5\,0\,0}$ inch in thickness, and set on end upon the dentine of the tooth. The enamel is very readily eaten away by acids, hence the need of using a chalky tooth-powder, especially after vinegar, steel-drops, and the like have come in contact with the teeth.

ENCEPHALITIS (ἐγκέφαλος, the brain) means inflammation of the brain.

ENCEPHALITIS LETHARGICA, also known as SLEEPY SICKNESS and as EPIDEMIC ENCEPHALITIS, VON ECONOMO'S DISEASE, is a disease that appears from time to time, especially in spring, in the form of epidemics. It is a virus infection, attacking chiefly the basal ganglia, the cerebrum, and the brain stem. These undergo dropsical swelling, hæmorrhages, and ultimately destruction of areas of tissue involving both nerve-cells and fibres. The process may involve other parts of the brain, the spinal cord, and even other organs.

Symptoms.—The illness begins usually with rise of temperature and increasing drowsiness or lethargy which may gradually proceed to a state of complete unconsciousness. In some cases, however, the patient instead of being drowsy passes at first through a stage of restlessness which may amount to maniacal excitement. As a rule the drowsiness deepens somewhat gradually over a period of a week or more, and accompanying it there appear various forms of paralysis, shown by drooping of the eyelids, squint, and weakness of one or both sides of the face. The nerves controlling the muscles of the throat are also sometimes paralysed, causing changes in the voice and difficulty in swallowing. In some cases the disease affects the spinal cord, producing severe pain in one or more of the limbs, and it is frequently followed by partial paralysis. Signs of inflammation are not infrequently found in other organs, and hæmorrhages may be visible beneath the skin and in the muscles, or blood may be vomited up or passed in the stools. The effects last usually for many months, the patient remaining easily tired and somnolent or frequently showing rigidity of muscle, mask-like facies, festinant gait, and rhythmical coarse tremors, resembling the 'clinical picture' of paralysis agitans, and known in epidemic encephalitis as PARKINSONISM. Other cases show a considerable resemblance in symptoms to chorea, and still others to the disease known as general paralysis, and many cases which result in physical recovery are left with profoundly deteriorated mental powers.

Treatment.—The recognition of typical cases is not difficult from the lethargic condition which is commonly present, but in some of the unusual types diagnosis is only made with considerable difficulty from the other diseases which the condition resembles. Various sera have been recommended with a view of checking the process of inflammation and small hæmorrhages in the brain. A method to which recourse is sometimes had for a similar purpose is the production of an abscess in some muscle at a distance

from the nervous system, *e.g.* in the thigh, by the injection of a small amount of turpentine. The patient requires careful nursing and feeding and the administration of general remedies for symptoms, such as excitement, when they arise. The tremors and weakness, occurring late, are often greatly benefited by hyoscine or stramonium.

ENCEPHALOID (ἐγκέφαλος, brain; εἶδος, form) is the name applied to a form of cancer which, to the naked eye, resembles the tissue of the brain.

ENCEPHALOMYELITIS means inflammation of the substance of both brain and spinal cord.

ENCHONDROMA (ἐν, in; χόνδρος, cartilage; *-oma*, termination meaning tumor) means a tumor formed of cartilage. (*See* TUMORS.)

ENCYSTED (ἐν, in; κύστις, a bladder) means enclosed within a bladder-like wall. The term is applied to parasites, collections of pus, etc., which are shut off from surrounding tissues by a membrane or by adhesions.

ENDARTERITIS (ἔνδον, within; ἀρτηρία, an artery) means inflammation of the inner coat of an artery. (*See* ARTERIES, DISEASES OF.)

ENDEMIC (ἐν, in; δῆμος, the people) is a term applied to diseases which exist in particular localities or amongst certain races. Some diseases which are at times epidemic over wide districts, have a restricted area, where they are always endemic, and from which they spread. For example, both cholera and plague are endemic in certain parts of Asia.

ENDERMIC (ἐν, in; δέρμα, the skin) method of applying drugs is not now much used, except in the case of purely local affections, such as facial neuralgia. It consists in applying a blister, removing the bleb, and then laying the drug which is to be absorbed upon the raw surface.

ENDO- (ἔνδον, within) is a prefix meaning situated inside.

ENDOCARDITIS (ἔνδον, within; καρδία, the heart) means inflammation of the smooth membrane lining the heart, especially that over the heart valves. (*See* HEART, DISEASES OF).

ENDOCRINE GLANDS (ἔνδον, within; κρίνω, I separate) is a term applied to certain organs whose function is to secrete into the blood or lymph a substance which plays an important part in regard to general chemical changes or to the activities of other organs at a distance. Some organs have a double function, such as the pancreas, which pours digestive secretions by a duct into the intestine, and, at the same time, has an endocrine or internal secretion which is absorbed by the blood. Various diseases arise as the result of defects or excess in the internal secretions of the different glands. The chief endocrine glands are the thyroid gland, adrenal bodies, pituitary body, parathyroid glands, pancreas, ovaries, and testicles. A certain amount of antagonism exists between the different endocrine glands: for example, secretion of the adrenal glands checks the action of pancreatic secretion. Other glands have an associated action; for example, extract of pituitary gland stimulates the production of normal secretion of the thyroid. During healthy bodily activity there appears to be a constant state of balancing between the action of the different endocrine secretions. The structure of these glands is noted elsewhere under the appropriate headings, and only a short account will be given here of the action of their secretions.

THYROID GLAND.—This gland, situated in front of the neck, produces a secretion which has a very important effect in regulating the general nutrition of the body. When it is defective, the conditions known as myxœdema and cretinism result; while excess or perversion of the secretion is associated with different types of the condition generally known as exophthalmic goitre. An extract is prepared from the thyroid glands of sheep and other animals, and is used in cases where the secretion is defective. It forms one of the most powerful stimulants of general bodily activity. The active principle of this secretion is thyroxine.

ADRENAL BODIES. — These two glands, also known as SUPRARENAL GLANDS, lie immediately above the kidneys. The central or medullary portion of the glands forms the secretion known as adrenaline or epinephrine. Adrenaline acts upon structures innervated by sympathetic nerves; its action is 'sympatho-mimetic'. Briefly, the blood-vessels of the skin and of the splanchnic viscera (except the intestines) are constricted, and at the same time the arteries of the muscles and the coronary arteries are dilated; systolic blood-pressure rises; blood-sugar increases; the metabolic rate rises; muscle fatigue is diminished. Adrenaline can be synthetically prepared in the laboratory. This substance is very widely used in medicine in 1 in 1000 solution, for the purpose of checking bleeding, relieving congestion of mucous membranes, for the relief of asthma, and in the treatment of anaphylactic shock. An extract of the superficial or cortical part of the gland is also available for use in the cases of Addison's disease that are occasionally met.

PITUITARY GLAND.—This gland is attached to the base of the brain and rests in a hollow on the base of the skull immediately above the hinder part of the throat. The anterior, intermediate, and posterior parts of the gland appear to produce different secretions: that from the intermediate and posterior parts known as 'pituitrin' has a powerful action in stimulating the contractions of unstriped muscle-fibres found, for example, in the uterus, intestine, and blood-vessels. Pituitary extract (posterior lobe) is therefore greatly employed in obstetric practice for its valuable action in checking bleeding and increasing the contractions of the uterus during delivery. It is also used in the treatment of shock on account of its action in contracting blood-vessels and raising the pressure of the blood.

The anterior part secretes hormones which stimulate growth, development of sex, and secretion of milk, and which exert a controlling influence on most of the other endocrine glands—thyroid, adrenal, and reproductive glands.

PARATHYROID GLANDS.—These are four minute glands lying at the side of or behind the thyroid. They have a certain effect in controlling the absorption of lime salts by the bones and other tissues. When their secretion is defective, tetany occurs.

PANCREAS.—This gland is situated in the upper part of the abdomen and, in addition to the digestive ferments which it produces, a substance known as insulin is absorbed from it into the circulating blood. This has the effect of adapting sugary foods for incorporation in the muscles and other tissues that particularly require such foodstuffs. Its defect is followed by the production of the disease known as diabetes.

OVARIES AND TESTICLES.—In addition to their main function of producing reproductive cells, these organs secrete substances which have a general effect upon the other bodily tissues.

The ovary secretes at least two hormones known respectively as œstradiol (follicular hormone), and progesterone (corpus luteum hormone). Œstradiol develops (under the stimulus of the anterior pituitary lobe) each time an ovum in the ovary becomes mature. Œstradiol causes extensive proliferation of the endometrium lining the uterus, a stage ending with shedding of the ovum about 14 days before the onset of menstruation. The corpus luteum which then forms secretes both progesterone and œstradiol. Progesterone brings about great activity of the glands in the endometrium. The uterus is now ready for the 'nesting' of the ovum—if fertilised. If fertilisation does not occur, the corpus luteum degenerates, the hormones cease acting, and menstruation takes place.

ENDOMETRITIS (ἔνδον, within; μήτρα, the womb) means inflammation of the mucous membrane lining the womb. (*See* UTERUS, DISEASES OF.)

ENDOMETRIUM is the mucous membrane which lines the interior of the uterus.

ENDOTHELIUM (ἔνδον, within; θηλή, nipple) is the term applied to the membrane lining various vessels and cavities of the body, such as the pleura, pericardium, peritoneum, lymphatic vessels, blood-vessels, and

joints. It consists of a fibrous layer covered with thin flat cells, which render the surface perfectly smooth and secrete the fluid for its lubrication.

ENEMA (ἔνεμα) means an injection of fluid into the bowel.

Uses. — PURGATIVE ENEMATA are given generally in large bulk, so as to distend the rectum, and they contain also various stimulating substances. For an adult, 1 to 2 pints are injected, for a young child about 6 ounces. The process of injection should be slow, and the person should retain the enema as long as he can, in order to obtain the maximum effect. The water may be cold or tepid, and may contain soap, or a wineglassful of castor oil or olive oil, or a large tablespoonful of Epsom salts. To expel flatulence, two tablespoonfuls of turpentine may be added

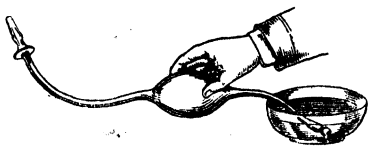

FIG. 161.—Enema syringe.

to each pint of warm water. Instead of water, a couple of teaspoonfuls of pure glycerin may be used, or half a pint of warm olive oil. The frequent use of enemata is unhealthy, because they gradually distend the bowel, especially if injected warm, and so ultimately increase the constipation.

SEDATIVE ENEMATA are used to quiet spasm, and check excessive action of the bowels. When a person is being fed by nutrient enemata, he should receive one sedative enema daily consisting of a pint of warm water containing two teaspoonfuls of common salt. A similar enema given in larger quantities is very soothing for many forms of irritation such as colitis. In very painful conditions of the bowel and of surrounding organs, 4 ounces of thin starch containing 20 to 60 drops of laudanum and injected tepid gives great relief.

NUTRIENT ENEMATA are given when the stomach is seriously deranged and cannot retain or cannot digest food.

A nutrient enema consists of dextrose 5 per cent solution in normal saline solution, that is, ½ oz. of dextrose and ½ teaspoonful of common salt to ½ pint of warm water. The enema must be administered very slowly, and preferably run in through a small

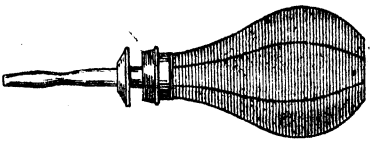

FIG. 162.—Bag syringe for administering enema.

funnel and catheter tube. It may be given, to the amount of 8 or 10 ounces, every 4 hours, that is five times in 24 hours.

HEALING ENEMATA are given when ulcers and inflammatory conditions are present in the lower bowel, consisting of such substances as small quantities of starch and laudanum, or of nitrate of silver solution (½ grain to the ounce). A form of enema known as '*irrigation*' is often used for healing and cleansing purposes. Several pints of warm, weak salt solution (2 teaspoonfuls of salt to every pint of water) or boracic acid solution are introduced very slowly, by a douche, into the bowel, and then allowed to run off by lowering the tube, very much in the same way that the stomach is washed out.

ENEMATA FOR 'THREAD-WORMS in children should consist of 4 to 6 ounces of strong brine made from common salt and water, or the same amount of infusion of quassia.

Mode of administration. — The instrument used for nutrient enemata should be an india-rubber tube 3 or 4 feet in length, with a funnel at one end, and soft rubber nozzle, with rounded end, at the other. For purgative enemata, the rubber syringe with a ball in the centre may be used, and for small enemata an india-rubber bag which contains the exact amount required. In all cases where the sick person does not himself introduce it, the old bone or metal nozzle should be replaced by a soft rubber one, because much pain and injury may be inflicted

by a rigid one carelessly or forcibly introduced.

The patient lies upon his left side with the hips raised on a thick pillow, and should remain so after the enema has been given. The nozzle is oiled, introduced forwards and upwards with a screwing motion, and should be passed gently up for 3 or 4 inches. The fluid is now pumped, or, if a tube and funnel be used, allowed to flow gently in by raising the funnel. In the case of nutrient enemata, fully fifteen or twenty minutes should be spent in letting the fluid slowly enter, otherwise the bowels may move and the whole enema be rejected.

ENOPHTHALMUS, or ENOPHTHALMOS (ἐν, in; ὀφθαλμός, eye), is a term applied to abnormal retraction of the eye into its socket, for example, when the sympathetic nerve in the neck is paralysed.

ENTAMŒBA (*see* AMŒBA).

ENTERALGIA (ἔντερον, the intestine; ἄλγος, pain) is another name for colic.

ENTERIC FEVER, or TYPHOID FEVER (ἔντερον, the intestine), is a continued fever characterised mainly by its insidious onset, by a peculiar course of the temperature, by marked abdominal symptoms occurring in connection with a peculiar ulceration of the bowels, by an eruption upon the skin, by its uncertain duration, and by a liability to relapses.

This fever has received various names, such as gastric fever, abdominal typhus, infantile remittent fever, slow fever, nervous fever, etc. Until the middle of last century typhoid was not distinguished from typhus fever. For, although it had been noticed that the course of the disease and its morbid anatomy were different from those of ordinary cases of typhus, it was believed that they merely represented a variety of that malady. The distinction between the two diseases appears to have been first accurately made in 1836 by Dr. Gerhard, of Philadelphia, and still more fully demonstrated by Dr. A. P. Stewart, of Glasgow, in 1840. Subsequently all doubt upon the subject was removed by the careful clinical and pathological observations made by Sir William Jenner at the London Fever Hospital (1849–51). At the end of the nineteenth century it was noticed that cases of fever resembling typhoid but of shorter duration occurred, and these were found to be due to bacilli resembling the typhoid bacillus and are known as paratyphoid fevers. This group of fevers again has a resemblance, both as regards symptoms and as regards the causal bacteria, to cases of food-poisoning, dysentery, and summer diarrhœa.

Causes.—It has been proved that a bacillus, discovered first by Eberth in 1880, and known as the *Bacilius typhosus*, is the direct cause of the malady. (*See* BACTERIOLOGY.) The bacilli found to be responsible for cases of paratyphoid fever are known as *Bacillus paratyphosus A* and *Bacillus paratyphosus B*, the latter being the commoner. Other bacilli which do not altogether correspond to either of these are also responsible for mild attacks of fever, sometimes grouped as paratyphoid C. The bacillus, just as in the case of the poison of other infectious diseases, is not equally hurtful at all times and in all circumstances. Thus, where the discharges, sheets, etc., from typhoid patients are carefully disinfected, there is little risk of direct spread from person to person. In many hospitals the typhoid cases are therefore treated in the general wards with little or no risk to the other patients, provided certain precautions be taken.

All insanitary conditions in respect of drainage of houses and localities furnish the most ready means for the spread of the contagion of typhoid fever. The most certain means of preventing its appearance or checking its spread are the water-carriage system of sewage disposal; prevention of pollution of water-supplies, food, milk, and shell-fish with human excreta; chlorination of drinking water; pasteurisation of milk; control of the house-fly; personal cleanliness; detection of carriers of enteric bacilli. The bacillus resides in the stools and urine of typhoid patients. Thus, in badly laid drains, where the contents stagnate, the

ENTERIC FEVER

bacillus may increase indefinitely, and, by the contamination of drinking-water in places where wells or cisterns are exposed to sewage pollution, convey infection to a whole community. Dust may also act as the medium which conveys the bacilli, in cases where the discharges of a typhoid patient or the sewage is allowed to dry, and so get blown into drinking-water or on to food. Milk may readily be contaminated by the bacillus and form the cause of an epidemic, when a case of the fever has occurred in a dairy. The source of an epidemic has also been traced to the eating of oysters taken from oyster-beds near which contaminated sewage is discharged. During an epidemic, it can be readily understood that flies may also form a means of contamination between uncovered stools and uncovered food. It may therefore be said that the spread of typhoid fever depends upon food or drink contaminated by a bacillus which is derived more or less directly from the discharges of previous typhoid cases.

Typhoid fever is most common among the young, the majority of cases occurring between the ages of fifteen and twenty-five, though it does occur in rare instances at or beyond middle life. It attacks the well-to-do as frequently as the poor. The greater number of cases appear to occur in autumn, and it prevails in all countries, though some of its features may be modified by climate and locality.

The chief symptoms will be better understood by a brief reference to the principal changes that take place in the body during the disease. The bowels are chiefly affected, particularly the lower end of the small intestine, where the 'solitary glands' and 'Peyer's patches' on the inner surface of the bowel (*see* INTESTINES) pass through changes that bear a distinct relation to the symptoms exhibited by the patient during the course of the disease. (1) During the first eight or ten days of the illness these glands, which in health are comparatively indistinct, become enlarged and prominent as the result of inflammation. (2) During the second week of the fever these enlarged glands undergo a process of sloughing, being cast off either in fragments or *en masse*. (3) From the second week onwards during the remainder of the fever, and even into the stage of convalescence, the ulcers formed by this process remain open though slowly healing. The ulcers vary in size according to the gland masses that have sloughed away, and they may be few or many in number. They are frequently, but not always, oblong in shape, with their long axis in that of the bowel, and they have somewhat thin and ragged edges. They may extend through the thickness of the bowel to the peritoneal coat, and they may perforate this, or may erode blood-vessels in their progress. (4) During convalescence the ulcers usually heal, leaving no contraction in the wall of the bowel.

The mesenteric glands associated with the intestine become enlarged, but usually subside without abscess formation as recovery takes place. The spleen becomes soft and much enlarged, this enlargement being a useful guide to the physician in cases which are difficult to diagnose. As in other fevers, the muscular tissues soften and waste, particularly those of the heart, and various complications affecting other organs may arise.

Symptoms.—The symptoms at the *onset* of typhoid fever are very much less marked than those of most other fevers, and the disease in the majority of instances sets in somewhat insidiously. Indeed, it is no uncommon thing for patients with this fever to go about for a considerable time after it has begun. The most marked of the early symptoms are headache, lassitude, and discomfort, together with sleeplessness and feverishness, particularly at night; this last symptom is that by which the disease is most readily detected in its early stages. Bleeding at the nose is also an early symptom in many cases. The peculiar course of *the temperature* is also one of the most important diagnostic evidences of this fever. During the first week it is slightly raised in the morning, but in the evening there is a marked ascent, with a fall again towards morning, each morning and evening, however,

showing respectively a higher point than that of the previous day, until about the eighth day, when, in an average case, the highest point is attained. This varies according to the severity of the attack; but it is no unusual thing to register 104° or 105° Fahr. in the evening and 103° or 104° in the morning. During the second week, the daily range of temperature is comparatively small, a slight morning remission being all that is observed. In the third week the same condition continues more or less; but frequently a slight tendency to lowering may be discerned, particularly in the morning temperature, and the fever gradually dies down as a rule between the twenty-first and twenty-eighth days, although it is liable to recur in the form of a relapse. Although the patient may, during the earlier days of the fever, be able to move about, he feels languid and uneasy; and usually before the first week is over he has to take to bed, and soon the effects of the attack become more apparent. He is restless, hot, and uncomfortable, particularly as the day advances, and his cheeks show a red flush, especially in the evening or after taking food. The *pulse* in an ordinary case, although more rapid than normal, is not accelerated to an extent corresponding to the height of the temperature, and is, at least in the earlier stages of the fever, rarely above 100. In severe and protracted cases, where there is evidence of extensive intestinal ulceration, the pulse becomes rapid and weak. The *tongue* has at first a thin whitish fur and is red at the tip and edges. It tends, however, to become dry, brown or glazed-looking, and fissured transversely, while sordes may be present about the lips and teeth. There is much thirst and in some cases vomiting.

From an early period in the disease *abdominal symptoms* show themselves and are frequently of great help in diagnosis. The abdomen is somewhat distended, and pain accompanying some gurgling sounds may be elicited on light pressure about the lower part of the right side close to the groin—the region corresponding to that portion of the intestine in which the morbid changes already referred to are progressing. *Diarrhœa* is a frequent but by no means constant symptom. When present, it may be slight in amount, or, on the other hand, extremely profuse, and it corresponds, as a rule, to the severity of the intestinal ulceration, and to the nature of the diet which the patient has been taking. The discharges are highly characteristic, being of light-yellow colour, resembling 'pea soup'

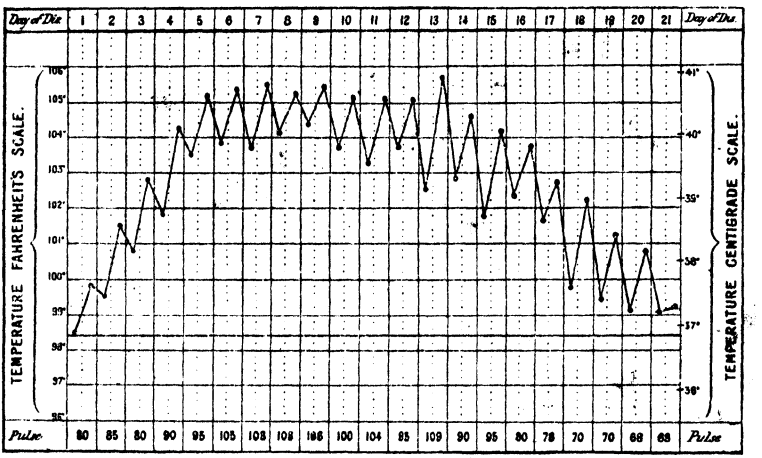

FIG. 163.—Chart showing the ordinary course of temperature and its gradual subsidence in a case of typhoid fever. The higher part of the curve is usually prolonged for a week or so more than is shown.

in appearance. Sometimes, especially in milder cases, constipation is found instead of diarrhœa. Should intestinal hæmorrhage occur, as is not infrequently the case during some stage of the fever, the stools may be dark brown, or composed entirely of blood. Enlargement of the spleen and liver can usually be made out by the physician. The urine is scanty and high-coloured. When the fever is well developed from the second week onwards, the *blood* shows a well-marked feature known as 'Widal's reaction'. (*See* AGGLUTINATION.)

About the beginning, or during the course of the second week of the fever, an *eruption* frequently makes its appearance on the skin. It consists of small isolated spots, oval or round in shape, of a pale pink or rose colour, which are seen chiefly upon the abdomen, chest, and back, and they come out in crops, which continue for four or five days and then fade away. At first they are slightly elevated, and disappear on pressure. In some cases they are very few in number, and their presence is made out with difficulty; but in others they are numerous and sometimes show themselves upon the limbs as well as upon the body. They do not appear to have any relation to the severity of the attack, and in a very considerable proportion of cases (particularly in children) they are entirely absent. Besides this eruption there are frequently numerous very faint bluish patches or blotches about half an inch in diameter, chiefly upon the body and thighs. When present, the rose-coloured spots continue to come out in crops till nearly the end of the fever, and they may reappear should a relapse subsequently occur.

These various symptoms persist throughout the third week, usually, however, increasing in intensity. The patient becomes prostrate and emaciated; the tongue is dry and brown, the pulse quickened and feeble, and the abdominal symptoms more marked; while nervous disturbance is exhibited in delirium, in tremors and jerkings of the muscles (*subsultus tendinum*), in drowsiness, and occasionally in 'coma vigil'. (*See* TYPHUS FEVER.) In severe cases, the exhaustion reaches an extreme degree, but even in such instances the condition should not be regarded as hopeless. In favourable cases, a change for the better may be expected between the twenty-first and twenty-eighth days, though it takes place by a 'lysis' or gradual subsidence of the symptoms (the morning and evening temperatures descending, the pulse becoming stronger, the diarrhœa passing off, the tongue becoming clean, etc.), not by a 'crisis' as in typhus fever or pneumonia. Convalescence proceeds slowly, and relapses are apt to occur (due frequently to errors in diet). Such relapses may prolong the fever for two or three months, though this is not common.

Abscesses sometimes arise, especially in connection with inflammation in the periosteum of the bones, found after the patient has been for some time convalescent, and these form a troublesome and prolonged complication. Stiff back, known as 'typhoid spine', is an occasional sequel to this disease, due either to inflammation in the spine or more commonly to changes in the muscles with development of fibrous tissue, causing the patient for long, it may be for years, to suffer from severe 'rheumatic' pains. Inflammation of the bile passages, with retention of the bacilli in these and their constant discharge in the stools, is also an occasional sequel; and, though this may cause no trouble to the patient, it renders him a source of danger to others as a 'carrier' of the disease. (*See* INFECTION.)

When death takes place, it is generally due to one of the following causes: (1) Exhaustion in the second or third week or later; (2) hæmorrhage from the bowels; (3) perforation of an ulcer and the onset of peritonitis; (4) excessive rise of temperature; (5) complications, such as inflammation of the lungs.

Treatment.—The preventive treatment includes all the municipal and domestic measures that aim at securing pure supplies of water and milk and well-laid drains. (*See* SANITATION.) Inoculation with anti-typhoid vaccine is a precaution which ought to be adopted by persons about to proceed to a country, such as India, where the

disease is rife. (*See* VACCINE.) A form of typhoid vaccine for oral administration is also available.

When an outbreak of typhoid fever occurs in a family, the source of the milk supply especially should be scrutinised. The discharges of a typhoid patient should be mixed so soon as passed with a strong disinfectant (*see* DISINFECTION). Similar care should be taken to sterilise all sheets, towels, etc., soiled by the patient. Special care is necessary on the part of those in attendance upon a typhoid fever case to cleanse the hands at once after touching the patient, and especially after they have become in any way soiled by contact with his discharges.

Very special care is necessary in typhoid fever with regard to diet. Milk is of great service in typhoid, but it must be administered with due regard to time and to the digestive powers of the patient. The usual quantity given is from 3 to 4 oz. regularly administered every two or three hours, that is 1½ to 2 pints daily. In the intervals water or other fever drink may be given from time to time. When given too frequently or in too great quantity, it may, by its imperfect digestion, prove a source of irritation to the bowels. In such a case its admixture with lime-water or peptonising it may render its digestion less difficult, but sometimes its use must for a time be suspended. Barley water or simple soups, such as chicken-broth, beef-tea, etc., are occasionally useful either as substitutes for or in addition to milk. In convalescence, the diet should still be largely milk and soft matters, such as custards, light puddings, meat jellies, boiled bread and milk, or one of the numerous proprietary invalids' foods; but other solid foods, with the exception of fish, should be for a long time avoided. In changing the diet it is of importance to note its effect upon the temperature, which may sometimes be considerably disturbed from this cause, even after the apparent subsidence of all fever.

The more prominent symptoms which mark the course of typhoid fever frequently call for special treatment. Thus, when the fever continues long, with little break in its course, antipyretics such as quinine, salicin, and salicylate of soda, phenacetin, antipyrine, antifebrin, etc., may occasionally be given.

For a similar purpose the cold bath is recommended by many authorities, but the treatment is difficult to carry out except in hospital. Other methods of applying cold, while probably less effectual than the bath, are much more available, as, for example, the tepid or cold pack (*see* WET PACK), the frequent sponging (about every four hours) of portions of the body with tepid water, or the application of ice-bags to the head. When diarrhœa is excessive, it may be restrained by such remedies as chalk mixture, bismuth, Dover's powder, etc. In the event of perforation of the bowel, an immediate operation may in some cases give the patient a chance of life (see PERITONITIS), but this chance is very small. With regard to the condition of the mouth and tongue, much comfort is gained if the patient's mouth and teeth be washed out occasionally with boric lotion in tepid water, and the lips and tip of the tongue lightly smeared with boroglyceride or some emollient ointment. Treatment by serum has not been satisfactory. Vaccine treatment has been tried, and sulphanilamide has also been given.

In the convalescent stage, and even after apparently complete recovery, the utmost care should be observed by the patient as to diet, all hard and indigestible substances being dangerous from their tendency to irritate or reopen unhealed ulcers, and bring on a relapse of the fever or cause a sudden perforation. Lastly, the general health demands careful attention for a length of time, in view of the risks of chest and other diseases.

ENTERITIS (ἔντερον, the intestine) means inflammation of the intestines. (*See* DIARRHŒA, *and* INTESTINES, DISEASES OF.)

ENTEROCELE (ἔντερον, the intestine; κηλή, a tumor) means a hernia of the bowel. (*See* HERNIA.)

ENTEROGENOUS CYANOSIS.—This is a rare condition characterized by blueness of the lips and face (cyanosis) and the presence in the blood of

sulphæmoglobin and methæmoglobin, especially the former. It is usually the result of taking drugs, especially those derived from aniline (*e.g.* phenacetin). Recovery follows discontinuance of the drug.

ENTEROPTOSIS (ἔντερον, the intestine; πτῶσις, a fall) means a condition in which, owing to a lax condition of the mesenteries and ligaments which support the bowels, the latter descend into the lower part of the abdominal cavity. The condition is aggravated by tight lacing and by the lax condition of the abdominal walls which follows repeated child-bearing, and so is commoner in women.

Treatment.—Massage of the abdominal muscles and viscera, and the wearing of a well-shaped abdominal belt (*see* BELTS) give most relief.

ENTEROSTOMY (ἔντερον, intestine; στόμα, mouth) means an operation by which an artificial opening is formed into the intestine.

ENTOZOA (ἐντός, within; ζῷον animal) are animals which are occasionally found within the human body, and derive nourishment from its fluids, or from the digested food. (*See* PARASITES.)

ENTROPION (ἐν, in; τρέπω, I turn) means a condition in which, as a result of disease, the edge of the eyelid is turned inwards towards the ball of the eye. (*See* EYE, DISEASES OF.)

ENURESIS (ἐν, in; οὐρέω, I make water) means the unconscious or involuntary passage of urine. (*See* URINE.)

ENZYME is the name applied to a chemical ferment produced by living cells. Enzymes are present in the digestive fluids and in many of the tissues, and are capable of producing in small amount the transformation on a large scale of various compounds. Examples of enzymes are found in the ptyalin of saliva and diastase of pancreatic juice which split up starch into sugar, the pepsin of the gastric juice and the trypsin of pancreatic juice which break proteins into simpler molecules and eventually into the constituent amino-acids, the thrombin of the blood which causes coagulation, etc.

EOSINOPHIL is any cell in the body with granules in its substance that stain easily with the dye eosin. About 2 per cent of the white cells of the blood are eosinophils. Eosinophil cells are also present in the pituitary gland.

EOSINOPHILIA means an abnormal increase in the number of eosinophils in the blood. It occurs in Hodgkin's disease, in asthma and hay fever, in some skin diseases, and in parasitic infestation.

EPANUTIN (*see* DIPHENYLHYDANTOINATE).

EPHEDRINE is an alkaloid derived from the Chinese plant *Ma Huang*, much used for asthma, in doses of ¼ to 1½ grains. It is similar to adrenaline in both chemical constitution and pharmacological action.

EPHELIS means sunburn, or brown discoloration of the skin produced by constant exposure to great heat.

EPHEMERAL FEVER (ἐφήμερος, for one day), or MILK-FEVER, is the name given to a slight feverish attack, which often comes on about the third or fourth day after childbirth, in consequence of constipation, tension of the breasts, or other trifling cause. It lasts only for a day or so, hence its name.

EPI- (ἐπί, upon) is a prefix meaning situated on or outside of.

EPICUTAN is the name given to a powder formed from protein derivatives from the young chick embryo. This product owes its appearance to the work of Dr. Fischer of Copenhagen, a recognised authority on tissue-culture. The outbreak of war in 1939 interfered with its proper clinical trial, but an article in the *British Medical Journal* of February 17, 1940, showed that a sample was effective in accelerating the healing of wounds.

EPIDEMIC (ἐπί, upon; δῆμος, the people) is a term applied to a disease which affects a large number of people in a particular locality at one time. The term is in a sense opposed to 'endemic', which means a disease

always found in the locality in question. A disease may, however, be endemic as a rule, for example, malaria in swampy districts, and may become at times epidemic, when an unusually large number of people are affected.

As a rule, an epidemic disease is infectious from person to person, but this is not necessarily the case, since many persons in a locality may simply be exposed to the same cause at one time; for example, outbreaks of scurvy or lead-poisoning are epidemic in this sense.

The laws which govern the outbreak of epidemics are by no means fully understood. Infected food supplies, such as drinking water contaminated by the evacuations of persons sick of cholera or typhoid fever, or milk tainted by the virus of scarlatina, have been traced in repeated instances as the cause of outbreaks of these diseases. The migrations of certain of the lower animals, such as rats, are in some cases responsible for the spread of plague, from which these animals die in great numbers. Certain epidemics come with regularity at certain seasons. Thus typhoid fever begins to show itself in August, increases during the autumn months, and gradually decreases during the winter. Scarlatina and diphtheria are also autumnal complaints, and produce their epidemics in September, October, and November. Whooping-cough, on the other hand, is a spring complaint, and very few cases occur in autumn. Measles produces two epidemics, as a rule, one in midsummer and one in December. Infantile diarrhœa, which is a very fatal complaint, particularly among the children of the poor, appears regularly in June, quickly reaches its height in July, and gradually disappears during August and September. These seasonal variations depend largely, no doubt, upon conditions like the amount of sunshine, the rainfall, and the temperature of the ground, and the aggregation of susceptible individuals. Infantile diarrhœa depends most closely upon the temperature of the ground.

There is another variation, both as regards the number of persons affected and the number who die in successive epidemics, the severity of successive epidemics rising and falling over periods of five or ten years. Further, scourges like plague and cholera have swept over whole continents at longer periods, and then died down without apparent cause. The reason for these latter variations is still obscure.

EPIDEMIC ENCEPHALITIS is another term for ENCEPHALITIS LETHARGICA.

EPIDYDIMIS (ἐπιδιδυμίς) is the name applied to an oblong body attached to the upper part of each testicle, composed of convoluted vessels and ducts. It is liable to be the seat of tuberculous and other inflammation.

EPIGASTRIUM (ἐπί, upon; γαστήρ, the stomach) is the region lying in the middle of the abdomen over the stomach. (*See* ABDOMEN, REGIONS OF.)

EPIGLOTTIS (ἐπιγλωττίς) is a leaf-like piece of elastic cartilage covered with mucous membrane, which stands upright between the back of the tongue and the glottis, or entrance to the larynx. In the act of swallowing, it prevents fluids and solids from passing off the back of the tongue into the larynx.

EPIGNATHUS is the term used to describe a mal-development of the fœtus in which the deformed remains of one twin stick out of the mouth of the other.

EPILATION (*e*, out; *pilus*, hair) means the removal of hair by the roots. (*See* DEPILATION.)

EPILEPSY (ἐπίληψις), or FALLING SICKNESS, is a term which, as generally understood, is applied to a nervous disorder characterised by a fit of sudden loss of consciousness, attended with convulsions.

There may, however, exist manifestations of epilepsy much less marked than this, yet equally characteristic of the disease; while, on the other hand, it is to be borne in mind that many other attacks of a convulsive nature have the term 'epileptiform' applied to them because they resemble epilepsy.

Epilepsy was well known in ancient times, and was regarded as a special infliction of the gods, hence the names

morbus sacer, morbus divus. It was also termed *morbus Herculeus,* from Hercules being supposed to have been epileptic, and *morbus comitialis,* from the circumstance that when any one at a meeting in the forum was seized with an epileptic fit the assembly was at once broken up. *Morbus caducus, morbus lunaticus astralis, morbus demoniacus, morbus major* were all terms used to designate epilepsy.

The forms which this disease manifests have been differently described by different writers, but there are two well-marked varieties of the epileptic seizure, either of which may exist alone or both may be found to occur in the same individual. To these the terms *epilepsia gravior* and *epilepsia mitior,* or *le grand mal* and *le petit mal* are generally applied. The former of these, if not the more common, is at least that which attracts most attention, being what is generally known as an epileptic fit. In addition to these two forms there is a type known as *Jacksonian epilepsy,* in which the seizure consists of convulsive movements commencing in a single muscle or group of muscles, consciousness being in general retained. Cases of this type shade off, however, into *grand mal,* and indeed the subjects of Jacksonian epilepsy are apt, at a later stage, to be affected by typical seizures of severe type.

Causes.—In the very rare instances of persons dying in the epileptic fit, the *post-mortem* appearances presented by the brain are in general either entirely negative or of such indefinite character as cerebral congestion, while, on the other hand, in chronic cases of epilepsy, such lesions as atrophy and degeneration of brain substance or vascular disease are frequently met with, but are, as is well known, common to many other forms of nervous disease, and are much more probably the consequences rather than the causes of the epileptic attacks. The disease is commonly regarded as one of functional character. Many cases, especially those which begin with the Jacksonian type of seizure, appear to be due to some organic disease of the brain, such as a tumor, inflammation of the membranes of the brain, or the scar of some old injury, but this certainly does not occur in the majority of cases of epilepsy.

Practically all that can be said about the direct cause is that in the healthy brain nerve energy is capable, under control of the will, of being expended in a sudden and explosive but regulated manner, while, in the disease known as epilepsy, uncontrolled discharges of energy, devoid of any purposive action, take place from time to time in an unusual manner.

Various predisposing factors must, however, be taken into account. In view of the possible hereditary nature of epilepsy medical men were apt to advise those with a family history of the disease not to marry. But it is now believed that direct transmission of the disease is uncommon, and medical prohibition of marriage and child-bearing is less dogmatically applied.

Age is of importance in reference to the production of epilepsy. The disease may appear at any period of life, but it most frequently first manifests itself between the ages of ten and twenty years, the period of second dentition and puberty, and again at or about the age of forty.

Among other causes which are influential in the development of epilepsy may be mentioned sudden fright, prolonged mental anxiety, overwork and alcoholism. Epileptiform fits, which at a later period may develop into typical epileptic seizures, also occur in connection with injuries of the head and organic disease of the brain, as well as with a depraved state of the general health, and with irritations in distant organs, as seen in the fits occurring in dentition, in kidney disease, and as the result of worms. The symptoms traceable to these causes are sometimes termed *sympathetic* or *eccentric epilepsy.*

Epilepsy is occasionally feigned by malingerers, but an experienced medical practitioner will rarely be deceived; and when it is stated that although many of the phenomena of an attack, particularly the convulsive movements, can be readily simulated, yet that the condition of the pupils, which are dilated during the fit, cannot be feigned, and that the impostor seldom bites his tongue, or injures

himself in falling, choosing some soft object instead of falling headlong, like the true epileptic, deception is not likely to succeed even with non-medical persons of intelligence. The electro-encephalogram (*see* ELECTRO-ENCEPHALOGRAPHY) in true epilepsy is characteristic.

Symptoms.—Although in most instances an epileptic attack comes on suddenly, it is in some cases preceded by certain premonitory indications or warnings. These are of very varied character, and may be in the form of some temporary change in the disposition, such as unusual elevation or depression of spirits, or of some alteration in the look. Besides these general symptoms, there are frequently peculiar sensations which immediately precede the onset of the fit, and to such the name of *aura epileptica* is applied. In its strict sense, this term refers to a feeling of a breath of air blowing upon some part of the body. This sensation, however, is not a common one, and the term has now come to be applied to any peculiar feeling which the patient experiences as a precursor of the attack. The so-called 'aura' may be of mental character, in the form of an agonising feeling of momentary duration; of sensory character, in the form of pain in a limb or in some internal organ, such as the stomach; or unusual feeling connected with the special senses, such as a strange smell or extraordinary vision; or, further, of a motor character, in the form of contractions or trembling in some of the muscles. The aura may be so distinct and of such duration as to enable the patient to lie down or seek a place of safety before the attack comes on.

The seizure is usually preceded by a loud scream or cry, which is not to be ascribed, as was at one time supposed, to terror or pain, but is due to the convulsive action of the muscles of the larynx, and the expulsion of air through the narrowed glottis. If the patient is standing he immediately falls, and often sustains serious injury. Unconsciousness is complete, and the muscles generally are in a state of stiffness or tonic contraction, which may be found to affect those on one side of the body in particular. The head is turned towards one or other shoulder, the breathing is for the moment arrested, the countenance first pale then livid, the pupils dilated, and the pulse rapid. This, the first stage of the fit, generally lasts for about half a minute, and is followed by the state of clonic (*i.e.* tumultuous) spasm of the muscles, in which the whole body is thrown into violent agitation. The eyes roll wildly, the teeth are gnashed together, and the tongue is often severely bitten. The breathing is noisy and foam (often tinged with blood) issues from the mouth, while even the contents of the bowels and bladder may be ejected. This stage lasts for a period varying from a few seconds to several minutes, when the convulsive movements gradually subside, and relaxation of the muscles takes place, together with partial return of consciousness, the patient looking confusedly about him and attempting to speak. This, however, is soon followed by drowsiness and stupor, which may continue for several hours, when he awakes either apparently quite recovered, or fatigued and depressed, and occasionally in a state of excitement which sometimes assumes the form of mania.

Epileptic fits of this sort succeed each other with varying degrees of frequency, and occasionally, though not frequently, with regular periodicity. In some persons they only occur once in a lifetime, or once in the course of many years, while in others they return every week or two, or even are of daily occurrence, and occasionally there are numerous attacks each day. When the fit occurs, it is not uncommon for one seizure to be followed by another within a few hours or days. Occasionally there occurs a constant succession of attacks extending over many hours, and with such rapidity that the patient appears as if he had never come out of the one fit. The term *status epilepticus* is applied to this condition, which is sometimes followed with fatal results. In many epileptics the fits occur during the night as well as during the day, but in some instances they are entirely nocturnal, and in such cases the disease may long exist and yet remain unrecognised either by the patient or by the physician, until ob-

served and described by some other person.

The other manifestation of epilepsy, to which the name *epilepsia mitior* or *le petit mal* is given, differs from that above described in the absence of the convulsive spasms. It is also termed by some authors *epileptic vertigo* (giddiness), and consists essentially in the sudden arrest of consciousness, which is of but short duration, and may be accompanied with staggering or some alteration in position or motion, or may simply exhibit itself in a look of absence or confusion, and, should the patient happen to be engaged in conversation, by an abrupt termination of the act. In general, it lasts but a few seconds, and the individual resumes his occupation without perhaps being aware of anything having been the matter. In some instances there is a degree of spasmodic action in certain muscles which may cause the patient to make some unexpected movement, such as turning half round, or walking abruptly aside, or may show itself by some unusual expression of countenance, such as squinting or grinning. There may be some amount of 'aura' preceding such attacks, and also of faintness following them. The *petit mal* most commonly coexists with the *grand mal*, but has no necessary connection with it, as each may exist alone.

Epilepsy appears to exert no necessarily injurious effect upon the general health, and, even where it exists in an aggravated form, is quite consistent with a high degree of bodily vigour. It is very different, however, with regard to its influence upon the mind; and the question of the relation of epilepsy to insanity is one of great and increasing importance. Allusion has already been made to the occasional occurrence of maniacal excitement as one of the results of the epileptic seizure. Such attacks, to which the name of *furor epilepticus* is applied, are generally accompanied with violent acts on the part of the patient, rendering him dangerous, and demanding prompt measures of restraint. These attacks are by no means limited to the more severe form of epilepsy, but appear to be even more frequently associated with the milder form—the *petit mal*—where they either replace

altogether or immediately follow the short period of absence of mind characteristic of this form of the disease. Numerous cases are on record of persons known to be epileptic being suddenly seized, either after or without apparent spasmodic attack, with some sudden impulse, in which they have used dangerous violence to those beside them, irrespective altogether of malevolent intention, as appears from their retaining no recollection whatever, after the short period of excitement, of anything that had occurred; and there is reason to believe that crimes for which the perpetrators have suffered punishment have been committed in a state of mind such as that now described. The subject is obviously one of the greatest medico-legal interest and importance in regard to the question of criminal responsibility, and it is now justly receiving much greater attention than formerly. This type of unconscious act, which may be of a violent nature or may consist merely in a series of ordinary actions of which the epileptic is quite unconscious, is known as *epileptic automatism*.

Apart, however, from such marked and comparatively rare instances of what is termed epileptic insanity, the general mental condition of the epileptic is in a large proportion of cases unfavourably affected by the disease. In general there exists some peculiarity, exhibiting itself either in the form of defective memory, or diminishing intelligence, or, what is perhaps as frequent, in irregularities of temper, the patient being irritable or perverse and eccentric. In not a few cases there is a steady mental decline which ends in dementia, and epileptic women are said to suffer in regard to their mental condition more than men. It also appears to be the case that the later in life the disease shows itself the more likely is the mind to suffer. Neither the frequency nor the severity of the seizures seems to have any necessary influence in the matter; and the general opinion appears to be that the milder form of the disease is that with which mental failure is more apt to be associated.

Treatment.—During the fit, little can be done beyond preventing the

patient as far as possible from injuring himself while unconsciousness continues. Tight clothing should be loosened, and a cork or pad inserted between the teeth. When the fit is over, the patient should be allowed to sleep, and have the head and shoulders well raised.

In the intervals of the attacks, the general health of the patient is one of the most important points to be attended to. The strictest hygienic rules should be observed, and all the causes which have been mentioned as favouring the development of the disease should as far as possible be avoided. Of medicinal remedies for epilepsy there are innumerable varieties, but only a few deserve mention as possessing any efficacy in controlling or curing the disease. The metallic salts, especially those of zinc, silver, and arsenic, have been employed, and apparently with benefit in some cases, but they seldom can be continued for any great length of time, owing to their liability to produce evil effects upon the health. Belladonna had the strong recommendation of Trousseau, who advised its administration either as a pill composed of the extract and powdered leaves, or in the form of atropine, in gradually increased doses, and continued for a length of time. The two most commonly used drugs—or groups of drugs—are the bromides and the barbiturates. Potassium or sodium bromide may be given separately or combined with luminal (phenyl barbitone). During 1939 most encouraging reports were received of a drug called sodium diphenylhydantoinate or phenytoin sodium (known under the proprietary names of Dilantin and Epanutin). It appears to be the most effective drug against epilepsy yet discovered. But it produces serious toxic reactions, and there is a narrow margin between the therapeutic and the toxic dose.

As regards diet, the red meats are generally forbidden, though it is doubtful if avoidance of them makes any great difference in the number of fits. The avoidance of salt has recently been shown to aid the effect of the bromide, and bread is sometimes baked with bromide of sodium or potassium instead of common salt, as a way of taking a large quantity of bromide that is convenient and unlikely to irritate the stomach. A diet specially rich in fats appears to benefit some epileptics.

'Epileptic colonies' have been established in many places where persons afflicted in this way can carry out productive work under safe conditions.

EPINEPHRINE (*see* ADRENALINE).

EPIPHORA (ἐπί, upon; φέρω, I carry) means a condition in which tears, instead of passing from the eye down into the nose, run over on the cheek. It is due to blocking of the tear-ducts. (*See* EYE.)

EPIPHYSIS (ἐπίφυσις) means the spongy extremity of a bone, attached to it for the purpose of forming a joint with the similar process of another bone. An epiphysis is covered on its surface by cartilage, is developed from a distinct centre of ossification, and in a young person is connected with the shaft of the bone by a plate of cartilage that disappears in the adult. Separation of an epiphysis is a form of fracture which sometimes occurs in children, and is apt to be more serious than a break through bony tissue because it involves damage to the plate of growing cartilage, so that, although union takes place readily, the subsequent growth of the bone may be interfered with and the full growth of the limb may afterwards fail to be attained.

EPISIOTOMY is the operation of cutting the outlet of the vagina in child-birth so as to facilitate the birth of the fœtus.

EPISPASTICS (ἐπί, upon; σπάω, I draw) are substances which produce blistering of the skin. (*See* BLISTERS.)

EPISTAXIS (ἐπί, upon; στάζω, I drop) means bleeding of the nose. (*See* HÆMORRHAGE.)

EPITHELIOMA (ἐπί, upon; θηλή, the nipple; *-oma*, meaning tumor) is a tumor of malignant nature arising in the epithelium covering the surface of the body. (*See* CANCER.)

EPITHELIUM (ἐπί, upon; θηλή, the nipple) means the cellular layer which upon the skin forms the cuticle, covers the inner surface of the bowels, and forms the lining of ducts and hollow organs, like the bladder, generally.

FIG. 164.—Scaly epithelium from the roof of the mouth. (Turner's *Anatomy*.)

It consists of one or more layers of cells which adhere to one another, and is one of the simplest tissues of the body. It is of several forms: for example, the cuticle is formed of scaly epithelium, the cells being in several layers and more or less flattened (*see* SKIN); the bowels are lined by a single layer of columnar epithelium, the cells being long and narrow in shape; the air passages are lined by ciliated epithelium—that is to say, each cell is provided with lashes which drive the fluid upon the surface of the passages gradually upwards; and the inner surface of the bladder consists of cells intermediate in shape between those of the skin and those of the bowel.

FIG. 165.—Columnar epithelium. *A*, Side view of a group of cells; *B*, surface view of the ends of a group of cells; *C*, a columnar cell from the mucous membrane of the small intestine. (Turner's *Anatomy*.)

FIG. 166.—Ciliated epithelial cells. (Turner's *Anatomy*.)

EPIZOÖTIC (ἐπί, upon; ζῷον, animal) is a term applied to any disease in animals which diffuses itself widely. The term corresponds to the word epidemic as applied to human beings. In plague, for example, an epizoötic in rats usually precedes the epidemic in human beings.

EPSOM SALTS is the popular name for sulphate of magnesium, which is perhaps the most commonly used saline purgative. For a dose, a heaped teaspoonful or more of the salt should be mixed with as little water as will dissolve it, and taken in the morning before breakfast, or the same quantity may be taken divided into three or four small doses, one of which is taken every quarter of an hour. (*See* PURGATIVES.)

Magnesium sulphate is used frequently for the treatment of dysentery and other inflammatory conditions of the bowels in order to remove by purgation the cause of the irritation. It is sometimes injected through a stomach-tube direct into the duodenum in order to produce a copious flow of bile in disorders of the liver and gall-bladder. External fomentations of 25 per cent magnesium sulphate solution are frequently applied in cases of rheumatic joints, erysipelas, and other forms of inflammation. It has also been used for injection beneath the skin or into the spinal canal in the treatment of tetanus, eclampsia, and other convulsive disorders.

EPULIS (ἐπουλίς, a gumboil) is a term applied to any tumor connected with the jaws.

EQUINIA (*see* GLANDERS).

EREPSIN, or EREPTASE, is a ferment secreted by the intestine which breaks up peptides into amino-acids.

ERGOSTEROL is a sterol found in yeasts and fungi and in plant and animal fat. Under the action of sunlight or ultra-violet rays, it produces vitamin D2. The substance changed in this way is known as calciferol, and is used for the prevention and cure of rickets and osteomalacia. A similar change in the ergosterol of the skin is produced when the body is freely ex-

posed to sunlight. Calciferol is not so active as, and differs chemically from, the vitamin D occurring in fish-liver oils.

ERGOT is the spawn of *Claviceps purpurea*, a fungus which grows in the grain of rye. It contains several active principles which have all more or less the same action, especially to alkaloids ergometrine and ergotoxine. The drug causes prolonged contraction of unstriped muscle fibres all over the body, particularly the muscle fibres of the blood-vessels and of the womb. When the drug is administered to fowls, the action on the blood-vessels is easily tested, because the comb and wattles become bloodless and finally shrivel up.

Uses.—The drug is used mainly to check hæmorrhage, particularly that which is apt to follow upon childbirth. It is also used to check hæmorrhage from organs like the lungs and kidneys, which are inaccessible for direct applications, but in these cases is not of much use. It is also given in small doses for some time after childbirth to reduce the womb to its proper size in cases where this is not taking place naturally.

ERGOT POISONING occasionally occurs among persons who eat bread made from diseased rye. Several terrible epidemics [*St. Anthony's Fire*] occurred in France and Germany during the Middle Ages. Its symptoms are the occurrence of spasmodic muscular contractions, and the gradual production of gangrene in parts like the fingers, toes, and tips of the ears.

ERIGERON is a yellowish oil resembling turpentine, and possessing similar properties, distilled from *Erigeron canadense* or fleabane.

EROSION (*erodo*, I gnaw away) means a process of gradual wearing down of structures in the body. The term is applied to the effect of tumors, when they cause destruction of tissue in their neighbourhood without actually growing into the latter; for example, an aneurysm may 'erode' bones in its neighbourhood. The term is also applied to minute ulcers, for example, 'erosions' of the stomach, caused by extreme acidity of the gastric juice.

ERRHINES (ἔρρινον) are drugs which cause running at the nose, *e.g.* iodide of potassium.

ERUCTATION (*eructo*, I belch), or belching, means the sudden escape of gas or of portions of half-digested food from the stomach up into the mouth. The production of gases in the stomach is usually associated with dilatation of that organ. These gases consist mainly of carbonic acid gas and marsh gas, and are frequently inflammable. Many nervous persons and also persons who suffer from acid dyspepsia, have a bad habit of gulping down mouthfuls of air when digestion is uncomfortable. This air is after a little while belched up again. Eructations of extremely sour fluid prove the existence of acid dyspepsia. (*See* DYSPEPSIA.) Some persons, especially those in whom dyspepsia occurs from time to time, have at other times the peculiarity of bringing up fragments of food an hour or two after meals.

ERUPTION (*erumpo*, I break out), or RASH, means an outbreak, in a scattered form, upon the surface of the skin, usually raised and red, and, it may be, also covered with scales, or crusts, or vesicles containing fluid. The appearance of an eruption depends, to a certain extent, upon the nature of the disease, or other source of irritation, which causes it; for example, the eruption of measles is always distinguishable from that of chicken-pox. But the same disease may also produce different eruptions in different persons, or in the same person in different states of health, or even on different parts of the body at one time.

Eruptions may be acute or chronic. Most of the acute eruptions belong to the exanthemata, *i.e.* they are bright in colour and burst out suddenly like a flower. These are the eruptions of typhus fever, typhoid fever, scarlatina, measles, German measles, smallpox and chicken-pox. In general the severity of these diseases can be measured by the amount of eruption, but in cases where the eruption is 'suppressed', or, as it is popularly termed, 'goes in', the disease is apt to be very serious. The appearance of the eruption, therefore, seems to exercise some beneficial

effect upon the course of the disease. (See under these various headings.)

Some eruptions are very transitory, like nettle-rash, appearing and vanishing again in the course of a few hours.

For chronic eruptions see SKIN, DISEASES OF.

ERYSIPELAS (ἐρυσίπελας, probably derived from ἐρυθρός, red; and πέλλα, skin)—synonyms, *the Rose*, *St. Anthony's Fire*—is a disease characterised by diffuse inflammation of the skin, or of the subcutaneous cellular tissue, attended with fever. In the Middle Ages this disease was confused with ergot poisoning.

Causes.—It has long been known that the disease is of a highly infectious nature. This contagiousness of

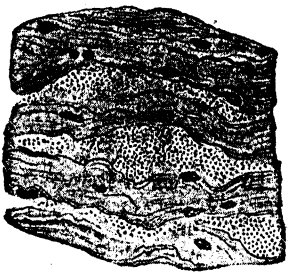

FIG. 167.—Streptococcus of erysipelas growing up the connective tissue spaces of the skin. Magnified by 250. (Thoma's *Pathology*.)

erysipelas was often illustrated in the surgical wards of hospitals, where, having once broken out, it was apt to spread with great rapidity, and to produce disastrous results, as well as in lying-in hospitals, where its occurrence gave rise to the spread of a form of puerperal fever of virulent character. Not only is the disease communicated from wounds already the seat of erysipelas, but infection of wounds by various suppurative diseases seems capable of producing it. The infecting organism is the *Streptococcus pyogenes*. Erysipelas is slightly commoner in women than in men, and is commonest between the ages of 50 and 60.

Symptoms.—When the erysipelas is of moderate character, there is simply a redness of the skin, which feels somewhat hard and thickened, and upon which there often appear small vesicles. This redness, though at first circumscribed, tends to spread and affect the neighbouring sound skin, until an entire limb or a large area of the body may become involved in the inflammatory process. There is usually considerable pain, with heat and tingling in the affected part. As the disease advances, the portions of skin first attacked become less inflamed, and exhibit a yellowish appearance, which is followed by slight desquamation of the cuticle. The inflammation in general gradually disappears. Sometimes, however, it breaks out again, and passes over the area originally affected a second time. But besides the skin, the subjacent tissues may become involved in the inflammation, and give rise to the formation of pus. This is termed *phlegmonous erysipelas*, and is much more apt to occur when the disease starts in a wound or ulcer. Occasionally the affected parts become gangrenous. Certain complications are apt to arise in erysipelas affecting the surface of the body, particularly inflammation of serous membranes, such as the pericardium, pleura, and peritoneum.

Erysipelas of the face usually begins with symptoms of general illness, the patient feeling languid, drowsy, and sick, while frequently there is a distinct shivering followed by fever, and the temperature may rise to 104° or 105°. Sore throat is sometimes felt, but, in general, the first indication of the local affection is a red and painful spot at the side of the nose or on one of the cheeks or ears. Occasionally the inflammation begins in the throat and reaches the face through the nasal fossæ. The redness gradually spreads over the whole surface of the face and is accompanied with swelling which, in the lax tissues of the cheek and eyelids, is so great that the features soon become unrecognisable and the eyes quite closed. The spreading edge of the red area is usually sharply marked and raised. Advancing over the scalp, the disease may invade the neck and pass on to the trunk, but in general the inflammation remains confined to the face and head. While the disease progresses, besides the pain tenderness, and heat of the affected parts, the constitutional symptoms are very severe. Delirium is a frequent accompaniment. The attack in general

lasts for a week or ten days, during which the inflammation subsides in the parts of the skin first attacked, while it spreads onwards in other directions, and after it has passed away there is some slight desquamation of the cuticle.

Although in general the termination is favourable, serious and occasionally fatal results follow from inflammation of the membranes of the brain, and in some rare instances sudden death has occurred from suffocation arising from œdema of the glottis, the inflammation having spread into and extensively involved the throat. Persons who have had one attack of erysipelas appear to enjoy protection from another attack only for a very limited period, probably a few weeks or months. But apart from this, they certainly appear more liable to attacks than those who have never suffered from the disease.

Erysipelas occasionally assumes from the first a violent form, under which the patient sinks rapidly. It is sometimes a complication in certain forms of exhausting disease, such as consumption or typhoid fever, and is then to be regarded as of serious import. A very fatal form occasionally attacks new-born infants, particularly in the first four weeks of life (*Erysipelas neonatorum*). In epidemics of puerperal fever, this form of erysipelas has been specially found to prevail.

Treatment.—In the majority of cases, attention to the functions of the stomach and bowels, with a diet consisting of plenty of easily digested food, is of chief importance. Some physicians recommend tincture of perchloride of iron to be taken internally in large doses. In more serious cases, where the person is highly fevered and exhausted, food of a stimulating kind is necessary and strong soups with various kinds of meat extracts may be given.

As regards local treatment, it is sometimes sufficient in slighter cases to dust the affected part with a mixture of starch and boric acid powder and to wrap it in cotton-wool so as to prevent exposure to changes of temperature. A method of treating early cases and preventing their further development consists in smearing on and for some distance around the discoloured area a mixture of ichthyol (1 part) in glycerin (4 parts). This is applied several times daily and is covered thickly with cotton-wool, which is changed each time the ichthyol is renewed. Another method in early cases is to paint the area and for some distance round it with strong tincture of iodine. This is supposed to check the spread of the disease through causing the lymph spaces around the area to become blocked. Lint soaked in a saturated solution of magnesium sulphate and covered with oil-silk is another local application. When erysipelas is associated with suppuration, the affected part has to be incised and the wound washed out frequently with some antiseptic lotion.

In severe cases associated with marked general symptoms, it is a frequent practice to inject antistreptococcic serum, but this method of treatment has on the whole proved disappointing. In prolonged or recurrent cases a vaccine is sometimes used by hypodermic injection.

The 'new chemotherapy' that has developed since 1935 has put in the hands of the physician two most valuable remedies against erysipelas—namely, sulphanilamide and sulphapyridine. Since the use of sulphonamide drugs in the treatment of erysipelas the fatality-rate of the disease in one fever hospital fell steeply between 1935 and 1939.

ERYTHEMA (ἐρύθημα) is a general term signifying several conditions in which areas of the skin become congested with blood, and consequently a red eruption appears. The eruption is accompanied by tingling, and often by itching and pain.

Causes.—It may be due to heat, such as exposure to the sun, or the constant exposure, by cooks or iron-workers, of the face, hands, or legs to a blazing fire. Another form, known as 'erythema pernio', is due to exposure to cold and wet. (*See* CHILBLAINS.) A third variety, which appears, usually on the front of the legs, in the form of red or livid, tender swellings, often over an inch in breadth, is known as 'erythema nodosum', and is thought to be a manifestation of rheumatism, or of

tuberculosis. In infants suffering from dyspepsia or diarrhœa, a form of erythema, very like the rash of scarlatina, may appear quickly over the whole body. Adults may also, especially in the spring and autumn, owing probably to errors in diet, suffer from a severer form, which begins as red blotches on the hands, and, spreading up the arms to the body, produces lumps and vesicles, or even large blebs full of fluid. This form, on account of the diversity of the appearances in different parts, is known as 'erythema multiforme'. It also occurs as a drug-rash from the use of such drugs as belladonna or copaiba.

ERYTHROBLASTOSIS FŒTALIS (*see* ICTERUS GRAVIS NEONATORUM).

ERYTHROCYTE (ἐρυθρός, red; κύτος, cell) is another name for a red blood or copaiba.

ERYTHROEDEMA. Other terms for this condition are ACRODYNIA and PINK DISEASE. This is a disease of infants in which there are the following features: restlessness, weakness, neuritis, and swelling and redness of the face, fingers, and toes. It is possibly the result of vitamin deficiency.

ERYTHROL is a sugar derived from *Rocella tinctoria* and other lichens. It is used in combination with nitric acid to form erythrol tetranitrate, or erythrityl tetranitrate, which produces a prolonged effect in dilating blood-vessels. This is employed in such diseases as angina pectoris, chronic Bright's disease, etc., mixed with sugar of milk or chocolate tablets. The dose is from ¼ to 1 grain several times daily.

ERYTHROMELALGIA (ἐρυθρός, red; μέλος, limb; ἄλγος, pain), or RED NEURALGIA, is a condition in which the fingers or toes, or even larger portions of the limbs, become purple, bloated in appearance, and very painful. In persons suffering from this condition, which is not a common one, the attacks come and go, being worse in summer (unlike chilblains), and worse on exertion or when the affected parts are warmed or allowed to hang down. The condition may appear without apparent cause, but is often associated with diseases of the nervous system, like disseminated sclerosis or locomotor ataxia. The only relief is got, as a rule, by elevation, rest in bed, and application of cold.

ESCHAR (ἐσχάρα, a slough) is a piece of the body killed by heat or caustics.

ESCHAROTICS are the more powerful varieties of caustics, such as mineral acids, which produce death, to some depth, of tissues with which they come in contact. (*See* CAUSTICS.)

ESMARCH'S BANDAGE is a rubber bandage which is applied to a limb from below upwards in order to drive blood from it.

ESSENCES are strong solutions of active substances, for example, essence of rennet, essence of pancreatin. Some of these are made by solution in water, but the aromatic essences are usually solutions of volatile oils (*e.g.* essence of peppermint, essence of vanilla), in rectified spirit of the strength 1 in 5.

ESTER. — An organic compound formed from an alcohol and an acid by the removal of water. A compound formed by the replacement of the hydrogen of an acid by a hydrocarbon radical. Also known as *compound ether, ethereal salt.* Fats, for instance, are esters of fatty acids and glycerol.

ETHER, or ETHYL OXIDE, is a colourless, volatile, highly inflammable liquid formed by the action of sulphuric acid upon alcohol, with the aid of heat. Ether boils below the body temperature, and so when sprayed over the skin rapidly evaporates. It dissolves many substances, such as fats, oils, resins, better than alcohol or water, and is accordingly used in the preparation of many drugs.

Uses.—Externally it is used as a cleansing agent before operations. By inhalation it is used as a general anæsthetic. (*See* ANÆSTHETICS.) Internally it is used occasionally for relieving pain such as colic, and also for its stimulating properties. For its use as an intoxicant see DRUG HABITS. In cases of heart failure and collapse from other causes half a drachm to a drachm is often injected hypodermically.

ETHISTERONE is the name approved by British Pharmacopœia for the orally active analogue of progesterone. Ethisterone is also known as pregneninolone or anhydrohydroxy-progesterone. It is given in certain cases of menorrhagia and habitual abortion, where a deficient secretion of the corpus luteum is suspected. (*See* PROGESTERONE.)

ETHMOID (*ἠθμός*, a sieve; *εἶδος*, form) is the name of a bone in the base of the skull which separates the cavity of the nose from the membranes of the brain. It is a spongy bone with numerous cavities or sinuses.

Chronic suppuration in the ethmoidal sinuses causing a nasal discharge is sometimes responsible for inflammation in neighbouring parts such as the eye.

ETHYL BROMIDE and ETHYL CHLORIDE are clear, colourless liquids, produced respectively by the action of hydrobromic and hydrochloric acids upon alcohol. Both are extremely volatile, and rapidly produce freezing of the surface, when sprayed upon it. Accordingly they are used to produce insensibility to pain for small and short operations. Ethyl chloride is put up in graduated glass or metal tubes, with a fine nozzle. The tube is warmed by the hand and the liquid jets out in a fine spray which evaporates at once and so freezes the skin upon which it is sprayed. Ethyl chloride is also used by inhalation to produce general anæsthesia for very brief operations, such as removal of tonsils and tooth extraction. Unconsciousness is produced in the course of one or two minutes, but consciousness returns after its use with almost equal rapidity. It is also used to get the patient under the anæsthetic in combination with nitrous oxide gas or with ether.

ETHYLENE is a colourless inflammable gas used as an anæsthetic, compressed in metal cylinders.

ETIOLOGY, ÆTIOLOGY (*αἰτία*, cause; *λόγος*, discourse), means the group of conditions which form the cause of any disease.

EU- (*εὖ*, well) is a prefix meaning satisfactory or beneficial.

EUCAINE (trimethyl - benzoxy - piperidine) is a substance closely resembling cocaine both in chemical composition and in action upon the body, but, while cocaine is extracted from a plant, eucaine is a laboratory product. It has two advantages over cocaine: it can be boiled, and so sterilised for injection, without being destroyed, and it has four-tenths the toxicity of cocaine. It has, however, a greater irritant and a slightly less anæsthetic effect.

EUCALYPTUS, or BLUE-GUM (*Eucalyptus globulus*), is a tree, originally a native of Australia, and now grown all over the world. Its important constituent, oil of eucalyptus, is an oil of pleasant smell and spicy taste, which is obtained by distillation from the leaves of the tree. From the oil there is also obtained a camphor-like body known as eucalyptol. Similar oils are obtained in varying amount from most species of gum-trees, some of which have peculiar and fragrant odours. Groves of eucalyptus trees exert a marked influence upon the soil and air in their neighbourhood. The trees, which reach a great size, and have wide-spreading roots, remove much moisture from the soil, and have accordingly a powerful action in drying up swampy ground. The oil constantly exhaled from the leaves has the power of oxidising and destroying large quantities of the foul gases which emanate from swamps, and of checking to some extent the growth of microbes. Accordingly these trees have a beneficial influence upon unhealthy districts in which they are planted.

Uses. — The oil is largely used as a disinfectant and deodorant. Two ounces of oil of eucalyptus, placed in a porous earthenware vessel so as to impregnate its substance, will keep the air of a water-closet in which the vessel is suspended perfectly free from smell for several months. For a similar purpose, it may be mixed with eight times its weight of sawdust and used to sprinkle on floors.

It is also used as an inhalation or internally in bronchitis and in coryza.

EUGENICS (*εὖ*, well; *γεννάω*, I beget) is a term applied to the study and cultivation of conditions that may improve the physical and moral qualities of future generations.

EUMYDRIN, or atropine-methyl nitrate, has been used successfully in the treatment of congenital pyloric stenosis, and is thought by some to obviate the necessity for operation in this condition.

EUONYMIN is a dry extract made from the bark of the Wahoo-tree (*Euonymus atropurpureus*), a native of the United States. It has a mild purgative action, and to some extent also stimulates the liver. It is given usually in doses of 1 grain combined with other purgatives in a pill.

EUPAD is a mixture of calcium chloride and boric acid, 25 grams of which dissolved in 1 litre of water form 'eusol'.

EUPATORIUM is a drug used in household medicine. It consists of the powdered leaves of the thoroughwort (*Eupatorium perfoliatum*), a native plant of the United States. A hot infusion is given in colds and chills to produce perspiration and a cold infusion as a bitter. The fluid extract is also given in teaspoonful doses.

EUSOL (*see* HYPOCHLOROUS ACID).

EUSTACHIAN TUBES are the passages, one on each side, leading from the throat to the middle ear. Each is about 1½ inches long and is large at either end, though at its narrowest part it only admits a fine probe. The tubes open widely in the act of swallowing or yawning. The opening into the throat is situated just behind the lower part of the nose, so that a catheter can be passed through the corresponding nostril into the tube for inflation of the middle ear. (*See also* EAR *and* NOSE.)

EUTHANASIA (*εὖ*, well; *θάνατος*, death) means the procuring of an easy and painless death. It has been advocated in some quarters that a medical man should have the power to put to death painlessly, by means of such drugs as morphia, any person suffering from a painful, distressing, and incurable disease the outcome of which is inevitably fatal, the patient or his relatives consenting. Various legal safeguards have been proposed, but there are obvious moral and religious—not to mention medical—objections to the recognition of such a procedure.

EVACUANT (*evacuans*, making empty) is a name for a purgative medicine.

EVIPAN is the proprietary term for N-methyl-*cyclo*hexenyl-methylbarbituric acid, now shortly and mercifully described by the *British Pharmacopœia* as hexobarbitone. The sodium salt injected into a vein makes the patient unconscious: this is known as "intravenous anæsthesia", and is a valuable addition to the medical man's equipment.

EXANTHEMATA (*ἐξ*, out; *ἀνθέω*, I blossom) is an old name used to classify the acute infectious diseases distinguished by a characteristic eruption. (*See* ERUPTION.)

EXCIPIENT (*excipio*, I mix with) means any more or less inert substance added to a prescription in order to make the remedy as prescribed more suitable in bulk, consistence, or form for administration.

EXCISION (*excisio*) means literally a cutting out, and is a term applied to the removal of any structure from the body, when such removal necessitates a certain amount of separation from surrounding parts. For example, one speaks of the excision of a tumor, of a gland, of a joint, etc. When an opening is simply made into the body the term 'incision' is used, and when a prominent part is merely cut across the word 'amputation' is employed.

EXCITEMENT (*see* DELIRIUM, HYSTERIA, *and* INSANITY).

EXCITING CAUSE of a disease is the name given to the direct or immediate cause, as opposed to 'predisposing' causes, which merely render the body more liable to the disease in question. For example, poor expansion of the chest and exposure to severe weather may be 'predisposing' causes of consumption, but the 'exciting' cause is infection with the tubercle bacillus.

EXCORIATION (*ex*, out of; *corium*, the skin) means the destruction of small pieces of the surface of skin or mucous membrane. (*See* CHAFING OF THE SKIN.)

EXEIRESIS means the evulsion of a part by operation, especially of the phrenic nerve. Exeiresis of the phrenic nerve is done in order to paralyse one-half of the diaphragm and so give rest to diseased lung on the side operated on.

EXERCISE is a matter of great importance in the maintenance of health, not so much to the young, in whom the expenditure of energy is generally as natural as breathing; nor to the labouring classes, whose daily work provides them with sufficient exertion, but more to those who practise sedentary callings, and to the well-to-do and indolent.

Effects of exercise. — Upon the muscles of the body exercise produces, by their contraction, loss of material and repair by new material, the muscles growing gradually as increased demands are made upon them. Upon the blood-vessels and lymph-vessels the contracting and relaxing muscles exert a pumping action, so that the blood and lymph circulate more rapidly.

It is calculated that the body of a man, 11 stones, *i.e.* 154 pounds, in weight, expends about 3400 foot-tons of energy daily, or sufficient to raise one ton to the top of a high British mountain. Of this about 260 foot-tons are expended on the work of the internal organs, viz. the beating of the heart, the movements of the chest in breathing, and of the stomach and bowels in digestion. The large amount of 2840 foot-tons is, on an average, necessary to maintain the body heat. The remaining 300 foot-tons represent the natural amount of external work of which the body is capable in health. The ordinary labourer does this in the course of his employment, but the clerk, the professional man, and the unemployed must perform a large part of it by some form of exercise.

Want of exercise.—The failure to perform at least a considerable part of this natural amount of work is followed by many bad results. In the young the muscles and bones do not develop as they should, and though they may increase in length they remain thin and puny. Further, the muscles which support the back become readily tired, producing 'round shoulders', or, since they are as a rule more tired on one side than on the other, causing curvature of the spine with elevation and 'throwing forward' of one shoulder. Deficient expansion of the chest is the result of never making special efforts in breathing, and this deformity is one of the chief predisposing causes of consumption. Where a single limb or one side of the body is not used in consequence of paralysis, the muscles undergo fatty degeneration and the joints become stiff. In those more advanced in years, faulty chemistry of the body, with bloodlessness, dyspepsia, and constipation, sets in when exercise and fresh air are insufficient. And, in the middle-aged, obesity, accompanied by degeneration of the heart muscle and blood-vessels, with a fat and flabby condition of all the muscles, is the result. (*See* CORPULENCE.) Further, the person who refrains from exercising his or her body in a rational manner, becomes a prey to all kinds of morbid inclinations.

Over-exercise, on the other hand, is equally bad. As a result of habitual over-exertion of certain muscles, though these muscles increase in size at first, actual wasting results later on. This appears, for example, in the thigh muscles of those who ride on horseback a great deal without other exercise. Persons who make great efforts beyond the capacity of their strength, particularly in running, are apt to bring on dilatation of the right side of the heart and emphysema of the lungs (*see* EMPHYSEMA), causing a form of 'asthma'. A similar condition is known in horses as 'broken-windedness'. A result of overstrain found in athletes is varicose veins. Persons who in youth engage in very athletic sports, such as rowing or racing, and who in later life do not keep up a fair amount of exercise, deteriorate much more than persons of poorer physique, being specially prone to accumulation of fat and to fatty degeneration of the over-developed heart. Some of the more immediate dangers of over-exertion are the following: a loss of tone and vigour, known as 'over-

training' or 'growing stale', results from some error of training, usually in diet, from actual exhaustion of the muscles, or from weakness of some internal organ. Dilatation of the heart is one of the commonest results of overstrain in those who have not had a proper course of 'training', and occurs especially after a long foot or cycle race. It may be transitory, producing breathlessness and pain in the chest, which pass off after half an hour's rest upon the back. Complete recovery may not take place, however, for some months or years. In persons who have a diseased heart-valve this may give way under great strain, causing sudden death. Accordingly, no person with valvular disease should indulge in racing. Rupture of a muscle with formation of a painful swelling or even dislocation of a joint or fracture of a bone sometimes follows a single excessive effort, such as throwing a cricket-ball. Rupture of a blood-vessel in the brain, lung, or eye is a more serious matter, but seldom occurs, except in elderly people, or in those who have diseased arteries. Hernia, or the forcing of some organ through the muscular wall of the abdomen, may result from a sharp, sudden strain, like a standing high-jump. By no means an uncommon result of training and over-exertion in those who are not perfectly sound is the rousing up of dormant lung or kidney disease, which otherwise might never have appeared. For all these reasons it would be well if heads of schools were in every case to cause boys or girls for whose safety they are responsible to be examined with the same degree of care as army recruits or candidates for life insurance, before allowing them to engage in any athletic sports.

Training involves a certain regimen and practice prior to engaging in special athletic efforts. The objects of training generally speaking are:

(1) To accustom certain muscles to perform a particular act, as, for example, the thigh and leg muscles to contract sharply and in a particular order for jumping; (2) to render the requisite muscles as large as possible, and remove, as far as may be, the fat deposited in and around them which impedes their action; (3) to strengthen the heart and deepen the breathing for prolonged efforts; and (4) to bring the whole body, and especially the nervous system, to a state of perfect health. For these objects, a course of special practice, combined with various general exercises, lasting usually over three weeks before the event for which the training is intended, is combined with a healthy form of diet. (*See* DIET.) Different trainers have, in addition, special rules of their own, usually founded on experience.

Training exercises.—The chief object of physical training is to produce a state of health and general physical fitness so that the body may be able better to withstand the strain of daily life, and to perform the work required of it without injury. Other objects of physical training are to obtain a good carriage and to prevent the undue accumulation of fat. The effect of physical exercises is important, not only on the muscles but also upon the heart, lungs, and other internal organs, especially when systematic exercises are carried out at the commencement of the day's activity.

The following exercises have been selected from the *Manual of Physical Training* used in the British army, and include groups of exercises for the different parts of the body. If ten or twelve of these exercises be chosen, and if each movement be carried out ten or twelve times slowly and methodically, this is sufficient to provide fifteen minutes of exercise. If these are carried out during dressing in the morning by

FIG. 168.—*Position of attention*, which forms commencement for most exercises; heels together, feet turned out at an angle of 45°, knees straight, trunk erect, arms hanging naturally from the shoulders, with palms turned towards thighs, neck erect, and eyes looking forwards.

FIG. 169.—*Position of hips firm.* The hands are raised quickly to grasp the waist with fingers in front and thumbs behind. This is the starting position for most arm exercises.

NECK EXERCISES

FIG. 170.—*Head bending backward.* In the position of attention, the head is bent slowly backward as far as possible, and then raised slowly to its former position.

FIG. 171.—*Head turning.* The head is turned slowly but strongly to the left as far as possible, then turned to its former position; then to the right as far as possible, and, finally, the position of attention resumed.

ARM EXERCISES

FIG. 172.—*Arm bending.* Keeping the elbows to the sides, the arms are quickly and sharply bent by carrying the hands up in front of the body and clenching the fists; the arms are then sharply stretched downward to the sides.

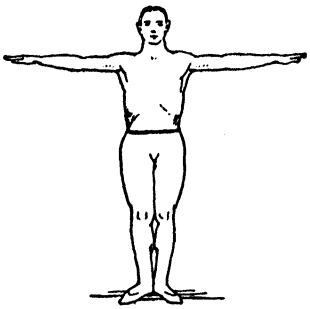

FIG. 173.—*Arms stretching sideways.* The arms are stretched sharply in line with the shoulders, palms downward and fingers fully stretched.

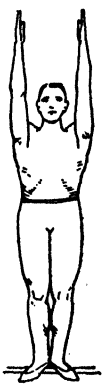

FIG. 174.—*Arms stretching upward.* The arms are stretched sharply upward to their fullest extent, palms inward and fingers fully extended.

The last three exercises strengthen the muscles of the arms and shoulders.

Leg Exercises

Fig. 175.—*Rising on tiptoe.* The heels are raised from the ground as high as possible and slowly lowered to the ground again. This develops the calf muscles.

Fig. 176.—*Full knee bending.* Keeping the heels together, these are raised from the ground as high as possible; the knees are then bent as much as possible, so that the buttocks are lowered to touch the heels; the original standing position is then slowly resumed. This strengthens the leg and thigh muscles and supples ankle, knee, and hip joints.

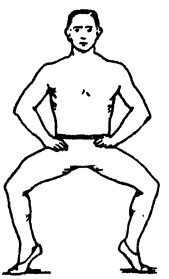

Fig. 177.—*Foot placing sideways with knee bending.* Each foot is carried one foot sideways; the heels are raised from the ground; the knees are bent till thigh and leg form a right angle; the knees are then straightened; the heels are slowly lowered and the original position of attention resumed. This exercises the adductor muscles of the thigh.

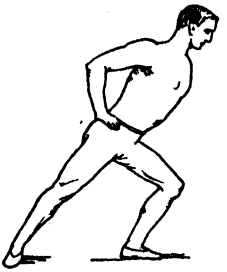

Fig. 178.—*Lunging.* The right foot is kept flat on the ground, and right leg straight; the left leg is carried three feet to the left and the body sharply inclined over the left foot, the trunk being in line with the right leg. To resume the original position, the left foot is pressed sharply on the ground and then carried back into the position of attention. The lunge may similarly be made to the right by carrying the right foot three feet to the right at starting.

Balancing Exercises

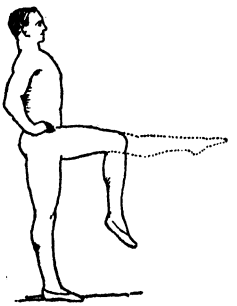

Fig. 179.—*Knee raising.* Standing on the right foot, the left knee is raised till the thigh is at right angles to the body with the leg hanging downward from the knee; the knee is then straightened and the leg then brought slowly down to its original position. The movement is repeated with the right leg.

Fig. 180.—*Leg raising backward.* Standing on the right foot, the left leg is raised as far as possible backward with the knee straight, and the toe pointed; the left leg is then slowly lowered to its original position. The movement is repeated with the right leg.

Dorsal Exercise

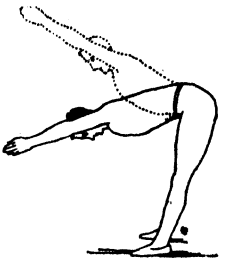

Fig. 181.—*Trunk downward bending.* Assume the position of Fig. 174. Bend the body as far downward as possible from the hips without rounding the back; slowly resume original position.

Lateral Exercises

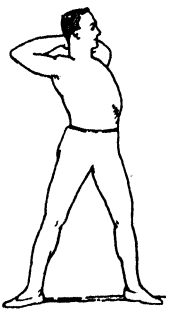

Fig. 182.—*Trunk turning.* Each foot is carried one foot outward, the hands are placed behind the neck, and, with the feet firm on the ground, the trunk is turned steadily as far as possible to the left; the original position is resumed, and the movement repeated to the right.

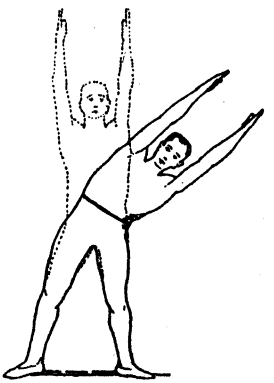

Fig. 183.—*Trunk bending sideways.* The arms are stretched upward, each foot is carried one foot outward, and, with the feet firm on the ground, the trunk is then bent steadily as far as possible to the left; the original position is resumed, the trunk is then bent to the right, and the original position again resumed.

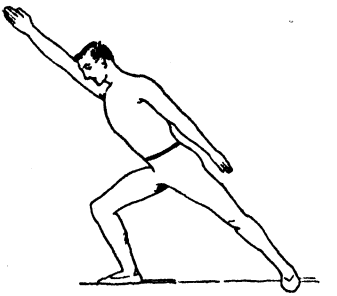

Fig. 184.—*Lunging with arms stretched.* Lunge outward as in Fig. 178; at the same time sharply stretch upward the arm corresponding to the forward foot and stretch downward, one hand's-breadth from the thigh, the arm corresponding to the rear foot, the movement of the arms being completed as the forward foot reaches the ground. Resume the position of attention, repeat towards opposite side.

Jumping Exercise

Fig. 185.—*Upward jumping.* Assume position of Fig. 176. Suddenly extend the knees and ankles and place the arms straight at the sides, springing from the ground vertically upward; drop to the ground on the toes with the knees practically straight, but allowing the ankles and knees to give, so that the position of Fig. 176 is resumed after landing. Repeat the movement.

Abdominal Exercises

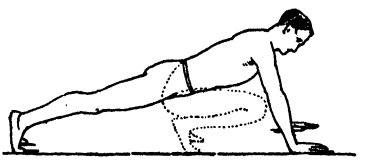

Fig. 186.—*On the hands.* Keeping the heels together, these are raised from the ground and the knees bent; at the same time the palms of the hands are placed on the ground rather more than the width of the shoulders apart, with arms straight. Keeping the arms straight, the feet are shot backward till the body and legs are straight, and fully stretched, the weight supported on the toes and hands.

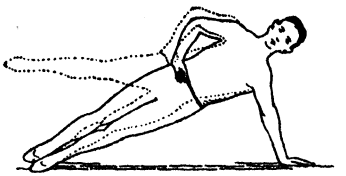

FIG. 187.—*Turning on the hand and leg raising.* From position of Fig. 186 raise the right hand from the ground and place it on the waist, at the same time turning the body to the right and placing the right foot immediately over the left; keeping left arm straight, raise right leg slowly as high as possible and slowly resume original position. Repeat by turning on the right hand.

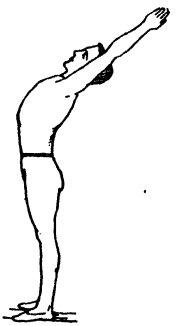

FIG. 188.—*Trunk backward bending.* Keeping the knees straight, raise the arms above the head and bend the upper part of the trunk slowly backward as far as possible. Slowly resume the original position.

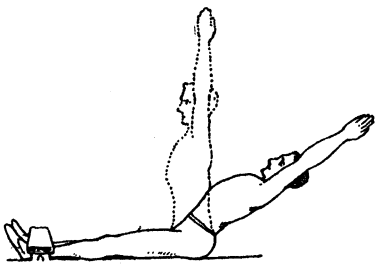

FIG. 189.—*Trunk backward bending with foot support.* Sitting on the ground with feet supported above and arms stretched upwards, bend slowly backward to touch the ground. Slowly resume original position.

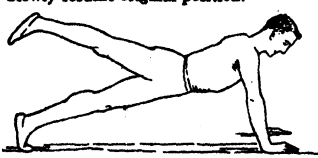

FIG. 190.—*Leg raising—on the hands.* Assume the position of Fig. 186; keeping the right leg straight, raise it as high as possible with toe pointed. Resume starting position and repeat with left leg.

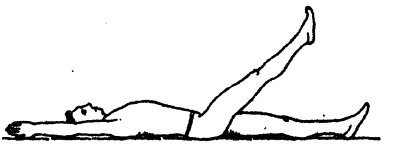

FIG. 191.—*Leg raising—on the back.* Assume the position of Fig. 176; place both hands on the ground to the rear and lower the body quickly backward to the ground, shooting the legs to the front. The body is then stretched flat on the back, feet together, and arms to the sides; stretch arms upward, keeping the knees straight, raise the right leg steadily without arching the back, lower the leg, and repeat with left leg. Repeat with both legs at one time.

business men and others whose duties prevent them from obtaining outdoor exercise by games, sufficient exercise is obtained to maintain a good standard of physical fitness.

EXFOLIATION (*ex*, out of; *folium*, a leaf) means the separation, in layers, of pieces of dead bone or skin.

EXOMPHALOS is the term applied to a hernia formed by the projection of abdominal organs through the umbilicus.

EXOPHTHALMIC GOITRE (ἐξ, out; ὀφθαλμός, the eye; *guttur*, throat) is a disease in which there is an enlargement of the thyroid gland, protrusion of the eyes, and other symptoms. (*See* GOITRE.)

EXOSTOSIS (ἐξ, out of; ὀστέον, a bone) means an outgrowth from a bone, usually the result of inflammation. (*See* BONE, DISEASES OF.)

EXPECTANT (*expectans*, waiting) is a term applied to a form of treatment in which the cure of the patient is left mainly to nature, while the physician simply watches for any unsatisfactory developments or symptoms, and relieves them if they occur.

EXPECTORANTS (*ex*, out of; *pectus*, the chest) are drugs which assist the removal of secretions from the air passages.

Varieties.—Most drugs used as expectorants have a very complicated mode of action. (1) Some act chiefly by making the secretion in the bronchial tubes more watery, and therefore less sticky; (2) others have exactly the opposite action, drying up the secretion where it is very copious; (3) a third group assists the act of coughing

in feeble persons, and so helps the removal of secretion; (4) while those in a fourth group soothe the lining membrane of the air passages and quiet ineffectual coughing. Some of the chief drugs, arranged as far as possible in the order of these groups, though several have a double action, are as follows: (1) steam inhalations, draughts of hot milk or water, chloride of ammonium, iodide of potassium, and, generally speaking, all alkalies; (2) volatile oils like anise, eucalyptus, and turpentine, menthol, balsam of tolu and Friar's balsam, syrup of squills and infusion of senega, inhalation of creosote or tar, and, generally speaking, all acids; (3) ipecacuanha, carbonate of ammonia and sal volatile, strychnine and tincture of nux vomica; (4) codeine.

Uses.—These drugs are combined in various ways in bronchitis and other chest conditions, but much skill is needed for their proper administration. For example, those in the first group are used in the early stages of acute and in chronic bronchitis, those in the next group are better for later stages of acute bronchitis, those of the third group are necessary for aged persons with pneumonia and bronchitis, and the members of the fourth group are applicable to the constant hacking cough of consumption.

EXPECTORATION (*ex*, out of; *pectus*, the chest) means either material brought up from the chest by the air passages, or the act by which it is brought up. The term is also used in place of 'sputum' for anything spat out. Expectoration varies considerably in character according to the site in which it is produced, and the disease with which it is associated.

Characters of expectoration.—There may be much cough productive of a very small amount of sputum at the commencement of an acute bronchitis or inflammation of the throat, and it must be remembered that young children and some older persons swallow their expectoration as soon as they have brought it up, instead of spitting it out.

The sputum from the throat in catarrh of this region is usually thick and sticky, speckled with black here and there owing to dust and smoke inhaled and deposited on the throat.

Watery, frothy expectoration is brought up in considerable quantities during the greater part of an attack of acute bronchitis, particularly in old people. A similar fluid is spat up when the lungs are œdematous or dropsical, as occurs sometimes in the course of heart or kidney disease. At a later stage of an acute bronchitis the sputum becomes more yellow and thicker in consistence, though in this disease it generally contains numerous air-bubbles.

When cavities are present in the lungs their contents are often expectorated as thick, yellow, oily-looking material, with few air-bubbles in it; and expectoration from this source, when spat into water, flattens out into a round disc resembling a coin, and hence gets the name of nummular sputum (Lat. *nummulus*, money).

Sputum with a 'rusty' tinge, and so sticky that it adheres to the dish into which it is spat, when the latter is turned upside down, is characteristic of pneumonia. Streaks of bright blood in such expectoration are regarded as rather a favourable sign for the outcome of the disease.

Bright red blood in large quantities may be brought up from the lungs, and then, as a rule, the person has suffered from recognised lung or heart disease for a considerable time, though coughing up of some blood is also occasionally one of the first signs of consumption. On the other hand, it must be remembered that spitting of blood may be due merely to a bleeding at the nose from which the blood has run backward down the throat; or to the rupture of a small vessel on the wall of the throat in cases where this part of the air passages is inflamed. Bleeding from the stomach has totally different characters from those of lung bleeding. That brought up from the lungs is bright red, frothy, and usually comes up with a hawk or with a few suppressed coughs, it may be by mouthfuls. Blood from the stomach is usually dark brown and granular from the action of the gastric juice, and is brought up by a definite act of vomiting. It results generally from

some ulcerated or congested state of the stomach.

Expectoration of a 'prune juice' colour occurring in the course of pneumonia is an ominous sign, and indicates usually that softening of parts of the lung is setting in.

In some diseases the sputum possesses a very foul smell, particularly in gangrene of the lung and in the condition known as bronchiectasis. (*See* LUNGS, DISEASES OF.)

Disposal of expectoration is now looked upon as a matter demanding public attention. The habit of spitting on the ground in public places is one which, in view of the dangerous nature of diseased sputum, should never be tolerated. Where spittoons are provided, these should be washed and disinfected every day.

Most consumptives who are able to go about carry with them a pocket flask containing a small quantity of

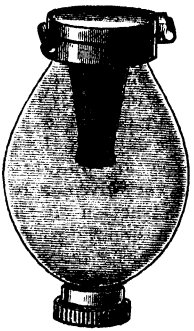

FIG. 192.—Sputum flask of commonly used form. There is at the upper end an opening with a spring lid which the patient raises when he wishes to spit. At the lower end is another opening with firmly fitting screw-cover, which is removed for emptying and washing the flask. One-third actual size.

some strong antiseptic (*e.g.* carbolic acid solution 1 in 5 or 1 in 20) into which the expectoration is received and by which it is disinfected before it is poured down the drains.

Microscopic examination of the sputum is of importance chiefly in diagnosing pulmonary tuberculosis by finding tubercle bacilli in it. In cancer of the lung the microscope may disclose malignant cells in the sputum, and in pneumonia pneumococci.

EXTENSION is the term applied to the process of straightening or stretching a limb. In cases of fractured limbs, extension is employed during the application of splints, in order to reduce the displacement caused by the fracture, and prevent movement of the broken ends of bone. It is effected by gently and steadily pulling upon the part of the limb beyond the fracture. Extension of a more permanent type is used in the after-treatment of some fractures, as well as in diseases of the spine, by placing the patient upon an inclined bed and affixing weights to his lower limbs or to his head by means of adhesive plaster or of straps. A similar procedure is often adopted in tuberculous disease of the knee or hip, to prevent the 'starting pains', which are apt to occur as the affected person is dropping off to sleep.

EXTRA is a Latin prefix meaning outside of or in addition, such as extracapsular, meaning outside the capsule of a joint, and extrasystole, meaning an additional contraction of the heart.

EXTRACTS are preparations, usually of a semi-solid consistence, containing the active parts of various plants extracted in one of several ways. In the case of some extracts the juice of the fresh plant is simply pressed out and purified; in the case of others the active principles are dissolved out in water, which is then to a great extent driven off by evaporation; other extracts are similarly made by the help of alcohol, and in some cases ether is the solvent. In the British Pharmacopœia extracts are made from about fifty drugs.

EXTRASYSTOLE is a term applied to premature contraction of one or more of the chambers of the heart. A beat of the heart occurs sooner than it should do in the ordinary rhythm and is followed by a longer rest than usual before the next beat. In extrasystole the stimulus to contraction arises in a part of the heart other than the usual. Extrasystoles often give rise to an unpleasant sensation as of the heart stumbling over a beat, but their occurrence is not usually of serious importance, and simply indicates undue irritability of the heart muscle.

EXTRAVASATION (*extra*, outside of; *vas*, a vessel) means an escape of fluid from the vessels or passages which ought to contain it. Extravasation of blood due to tearing of vessel walls is found in apoplexy, and in the commoner condition of the surface known as a bruise. Extravasation of urine takes place when the bladder or the urethra is ruptured by a blow on the abdomen or on the ork, or torn in a fracture of the pelvis.

EXUDATION (*exudo*, I sweat) means the process in which some of the constituents of the blood pass slowly through the walls of the small vessels in the course of inflammation, and also means the accumulation resulting from this process. For example, in pleurisy the solid, rough material deposited on the surface of the lung is an 'exudation'.

EYE.—The eyes are set, one on each side, in a deep four-sided cavity in the skull, called the 'orbit'. The edges of this are so prominent, especially above and to the inner side, that a flat object resting on them does not touch the eyeball, and therefore the eye is very seldom injured by a blow. The prominence of the eyebrow is largely due to air-spaces known as the 'frontal sinuses', lying in the substance of the frontal bone, and connected with the interior of the nose. The space behind the eyeball, and between it and the bone, is filled up by loose fat, which supports the ball as on an elastic cushion. The walls of the orbit almost meet in a point behind, leaving only two small gaps, through which pass nerves and vessels. The most prominent point of each eyeball is about 1½ inches from the middle line of the face, so that the two are 2½ inches apart. The eye is protected by two lids, upper and lower, which cover a varying amount of the globe, leaving usually an almond-shaped opening between their edges, which widens slightly as the eyes are turned up and down. The points where the lids join are known as the outer canthus and inner canthus. The inner canthus is tightly bound to the side of the nose, as may be seen by drawing the lids outwards, when a band stands out beneath the skin, between the nose and inner canthus; but the outer angle is freely movable up and down. Just within the inner canthus lies a small red swelling, the 'caruncle', which is merely a soft piece of skin, and often bears a few hairs. Within this, again, is a small fold, the 'semilunar fold', in the membrane covering the eyeball, which in some persons is fairly large, and represents the third eyelid found in birds and some other animals.

Eyelids.—Each of these consists of four layers. On the surface is skin, similar to the skin elsewhere on the body, but specially thin, loose, and pliant. Behind this comes a layer of muscle, the orbicular muscle, the fibres of which run round and round from one lid to the other, and serve to shut the eye. Next comes a stiff, fibrous layer, the 'tarsal plate', which gives stiffness to the lids, but which does not extend upwards and downwards the whole height of the lids, reaching, in the upper lid, only about one-third of an inch from the margin, in the lower one about half that distance. In the substance of this plate is embedded a row of straight glands, the Meibomian glands, the openings of which can be seen on the edge of the lid as a row of minute punctures. Small cysts very frequently form as a result of obstruction to these glands, and produce small, round, painless swellings upon the surface of the lid. Farthest back of all is a moist, red layer of mucous membrane, known as the 'conjunctiva'. This rubs over the surface of conjunctiva covering the eyeball, with which that on the lids is in fact continuous, at the upper margin of the upper lid and the lower margin of the lower lid. The conjunctiva, in passing from the lid to the surface of the eyeball, forms a pocket above and below. From the free margin of the lid projects a row of long, curved, elastic hairs, the eyelashes, which very materially protect the eyes from dust, insects, and the like. About one-fifth of the length of each lid away from the inner canthus one sees, on turning the lid a little outward, a small puncture on the margin of the lid. This puncture, the 'lachrymal puncture', leads off the tears from the surface of the eye.

Front of the eye.—When one sepa-

rates the lids widely, a large part of the 'white' of the eye comes into view. The white appearance is due to the sclerotic coat, composed of dense, white, fibrous tissue, shining through the translucent conjunctiva. In the centre of the sclerotic is set the clear transparent 'cornea', through which light passes into the eye. Behind the cornea again, is the beautifully-coloured 'iris', with a hole in its centre, the 'pupil', which looks black against the dark interior of the eye. A space is seen to exist between the cornea and iris, particularly if the eye be looked at from a little to one side, this space being filled with a clear transparent fluid. The colour of the iris depends upon the way in which the pigment is arranged in it: blue or grey eyes owe their colour to the presence of pigment at the back of the iris (in the posterior epithelial layer); in brown eyes pigment is present also in the pigment cells in the middle layer the stroma). If one attempts to look in through the pupil, one sees nothing, because, just as in looking into a camera, one obscures the entering light by placing one's head in front of it, and very little of the light which enters from the sides is reflected out again. If, however, one holds a mirror in front of the eye into which one wishes to look, in this way reflecting a bright beam of light into the eye, and if one then looks from behind the mirror through a small hole in its centre, one sees the interior of the eye brightly lighted up. The ophthalmoscope is an instrument constructed on this principle. By its help, one sees the interior as a general red ground. At one point is a round, pale area, the end of the optic nerve, and from the centre of it arteries and veins spread out over the inner surface of the eyeball. The signs of various diseases, not only of diseases of the eye, but also of various constitutional maladies which to some extent affect the structure of this organ, can be minutely studied with the help of the ophthalmoscope, which often therefore is of inestimable value to the physician.

Coats of the eyeball.—The eyeball rests upon a pad of fat in the cavity of the orbit, where it is held in place by the pressure of the eyelids; by the attachment of the conjunctiva; by the 'orbital fascia' and an envelope of fibrous tissue known as the 'Capsule of Tenon'; by six small muscles, which move it in different directions; and finally by the optic nerve, which enters from behind. The ball has three distinct coats:

(*a*) THE SCLEROTIC or fibrous coat is composed of dense, white, fibrous tissue, which gives its appearance to the 'white' of the eye. This coat completely encloses the ball, except behind, where the optic nerve pierces it, while in front it is modified so as to form the transparent 'cornea'.

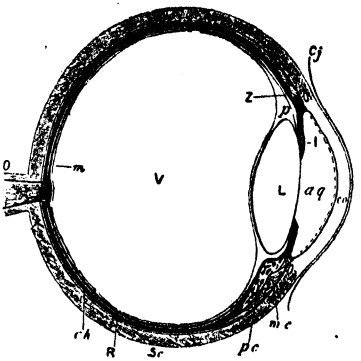

FIG. 193.—Diagrammatic section through the eyeball. *Cj*, Conjunctiva; *co*, cornea; *Sc*, sclerotic coat; *ch*, choroid coat; *pc*, ciliary processes; *mc*, ciliary muscle; *O*, optic nerve; *R*, retina; *I*, iris; *aq*, anterior chamber containing aqueous humour; *L*, lens; *V*, vitreous humour; *Z*, zonule of Zinn, which supports the lens; *p*, space known as the canal of Petit; *m*, position of the macula, or yellow spot. (Turner's *Anatomy*.)

It maintains the shape of, and gives its strength to, the ball of the eye, being very hard to cut or tear. The cornea, which has a greater curvature than the rest of the ball, is also formed from fibrous tissue arranged in layers, so as to be quite transparent. In front of and behind these layers is a thin protective membrane, and both surfaces, back and front, are covered by a layer of cells. All these are transparent, and the cornea forms, as it were, a window let into the front of the sclerotic.

(*b*) THE UVEA or vascular coat lies within the sclerotic coat, and consists of three parts. The *choroid membrane*, which forms its greatest

part, and lines more than two-thirds of the sclerotic, consists mainly of a network of vessels, which nourish the sclerotic coat and the interior of the eyeball. It is formed by the endings of a few 'ciliary' vessels which pierce the sclerotic coat on the front and back of the ball. The choroid membrane is prolonged forward into the *ciliary body*, a very complex structure, which forms a thickened ring opposite the line where the sclerotic passes into the cornea. To this line of junction between the sclerotic and cornea the ciliary body is firmly attached by the ciliary muscle, and, from the line of junction as a fixed point the ciliary muscle takes its bearing, and, in contracting, slackens the suspensory ligament of the lens, so as to allow the lens of the eye which is suspended from, or, as it were, 'set' in the ciliary body, to grow thicker and thinner in the act of accommodation for near and distant vision. (*See* ACCOMMODATION.) The iris and ciliary body are easily infected, and injuries to them are more dangerous for the whole eye than injuries to the cornea or to the eyeball farther outwards. The zone over the ciliary body, *i.e.* for a short distance outside of the edge of the cornea, is therefore called the 'dangerous zone' of the eye, and wounds to it frequently necessitate removal of the eye in order to save the sight of the other eye. (*See* EYE DISEASES AND INJURIES.) The farthest forward part of the choroid coat is known as the *iris*, and, as already stated, it is seen lying behind the cornea and separated from the latter by a slight space. The iris consists partly of fibrous tissue, partly of muscle fibres, interspersed with pigment cells, some of the fibres being arranged in a circular manner, others running from the edge of the pupil to the outer margin of the iris. These fibres, by their contraction, serve to narrow or dilate the pupil, according as the light entering the eye is strong or weak, and according as the eye gazes at a near or distant object. In the sharp angle formed by the meeting of the cornea and iris round their edges the fluids which keep the eyeball naturally tense filter out and in, to and from the neighbouring vessels. In the disease known as 'glaucoma' the angle through which this process takes place is blocked up, and the eyeball becomes very tense, painful, and hard till sight is lost. The iris and ciliary muscle are powerfully acted on by certain drugs. Thus when atropine or belladonna is put in the eye or taken internally the pupil becomes widely dilated, while under the influence of moderate doses of opium or morphia, or of eserine locally applied, it contracts. This action is a valuable sign of poisoning by these drugs.

(*c*) THE RETINA or nervous coat is the innermost of the three coats of the eyeball. The optic nerve ends, after piercing the sclerotic and choroid coats, by a sudden spreading out of its fibres in all directions to form this coat, which also contains blood-vessels and nerve and pigment cells. The retina in microscopic section can be seen to
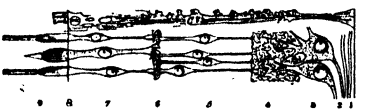
FIG. 194.—Diagrammatic section of the retina, showing its various layers, which are numbered as in the illustration. The first layer consists of nerve fibres, the ninth is the layer of rods and cones. The tenth layer, of pigment cells beyond the rods and cones, is not shown. (Turner's *Anatomy*.)

consist of no fewer than ten layers. Of these the outermost is a layer of pigment cells preventing the diffusion of light inside the eye, and the layer next to this is that of the rods and cones upon which light is received, and from which impressions are conveyed by the optic nerve to the brain, where the sensations to which the various forms of light give rise are perceived. The rods are coloured of a purple hue, 'visual purple', which fades for a time on exposure to bright light. They are excessively minute, being less than $\frac{1}{400}$ inch long and about $\frac{1}{10000}$ inch in thickness. The cones are still shorter. The total number of cones in one human eye exceeds 3,000,000, that of the rods being still greater. It is probable that in order that two points of light may be seen as separate, they must be sufficiently far apart for the rays proceeding from them to the eye to affect at least two cones. In the middle of the retina,

at the very back of the eye, is a ' yellow spot ', in the centre of which a ' central pit ' marks the ' point of clear vision '. Here the retina is very thin, and consists almost entirely of cones. Rods and cones stand closely side by side over the whole retina, except over the area where the optic nerve enters. As there are none over the ending of the nerve no light is perceived at this point, which is therefore called the ' blind spot '. The presence of the blind spot in each eye can easily be proved by taking a clean sheet of paper, making an X in the middle of it, and then, while one eye is closed, following with the other eye the point of a pencil which is slowly moved to the right in the case of the left eye and to the left for the right eye. When the pencil is about 3 or 4 inches from the X the latter suddenly disappears, reappearing as the pencil is followed farther on.

The contents of the eyeball are simple. The clear fluid separating the cornea from the iris, known as the ' aqueous humour ' of the eye, has been already mentioned. Immediately behind the iris and opposite the ciliary body, to which it is attached round its edge by a ligament, known as the ' zonule of Zinn ', lies the ' lens ', a clear elastic body about $\frac{1}{3}$ inch in diameter and convex on both surfaces. If the lens becomes opaque, as it sometimes does in later life, the condition is known as cataract. Behind the lens and filling up the greater part of the interior of the eyeball is a soft, transparent, jelly-like mass known as the ' vitreous humour '. The lens and vitreous humour are both of an albuminoid nature in chemical composition. The vitreous humour usually contains small specks and filaments, which cast shadows upon the retina when the eye looks at a bright cloud or whitened wall. They appear as floating blots or strings, and often cause alarm when noticed for the first time, but are of no importance and occur in almost every eye.

The lachrymal apparatus is an attachment to the eye designed to keep its surface clean. In the upper and outer part of the ' orbit ', between the eyeball and the bone, lies a gland, the ' lachrymal gland ', which secretes a saltish, clear, watery fluid, which is constantly conveyed, drop by drop, through several fine ducts to the upper part of the sac formed by the conjunctiva, between the upper lid and the eyeball. From here the fluid spreads out over the front of the eye, and is removed mainly by evaporation and partly through the minute ' lachrymal punctures ' which can be seen, one on the margin of each eyelid, about one-fifth of its length from its inner end. When the fluid runs over the margin of the lid it forms ' tears '. From the lachrymal punctures the fluid runs, carrying with it specks of

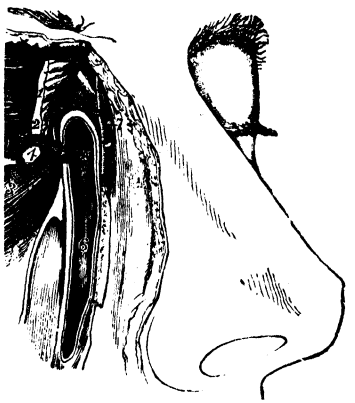

FIG. 195.—Lachrymal canals and duct dissected out. 1, Orbicular muscle of eyelids; 2 and 3, lachrymal canals · 4, caruncle; 5, lachrymal sac; 6, lachrymal duct to the nose; 7, end of facial artery. (Turner's *Anatomy*.)

dust, etc., through two small canals into the lachrymal sac and duct, which lie alongside the nose, and thence into the lower part of the nose.

Effect of light.—When rays of light from an object fall upon the eye, they are strongly refracted at the front surface of the cornea; next, they pass through the aqueous humour and then the lens, by which they should be so much refracted as to be brought to an accurate focus on the retina, producing upon the rods and cones a small inverted image of the object viewed. If a bright light falls upon the eye, the pupil is narrowed by muscular action of the iris, causing, if the light continues very bright, considerable eye-strain. Therefore, in reading, one should not let a bright light shine full into the eyes,

but should set it above one's head, behind one's back, or carefully shade it from the eyes. If the gaze turns to an object close at hand, the eyes look inwards, the pupils narrow, and the lenses become more convex by the automatic action of the muscles outside the eyeball, and of the muscle fibres in the iris and ciliary body. (*See* ACCOMMODATION.) As the eyes look at a distant object again, they take up the position of rest, the pupils widening, the ciliary muscle relaxing, and both eyes looking straight forwards. Hence the sensation of restfulness derived from looking in moderate light at a distant scene or even at a landscape picture. The images formed upon the retina are reversed in every way; thus rays from points towards the right hand fall upon the left side of both retinæ, and *vice versa*, while rays from the ground affect the upper part, and those from above the lower part of both retinæ. The different colours corresponding to rays of various wave length produce different effects upon the retina, and these, being converted into nerve impulses, are carried along the optic nerves to the hinder part of the brain, where they produce the varied sensations of light and colour, very much in the same way, probably, as the voice is received by a telephone, transmitted along wires in an altered form, and again reproduced in the receiver with all its original tones and modulations.

The sense of distance, solidity, and form implies an act of judgement based upon experience. To an infant the universe is a mass of colour spread before his eyes, but gradually he learns, with the help of other senses, that objects which appear large and distinct are close at hand and may be grasped, those which seem small and indistinct are far off. The impression of solidity is gained by the image of any object upon one retina being slightly different from the image of it upon the other, which can, so to speak, see a little way round the side of the object. This principle is utilised in making and viewing stereoscopic photographs. These, being taken from two different points, form, when viewed side by side, different images upon the two retinæ. The two images are combined by the mind into the sensations derived from a single scene which has depth as well as breadth and height. For further information see VISION.

EYE DISEASES AND INJURIES.—The delicacy of structure of the eye render any disorder of this organ highly important. Many of its disorders cannot be cured or can be remedied only to a small extent, such, for example, as loss of transparency in the cornea; while, in the case of others, such as cataract and high errors of refraction, the skill of the specialist may restore the eye from a state of almost complete uselessness to that of good vision. Most of the diseases are intricate in their course and treatment, requiring the highest degree of skill in handling. In the following account, some of the simpler and commoner diseases are dealt with. The subjects of CATARACT, CHOROIDITIS, GLAUCOMA, IRITIS, VISION, DEFECTS OF, SQUINTING, and SPECTACLES are dealt with under these headings.

STYE is one of the best known of eye affections, and consists of an inflammation situated round an eyelash, which occurs especially in young people. It begins as a general swelling of the lid accompanied by pain, and gradually suppurates. Very often as one stye subsides another appears. Usually some constitutional weakness is present, and not infrequently the person suffers from habitual constipation.

BLEPHARITIS (*βλέφαρα*, eyelids), or chronic inflammation of the margin of the lids, occurs in weakly children. It is known by a variety of names, and it may produce, if not treated, a red, watery condition of the eyelids, with loss of the eyelashes, known as 'blear eyes', which persists throughout life. It begins with swelling near the edge of the eyelid, usually the upper one, redness and the constant formation of a crust round the roots of the eyelashes. Very often the onset follows one of the acute diseases of childhood, especially measles. The lower lid becomes infected later.

Treatment consists in removing the crusts from the lids twice a day with warm solution of bicarbonate of soda (a teaspoonful to a tumblerful of water),

EYE DISEASES AND INJURIES

drying carefully, and at once applying some astringent and antiseptic, of which the favourite is ammoniated mercury ointment or yellow oxide of mercury ointment. The treatment must be persevered with for weeks or even months to prevent a relapse.

CYSTS of the lids often arise in connection with the Meibomian glands. They may last for many years, and give no trouble beyond that of irritation and disfigurement caused by their size, if they be large. Massaging the eyelid over the cyst daily with weak nitrate of mercury ointment occasionally brings about its gradual disappearance. It may be removed, when desired, by an opening on the hinder surface of

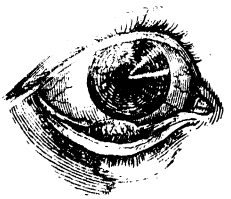

FIG. 196.—Cyst on the lower eyelid, with the lid pulled outwards to show it. (Miller's *Surgery*.)

the lid, which is turned outward for the purpose. The contents being scraped out, the cyst does not tend to refill. This small operation is done under cocaine.

PARALYSIS of the lids may occur from many causes, producing a drooping of the upper lid known as 'ptosis' when the 3rd nerve is affected, or a turning outward of the lower lid, together with inability to close the eye, when the 7th (facial) nerve is injured. (*See* PARALYSIS.) Paralysis of the muscles that move the eyeballs, causing double vision and an appearance of squinting, is a frequent symptom of chronic nervous diseases, such as disseminated sclerosis. It may also be caused by injuries to, and various morbid conditions within, the skull, causing interference with the 3rd, 4th, and 6th cranial nerves, which regulate these muscles.

SPASM of the lid is sometimes a troublesome condition. It may occur either in the form of frequent fluttering of the lid, popularly called 'life' in the eyelid, or there may be a partial closure of the eye, which will not relax. Fluttering of the lid is very common and usually has no obvious cause, the person being simply tired or 'run down'.

NYSTAGMUS—involuntary, rapid, rhythmical, usually fine, up-and-down or side-to-side, flickering movements of the eyeball—is a symptom of many nervous disorders, but, being due to a want of control of the nervous system over the action of the muscles which move the eyeball, is not really an eye disorder. It is observed also in persons who have had bad eyesight from childhood, and in miners.

WATERY EYE, or EPIPHORA (ἐπιφορά), in which the tears overflow on to the face, is also a slight but very annoying trouble. It results either from some irritation which causes over-secretion of tears or from some interference with the ducts which should convey the tears away to the lower part of the nose. Sometimes in old people with flabby eyelids, or in cases where there is a contracting scar on the face, the lower eyelid turns outwards so that the lachrymal puncture is drawn away from the eye and the tears cannot enter it, but collect in the hollow of the lid, and then run over the face. Usually there is a blockage, it may be of the canaliculus by an eyelash or other small object, or, more often, of the duct upon the side of the nose as a result of inflammation. In the latter case a small swelling forms upon the side of the nose, and, if one presses upon this with the finger, tears and mucus ooze back on to the eyeball. If this condition be permitted to continue, not only is there the annoyance of tears constantly trickling down the cheek, but suppuration is very apt to occur in the obstructed duct and to produce a small but unsightly sinus on the side of the nose, which can hardly be got to close. The presence of a suppurating tear sac is a source of danger to the eye, because, after any accident to or operation on the eye, virulent organisms are apt to spread from the sac and set up ulceration of the cornea.

Treatment of epiphora.—Where the cause is due to conjunctival irritation, a mild astringent lotion, *e.g.* tannic acid in the strength of 2 to 5 grs. to the

ounce of water, may be employed. Foreign bodies blocking the lachrymal punctures or canaliculi must be removed. When the lachrymal sac is distended with mucus and pus the canaliculus should be dilated, and a large probe passed down the nasal duct into the nose, so as to remove any obstruction and allow free drainage into the nose. Gentle washing out of the sac with a small syringe often helps to restore the parts to a more healthy state. In very bad cases many surgeons advocate removal of the lachrymal sac by operation.

CONJUNCTIVITIS, or inflammation of the conjunctiva, is a very common eye affection. Not in itself a serious condition, it may yet give

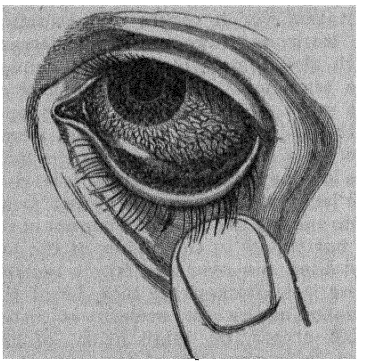

FIG. 197.—Eye showing simple conjunctivitis. Contrast with the more serious condition of iritis shown below. (Miller's *Surgery*.)

rise to grave complications, as, for instance, ulceration of the cornea.

A chronic state of redness or congestion of the eye, hardly amounting to conjunctivitis, is common in people whose eyes are much exposed to irritation from dust, smoke, cold winds, etc. In gouty or plethoric people a similar congested state of the conjunctivæ is often met with. Even the strain upon the eyesight due to errors of refraction may cause the eyes to appear reddened and tender. Cold in the head is very often associated with congestion of the conjunctiva, or even with a conjunctivitis more or less severe. In some infectious diseases, and notably in measles, conjunctivitis is a well-recognised symptom. Bacteriological investigations have shown conclusively

that micro-organisms are the cause of nearly all cases of acute and sub-acute conjunctivitis. This explains why epidemics of conjunctivitis often occur in schools, orphanages, and similar institutions, the infection being readily conveyed on towels, sponges, etc., from one person to another.

Symptoms of conjunctivitis.—The most characteristic sign of conjuncti-

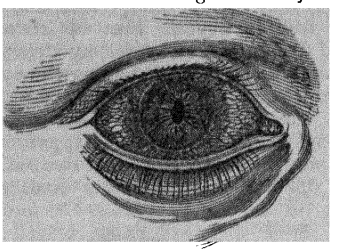

FIG. 198.—Eye showing iritis. (Miller's *Surgery*.)

vitis is that the affected eye becomes red or *bloodshot*. This is due to the dilatation of the numerous vessels which ramify over the conjunctival surface. The colour is often described as brick red, and it is specially to be noted that the redness is general, and not most marked round the cornea, as is the case in iritis. The *swelling* of

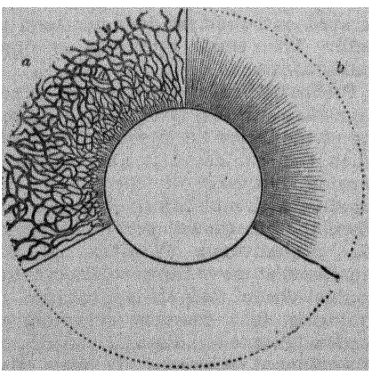

FIG. 199.—Diagram of the white of the eye, illustrating the appearance of the vessels that are congested, *a*, in superficial inflammation (conjunctivitis); *b*, in deep-seated inflammation (iritis). (Miller's *Surgery*.)

the conjunctiva in severe cases may be very marked, and a thickened fold may form round the edge of the cornea. Hæmorrhages in the conjunctiva from rupture of small blood-vessels are very frequently seen in acute cases, but

their presence does not afford any special cause for anxiety. Subjective symptoms vary greatly in severity. In mild cases there may be merely an annoying feeling of roughness or sand in the eyes, while in severe cases there may be very great *pain*. *Photophobia* (dread of light) is a constant symptom, but is not usually so intense as in iritis and keratitis.

The *discharge* from the eyes in the early stages is thin and serous, but assumes more or less the character of pus after a few days. The sticky secretions tend to keep the lids gummed together, so that there may be great difficulty in opening the eyes, especially in the morning. Both eyes are usually affected, but very often the disease begins in one eye some days before it attacks the other; the second eye in such cases becoming infected by accidental contamination with discharges from the inflamed eye. An attack of acute conjunctivitis lasts for one to two weeks.

Varieties of conjunctivitis. — In addition to the type of *simple acute conjunctivitis* above described, there are various more severe forms.

A very severe type of conjunctivitis, *ophthalmia of the new-born* or *ophthalmia neonatorum*, may attack children a few days after birth. It is due to infection with discharges, often gonorrhœal, from the maternal passages, and may be attended with very severe corneal ulceration, thereby destroying or doing great permanent harm to the eyesight. This disease has been held responsible for about one-fifth of all cases of blindness in young persons. It was at one time a terrible scourge in Maternity Hospitals, but is now much less common. Infection from the genital passages in cases of gonorrhœa may in the adult cause a *gonorrhœal conjunctivitis* of the most severe type.

Trachoma, or *granular conjunctivitis* (Egyptian ophthalmia), is a chronic, persistent, and severe form of conjunctivitis very common in the East and in many European countries. It is characterised by the appearance of nodules, pale in colour, and often compared to boiled sago grains, situated on the conjunctiva lining the lids. Very often the cornea in its upper half becomes covered with a hazy film containing a network of superficial blood-vessels. In the later stages of the disease there is much scarring and shrinking of the conjunctiva, and the lids are apt to be turned inwards, thereby causing the lashes to rub on the cornea. Loss of transparency of the cornea and consequent dimness of vision are therefore very frequent results of this

FIG. 200.—Entropion or turning inwards of the eyelashes against the eye, as a result of granular conjunctivitis. (Miller's *Surgery*.)

disease. In Great Britain the disease is rarely met with except among the alien population of large towns, Jews, Poles, etc. The disease is so serious and difficult to cure that in many civilised communities vigorous attempts are being made to check its spread among the population. No emigrant is allowed to enter the United States, Canada or Australia, if he is affected by this disease.

Follicular conjunctivitis is characterised by the presence of numerous small reddish elevations about the size of a pin's head, often arranged in rows on the conjunctiva lining the eyelids. It is often seen in children and young adults, but its effects are not serious, and it must not be confused with trachoma, which it may closely simulate.

Strumous conjunctivitis is a common form, seen usually in weakly, ill-nourished children. In this form of the disease little, elevated, yellowish-red, flattened nodules (phlyctenules) are seen on the conjunctiva near the corneal margin. Very commonly the disease involves the cornea producing ulceration and very great irritation and photophobia.

Treatment of conjunctivitis. — In *simple cases* all that is needed is to keep the eyes clean by frequent bathing with a mild antiseptic lotion, *e.g.* boracic lotion. The bathing is best done by pledgets of cotton-wool, which

can be burned after use. A special small flask known as an 'undine' with a long nozzle may be used to direct a stream of lotion over the eyeball. A mild antiseptic ointment, *e.g.* boracic or zinc ointment, should be smeared on the lid margins to prevent gumming of the lids. Bandaging the eye is not

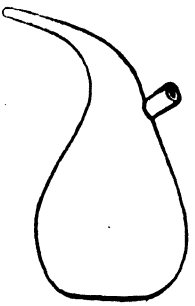

FIG. 207.—Undine for washing eye.

good treatment, as it prevents the escape of discharges from the eye, and thus encourages the growth of organisms. Similarly poultices of bread, porridge, etc., so often employed as a household remedy for inflamed eyes, may do great harm. The eyes may, however, be protected from light and draught by an eye-shade, which at the same time allows access of air.

In *severe cases* of conjunctivitis, and especially in the stage when the secretion is becoming purulent, the use of silver salts as astringents and antiseptics is of the greatest value. Silver nitrate (1-2 per cent) may be applied gently on a camel-hair brush once or twice. Its application is very painful, and on this account an organic salt of silver, *e.g.* protargol, 5 or 10 per cent, or argyrol, 20 per cent, applied twice daily, may be substituted. Thorough and frequent bathing of the eye is of primary importance.

The severe *ophthalmia of infants* is best treated by these silver salts. But nowadays (1943) ophthalmia neonatorum is successfully treated by giving one of the sulphonamide drugs *by mouth*. In many Maternity Hospitals a few drops of weak nitrate of silver solution (½ per cent) are instilled into the eyes of every child at birth. The application should at all events be made to the eyes of every infant

EYE DISEASES AND INJURIES

showing a discharge. This preventive method has greatly diminished the number of these unfortunate cases of destructive inflammation.

Many cases of *subacute conjunctivitis*, accompanied by inflammation of the lid margins, will yield readily to the use of zinc salts. Zinc sulphate lotion (1-2 grs. to the ounce of water) may be instilled thrice daily, and an ointment of zinc oxide rubbed into the lid margins at bedtime.

Trachoma is best treated by the application of a strong astringent, such as bluestone (sulphate of copper), to the inner surfaces of the lids. The application is made gently and repeated every few days. In cases where the granules are fleshy and prominent they may be squeezed out by the use of special forceps. Sulphanilamide is also of value. In old chronic cases operations often become necessary to relieve the turning inward of the lids.

In *strumous conjunctivitis* the best treatment is the daily application of a 1 per cent ointment of yellow oxide of mercury. In using the ointment a piece about as large as a small grain of barley should be laid gently within the lower lid margin, and then the eye being closed the lid should be gently massaged so as to rub the ointment over the whole eye. (Similarly, when drops are applied to the eye, the lower lid is pulled down, so as to form a sort of pocket into which the drops are allowed to fall.) Should the cornea be affected, the addition of atropine (¼-1 per cent) to the ointment will greatly relieve photophobia and promote healing. General treatment is very important in these cases. The diet should be plain and simple but nourishing, including especially milk, butter, and eggs. The meals should be regular, and the bad habit of giving a querulous child sweetmeats, biscuits, etc., between meals must be avoided. Fresh air, sunlight, and the strictest attention to cleanliness are of the greatest importance. Many children with this affection suffer from nasal catarrh and overgrowth of the tonsils and adenoid tissue of the naso-pharynx. Proper treatment of these affections will do much to improve the general health and expedite the cure of the ocular troubles. (*See* NOSE DISEASES.)

EYE DISEASES AND INJURIES

KERATITIS, or INFLAMMATION OF THE CORNEA (κέρας, 'horn'), is due to several causes. One form has just been mentioned as accompanying phlyctenular conjunctivitis. The most important form, however, is that known as 'interstitial keratitis', so called because it is an inflammation of the substance not of the surface of the cornea. It is nearly always a manifestation of inherited syphilis, and comes on between the ages of seven and twenty years. It may be also due to exposure, in the case of young persons of weak constitution, and in later life it is sometimes an accompaniment of rheumatic manifestations in other parts of the body, associated with septic absorption from the teeth,

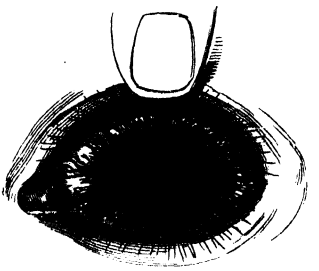

FIG. 202.—Eye showing keratitis. (Miller's *Surgery*.)

alimentary canal, or other sites of chronic infection and suppuration. The cornea gets dull and hazy, the sight being a good deal interfered with, and at the same time there are pain and intolerance of light. This disorder lasts usually four to six months, or longer, both eyes being affected, and it is almost always accompanied by iritis, which renders it still more serious. The treatment generally adopted is the use of atropine drops and the wearing of dark glasses. Special attention is paid to improving the constitution, and the majority of cases should be treated for syphilis. The chief danger of the disorder is that it leaves behind it opaque patches in the cornea, or changes in the choroid membrane, which interfere with vision or even obscure it altogether.

One dramatic advance in treatment has been the grafting of a new cornea in place of one that is so opaque by disease as to hinder vision. The new cornea is taken either from infants who have just died or from the eyes of adults excised because of local eye disease—*e.g.* glaucoma. Attempts—not very successful—have also been made to graft on human eyes the corneas of animals.

ULCER of the cornea arises from various causes, several of which have been mentioned. Two chief dangers attend an ulcer here, one being the fact that a white scar, which interferes with vision, especially if the ulcer has been severe, is certain to follow the ulcer; the other danger being that of perforation of the cornea (which is only about one millimetre in thickness), followed by more or less destruction of the eye.

Treatment of corneal ulcer.—The great essential is to keep the eye clean. Hence bandages, poultices, and such applications are in most cases likely to be harmful. Weak corrosive sublimate lotion (1-6000), or boracic or argyrol lotion, may be used to bathe the eye, and vaseline may be freely smeared on the lid margins. Atropine is used to combat the iritis which always attends severe ulceration of the cornea. If the ulcer is spreading, various methods are adopted by oculists to check it, such as application of a cautery to the spreading margin, the division of the ulcer and opening up of the anterior chamber by a fine knife, etc. It has always to be borne in mind that a corneal ulcer of the severe spreading kind may, if not checked, destroy the cornea in a few days, and with it all hope of useful vision in that eye. Hence the necessity for prompt and efficient treatment.

XEROPHTHALMIA is the term given to a condition in children characterised by inflammation of the cornea and eyelids, which leads to blindness unless treated in time. It is due to a deficiency of vitamin A in the diet, and is cured, not by local applications, but by giving vitamin A concentrates or food rich in this vitamin—milk, eggs, butter, carrots.

ARCUS SENILIS is the name given to a white ring which forms round the edge of the cornea with advancing years. (*See* AGE, NATURAL CHANGES IN.)

SCLERITIS, or 'HOT-EYE', is a not uncommon trouble in persons who

have a markedly gouty or rheumatic constitution. It consists of an inflammation of the sclerotic coat accompanied by patches of dusky redness over the white of the eye, pain, and watering of the eye. The condition subsides when protective glasses are worn, and the constitutional condition is treated; but it is very obstinate to cure and liable to recur. In young persons it is often tuberculous.

BLACK-EYE is an effusion of blood under the loose skin over and round the lids, due to a blow. Within the first few hours of a blow on the eye, much may be done to diminish the blackness by a pad of linen wrung out of cold water, or of Goulard's water, and tightly bound on by a handkerchief passing round the head. A time-honoured pad is a raw beef-steak, which is moist and cold. After the first day absorption may be hastened by gentle massage and the bruise may be made less apparent by the application of flesh-coloured grease paint.

WOUNDS OF THE EYE.—The eyebrow, cheek, nose, and even the eyelids are often wounded, but seldom the eye itself, on account of the efficient protection afforded to it by these parts. The danger of a wound to the eye consists, not so much in the wounding of any important structure, which will heal with great rapidity, as in the introduction of organisms which may set up inflammation. The most dangerous position for a wound is in the ciliary region or iris, that is just outside the margin of the cornea (*see* EYE), from whence a destructive inflammation not only of the wounded eye, but also of the other, causing total blindness, is apt to be set up. (*See* IRITIS.) Metallic particles which penetrate the eye should always, if possible, be removed, because the fluids of the eye act upon them to form irritating chemical compounds. Most eye hospitals are provided with a powerful electro-magnet, which will draw small particles of iron or steel from the deeper part of the eye into the anterior chamber, where they can be seen by the operator and successfully removed. Cinders or dust may lodge behind one of the lids or may be embedded in the cornea and cause much pain. In this case the eye should not be rubbed, but a handkerchief may be gently pressed against it. The lids should be drawn gently apart, and if the body be seen it should be wiped off the eye with a wet camel-hair brush or clean wet rag. If it cannot be seen

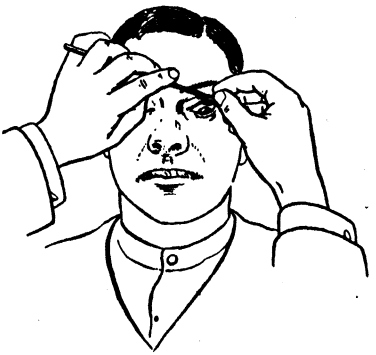

FIG. 203.—Method of turning out the upper eyelid in order to examine its inner surface and the upper part of the ball for cinders, etc.

the eyelids should be turned outwards and the inner surface of each lid examined. The lower lid is simply pulled downwards. To examine the upper lid, the person is told to look steadily downwards, a flat pencil, or paper-knife, or penholder, is laid horizontally along the centre of the lid, and the lid, being grasped by the eyelashes between the finger and thumb of the person who is looking for the foreign body, is gently and quite painlessly folded upwards over the pencil, etc. The irritating body is then brushed away, and the lid turned down again. If a piece of lime has got upon the eye it should be sponged with vinegar and water, and if acid has got into the eye it should be copiously bathed with baking soda in water.

EYE STRAIN (*see* VISION).

F

FACE is that part of the head extending from the eyebrows to the chin. It is supported by 14 bones, consisting of 2 nasal bones, 2 superior maxillary bones which carry the upper teeth, 2 lachrymal bones, 2 malar bones, 2 palate bones, 2 inferior turbinated bones at the sides of the nose, the vomer, forming a partition between the nostrils, and the inferior maxillary bone carrying the lower teeth. The lower jaw forms a joint of hinge shape with the temporal bones of the skull, while the other bones of the face are firmly fixed together by sutures. The face in man is relatively small, as compared with that in lower animals, on account of the development of the cranium containing the brain. For the same reason, the face has an almost vertical direction instead of being sloped backwards as in animals. This facial angle has formed one means of classifying different races. The angle, which is measured by drawing one line from the centre of the forehead to the projecting part of the upper jaw and another line from the lower margin of the ear to the base of the nasal opening, is in negroid races an acute angle, in most European races almost a right angle, while in the ancient Greek statues the face has an overhanging character.

The general character of the features depends chiefly upon the presence of air spaces in the frontal bone situated immediately behind the eyebrows and in the upper jaw-bones. The varying expressions which are connected with the emotions and the general expression denoting character are chiefly due to the action of numerous thin muscles situated around the openings of the eyes, nose, and mouth. (*See* MUSCLE). These are controlled by the 7th cranial nerve, which springs from the hinder part of the brain, passes through the skull to the ear, and, emerging immediately below the latter, passes forward on to the face round the edge of the lower jaw. In this position it is very liable to be wounded or to be injured by such conditions as cold, then giving rise to a flat and expressionless appearance of one side of the face, known as *Bell's Palsy* or *facial paralysis*. The sensory nerve of the face is the 5th nerve, which originates from the neighbouring part of the brain and within the skull divides into three portions called respectively ophthalmic, maxillary, and mandibular divisions. Each of these sends branches on to the face through a notch that can be felt near the inner end of the eyebrow, through an opening immediately beneath the eye, and through another opening near the middle of the chin. On their way to the face these nerves supply the parts about the eye, the teeth, upper and lower, and the muscles which move the lower jaw in chewing. The various parts of this nerve are particularly subject to neuralgia, caused by some serious irritation on their course.

The face is liable to certain deformities, of which hare lip and cleft palate are the principal. (*See* PALATE, MALFORMATIONS OF.) The skin of the face, which has an unusually free blood supply, bleeds with great freedom when wounded, but for the same reason wounds heal with special rapidity and freedom from suppuration. The contraction of scars after severe injuries, such as burns, sometimes leads to marked deformity of the eyelids, mouth, and nose. The skin condition known as acne (*see* ACNE) is very common in young persons about the chin and brow, disappearing as age advances. Boils, carbuncles, and other infectious conditions frequently occur on the face, and when situated about the upper lip present a considerable degree of danger from the liability of the infection to spread to the interior of the head. Tuberculous disease, known as lupus, is more frequent on the face than in any other situation and may lead to unsightly ulceration and scarring. Certain simple tumors, particularly sebaceous cysts and nævi or birth marks, very commonly affect the skin in this region, and cancer, in the form of epithelioma, is not uncommon in the later stages of life about the margins of the lip, nostril, or eyelid. This is

also one of the commonest sites of the slow-growing form of cancer known as rodent ulcer.

FACIAL NERVE is the seventh cranial nerve, and supplies the muscles of expression in the face, being purely a motor nerve. It enters the face immediately below the ear after splitting up into several branches.

FACIES is a term applied to the expression or appearance of the face, which often gives indications of the presence of disease in other parts of the body. Thus the *abdominal facies* is a pinched, anxious expression associated with severe disease in the abdomen. The *cardiac facies* is a condition present in some valvular defects of the heart showing bright purplish cheeks and lips, with a sallow hue of the rest of the face. The *typhoid facies* is a vacant, bewildered, and apathetic expression seen in typhoid fever and other debilitating diseases. The *Hippocratic facies* is a cast of countenance originally described by Hippocrates, in which the face is drawn, pinched, and livid, indicating approaching death.

FÆCES (*fæx*, dregs) is another name for the stools. (*See* CONSTIPATION, DIARRHŒA, STOOLS.)

FAINTING, or SYNCOPE, is a temporary loss of consciousness associated with feeble action of the heart.

Causes.—The manner in which the loss of consciousness is produced appears to be that the feeble heart is unable to pump blood up to the brain, thus causing anæmia of that organ, and rendering it unable to act. If the person who threatens to faint lies down, or, still better, if she sits and then bends forward so as to bring the head below the knees, the faint is averted. The feebleness may be due to some long-standing heart disease, which through an overstrain suddenly reaches a climax. Or it may be part of the general muscular relaxation which takes place in a hot bath, fainting in a bath being sometimes a cause of death in weak persons. Powerful emotion, generally of a sorrowful nature, but sometimes even great joy, is a common cause. Extreme pain, such as that due to the crushing of a limb, and shocks to the nervous system, such as a blow on the head or on the abdomen, are very apt to cause fainting, or even the more serious condition known as 'shock'. Disgusting smells and sights, breathing of bad air, and general exhaustion are also causes. As a rule, a combination of these causes is necessary, except in hysterical persons, and persons weak from some illness, who are specially liable to faints. Certain drugs which depress the heart's action, such as tobacco or chloroform, when taken in large amount, produce syncope.

Symptoms are well known. There are certain warning symptoms, such as pallor, feebleness of the pulse, a sinking feeling, and a dullness of sight and hearing. When the faint has occurred, the person lies still, breathing very faintly, with feeble pulse, pallid complexion, and often perspiration standing in drops on the face.

The faint, as a rule, lasts only a few seconds or minutes, but it may last for hours, and hysterical persons may pass from one faint, only to fall into another several times.

Treatment.—The faint may often be prevented by attending to the cause, as stated above. Sitting down and bending forwards so as to bring the head on a level with the knees, or taking rapid gulps of cold water, often is enough to prevent a threatened faint. The person in a faint should be laid flat on the back, and care should be taken that breathing is unimpeded. If care be not taken to leave the fainting person lying flat, death may ensue, but if this be attended to, nothing more is usually necessary. Stimulants may be applied to the skin in the form of cold compresses on the head, slapping of the hands, pinching of the cheeks; or to the nose in the form of smelling-salts or eau-de-Cologne, or the pungent fumes of burnt feathers. After recovery has taken place from the faint the tendency to its recurrence may be prevented by administration of some stimulant such as sal volatile or brandy.

FALLING SICKNESS is an old name or epilepsy. (*See* EPILEPSY.)

FALLOPIAN TUBES are tubes, one on each side, which are attached at one end to the womb, and have the other unattached but lying close to the ovary. Each is between 4 and 5 inches long, large at the end next the ovary, but communicating with the womb by an opening which admits only a bristle. These tubes conduct the ova from the ovaries to the interior of the womb.

FALSE MEMBRANE is the name given to the deposit which forms upon the walls of the air passages in cases of diphtheria. It consists partly of fibrin derived from the blood, partly of the destroyed surface of the mucous membrane upon which it rests, and it contains bacteria in enormous numbers. If it be removed, it leaves a raw and bleeding surface behind upon which new membrane quickly forms.

FANGO is the name of a kind of mud derived from thermal springs at Battaglio in Italy which is applied warm to gouty and rheumatic joints.

FARADISM (*see* ELECTRICITY IN MEDICINE).

FARCY is another name for glanders. (*See* GLANDERS.)

FARINACEOUS FOODS (*farina*, meal) are those derived from cereals. The chief are wheat, oats, barley, rye, maize, rice, and millet. Along with them are often included tapioca, sago, and arrowroot, which, however, are simply forms of starch, derived, the first from the cassava plant, the second from the pith of the sago palm, and the third from the root of a West Indian plant. Pease-meal and lentil flour are also popularly reckoned as farinaceous foods, though they are derived from pulses, and differ from the former in containing double the amount of the protein contained in the cereal foods. Revalenta Arabica is a popular food made chiefly from lentil flour. Semolina, farola, macaroni, and vermicelli are true farinaceous foods, being all preparations of wheat. Buckwheat is not properly a cereal but resembles these foods, and is largely eaten in the United States.

These foods, consisting mainly of starch, are classed as carbohydrate foods, and require the addition of protein foods, such as milk, or eggs, or meat, to form a perfect diet. (*See* DIET.) The percentage composition of various cereals, etc., as given by Hutchison, is as follows:

	Water.	Carbohydrates (Starch, Sugar, etc.).	Fat.	Protein.	Salts.
Wheat . .	12·0	73·4	1·7	11·0	1·9
Oats . .	6·9	69·9	8·1	13·0	2·1
Rye . .	11·0	74·4	2·3	10·2	2·1
Maize . .	12·5	70·9	5·4	9·7	1·5
Rice . .	12·4	79·8	·4	6·9	·5
Dried peas .	13·2	61·4	1·8	21·0	2·6
Lentils. .	11·7	60·4	2·0	23·2	2·7

Wheat and *rye* are mainly used in the form of bread, which is made by mixing with water, allowing yeast to act upon the dough thus formed till the latter is blown up with carbonic acid gas into a sort of sponge, and then baking. The starch of the flour is held together by an adhesive albuminous substance known as 'gluten', but, as this is not present in the other cereals, they cannot be used so well for bread-making. It is undoubtedly better to give 'whole-meal' bread to growing children, because it contains a slightly greater proportion of protein and salts than white-flour bread, and also the highly valuable B vitamins. *Oats*, by reason of their large percentage of protein, and still more on account of their fat, form when boiled an excellent food for children, though the same properties render them very indigestible when cooked in other ways. *Peas* and *lentils*, though they contain about double the amount of building material (protein) the cereals proper possess, nevertheless sometimes prove indigestible for children. *Maize*, like oats, when boiled, is a very fattening food. *Rice* takes the place among the Orientals that wheat takes in the Western hemisphere. It contains a small amount of building material (protein and salts) and very little fat, but it makes up for this by the fact that it is very easily digested, and that it is almost entirely absorbed from the bowels. These qualities render it also specially suitable for the use of invalids.

FASCIA is the name applied to sheets or bands of fibrous tissue which enclose and connect the muscles.

FASTIGIUM means the highest temperature reached in a feverish state.

FASTING means the abstention from, or deprivation of, food and drink sufficient to supply the waste resulting from the bodily activity and to maintain the body temperature.

The practice, which some persons carry out, of fasting one day a week or even of changing to a light diet at stated intervals, in the interests of health or of religion, is highly commendable, because it gives the digestive organs a periodic rest.

If food and drink be entirely suspended two results quickly follow: the body becomes thinner and lighter as it draws upon its stored-up nourishment, and also the temperature gradually falls. If water be taken in large quantities, the process of using up the fat and muscles in order to maintain the activity of the heart, lungs, and other vital organs, proceeds to an extreme extent, and the body grows very much emaciated before death. If water be withheld, death results much sooner, and the sufferings are great. Whether water be taken or not, death results from loss of temperature long before all the available stores of nourishment in the body are used up. If the body be well protected by clothes and blankets, the loss of heat is slower, and life is prolonged beyond the time that it lasts if the fasting person be poorly clad or exposed to severe cold, as in the case of Arctic explorers. It follows, too, that a person fasting and doing no work can survive very much better than one who is compelled at the same time to put forth great exertions, and so use up more of the bodily store of food. Persons are subjected to the worst combination then, when they are not only deprived of food, but have also a poor supply of water, are exposed to severe cold, and must make great muscular efforts.

Under the last-named conditions life could not be prolonged more than two or three days. But in the case of miners imprisoned by a fall of earth or flooding in a mine, and well supplied with water, life and health may be prolonged without any food for over a week. In the case of five miners imprisoned in Redding Pit, Scotland, in September 1923, they were brought up little the worse after being deprived of food for 214 hours.

Dogs may be kept alive with nothing but drinking water for five or six weeks, and it is probable that human beings may also survive for long periods with only a very small allowance of food. It follows, from what has been said under DIET, that fat is the most suitable food for sustaining life, if the food is to be reduced to a minimum.

The professional fasters who profess to subsist entirely without food for a month or six weeks probably have small supplies administered to them in their drinking water, or by other surreptitious means.

After prolonged fasting the return to food should be gradual, and no heavy meal should be taken for a day or two. Fasting as a method of treatment was used in the Allen method of treating diabetes. The patient was deprived of all nutritious food but received for one or more days, until the urine became free from sugar, fluid sufficient for his bodily needs in the form of beverages such as tea, coffee, and meat-extract soups. A state of partial starvation is used in treating ulcer of the stomach, the patient receiving nothing by the mouth for several weeks, if necessary, but being sustained by nutrient enemata of glucose, peptonised milk, etc.

FAT as a food has more energy-producing power weight for weight than any other food. Animal fat is a mixture in varying proportions of stearic, palmitic, and oleic acids combined with glycerin. Butter contains about 80 per cent of fat, ordinary cream contains 20 per cent fat, and rich cream 40 per cent, while olive oil is practically a pure form of fat. Fat requires when taken to a large extent in the diet to be combined with a certain proportion of either carbohydrate or protein in order that it may be completely consumed, otherwise harmful products, known as ketones, are apt to be formed in the blood. Each gram of fat has an energy-producing equivalent of 9.3 calories. (*See* ADIPOSE TISSUE, CORPULENCE.)

FATIGUE.—Fatigue is brought about in two ways. In the first place

muscles become fatigued by the lactic acid accumulating in them as the result of their activity. For the removal of lactic acid in the recovery phase of muscular contraction oxygen is needed. If the supply of oxygen is not plentiful enough, or cannot 'keep pace' with the work the muscle is doing, then lactic acid accumulates and fatigue results. There is also a nervous element in muscular fatigue: it is diminished by stimulation of the sympathetic nervous system.

Industrial workers.—Many factors enter into the maintenance of efficiency and the avoidance of fatigue, mental and physical. Intensity and direction of illumination, ventilation, temperature and humidity of the air, adequate diet, posture at work, rest pauses, monotony, and, above all, hours of work are among some of these factors. There is a level beyond which the human machine can no longer produce work satisfactorily. If this is exceeded it is shown by a reduction in the quantity and quality of the work done. If work is done under conditions of fatigue, damage to health results and accidents may occur. The shortening of unduly long hours of labour under improved hygienic conditions is followed by increased productive efficiency. During night work productive efficiency is much less than during the day.

Children are especially liable to suffer from over-pressure at work. This applies especially to children of nervous temperament, those who are anæmic or badly fed, those who are rapidly growing, and those who have too little sleep and recreation or have various physical defects in sight, hearing, etc. The time devoted to a lesson in any particular subject should not exceed three-quarters of an hour, and there should be an appropriate variation of subjects, sufficient intervals for rest, recreation, physical exercise and food. Fresh air and quiet in the classroom diminish fatigue. Home work should not be given to children under the age of nine years, and for several years after that age it should not take longer than one hour. The teachers should be carefully on the look out for imperfections of vision and hearing which cause strain and brain fatigue. (*See* CHILDREN, PECULIARITIES OF, *and* SCHOOL CHILDREN.)

FAT NECROSIS.—In injury to or inflammation of the pancreas the fat-splitting enzyme in it may escape into the abdominal cavity, causing death of fat-containing cells.

FATTY DEGENERATION.—As a result of anæmia, interference with blood or nerve supply, or because of the action of various poisons, body cells may undergo abnormal changes accompanied by the appearance in their substance of fat droplets.

FAUCES (*fauces*) is the name given to the somewhat narrowed opening between the mouth and throat. It is bounded above by the soft palate, below by the tongue, and on either side by the tonsil. In front of and behind the tonsil are two ridges of mucous membrane, the anterior and posterior pillars of the fauces.

FAVUS (*favus*, a honeycomb) is another name for honeycomb ringworm. (*See* RINGWORM.)

FEBRICULA (*febricula*) means a little fever. The term is applied to the transitory rise of temperature, lasting from a few hours to a few days, which accompanies the onset of a cold or chill. It is also applied to the so-called 'milk-fever' which sometimes comes on in women about the third or fourth day after childbirth. A similar condition is common in children who have eaten some indigestible substance, or received an enema, or suffered any other irritation of the digestive system, and in children these slight feverish attacks are often accompanied by a bright-red eruption, closely resembling, and often mistaken for, that of scarlet fever.

FEBRIFUGES (*febris*, a fever; *fugo*, I drive away), or antipyretics, are remedies employed to reduce the temperature of the body when it has been raised above that found in health. (*See* BATHS, COLD, USES OF, *and* FEVER.) In addition to the application of cold some of the chief febrifuges are aconite, alcohol, antipyrine, quinine, salicin, and salicylate of soda. (See also under each of these headings.)

FEEBLE-MINDEDNESS (*see* MENTAL DEFECTIVENESS).

FEEDING (*see* DIET, DIGESTION, FARINACEOUS FOODS, INFANT FEEDING, *and* NITROGENOUS FOODS). The manner and times of administering food are matters of considerable importance in regard to invalids. In health appetite forms the usual guide to the amount of food and to meal-times. Most persons in health take four meals in the course of the day, one meal being much larger than any of the others and taken either in the middle of the day or in the evening. During the course of a disease or in convalescence when the digestive powers are weak and a large meal cannot be borne, it is usually found more suitable to feed the patient in small amounts given at frequent intervals. The nature of the food must be such that it is very readily digested and the food is usually fluid. Milk and beef-tea form two of the articles most commonly chosen during the height of an illness, or occasionally farinaceous fluids, such as barley water or rice water, take the place of milk, or albumin water is administered instead of beef-tea. When a patient is fed on milk only, it is usual to administer 3 pints of milk during every twenty-four hours, for example in cases of pneumonia and typhoid fever. This may be supplemented or part of it may be replaced by beef-tea, barley water, etc.

The quantity of milk given at one time is usually from 6 to 8 oz., while of beef-tea 5 oz. or a teacupful forms the usual quantity at one time. These quantities are given at intervals of two or three hours, and a diet chart in a case of pneumonia would run somewhat as follows:

8 A.M. . . .	6 oz. milk
10 A.M. . . .	6 oz. milk
12 noon . . .	5 oz. beef-tea
2 P.M. . . .	6 oz. milk
4 P.M. . . .	6 oz milk
6 P.M. . . .	5 oz. beef-tea
8 P.M. . . .	6 oz. milk
10 P.M. . . .	6 oz. milk
12 P.M. . . .	6 oz milk
2 A.M. . . .	(asleep)
4 A.M. . . .	6 oz. milk.
6 A.M. . . .	6 oz. milk
	=54 oz. milk and 10 oz. beef-tea

It is sometimes convenient to feed the patient by means of a spoon, but, as a rule, the patient's head being raised by the nurse's arm passed beneath the pillow, the spout of a feeding-cup is introduced into his mouth and the

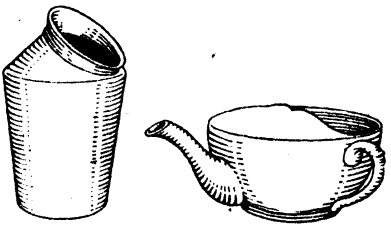

FIG. 204.—Two forms of feeding-cup. The cup on the left is used for more convalescent patients, who are partly raised in bed.

patient is thus able to drink without spilling the fluid. A form of glass from which the patient can drink more naturally consists of a tumbler with an elongated lip on one side, and this is often preferable. Still another method in which the patient may be fed with thin fluids is through a straw or piece of narrow india-rubber tubing. In this case the straw must be thrown away after use and the rubber tubing carefully boiled before being used again.

Food is frequently peptonised for administration to invalids. (*See* PEPTONISED FOODS; *see also* MILK, and for preparation of fluid foods for invalids see ALBUMIN WATER, BARLEY WATER, BEEF ESSENCE, BEEF-TEA, GRUEL, RICE WATER, TOAST WATER.)

FEMALE DISEASES (*see* MENSTRUATION; OVARIES, DISEASES OF; PREGNANCY; *and* UTERUS, DISEASES OF).

FEMUR is the bone of the thigh, and is the longest and strongest bone in the body. As the upper end of the femur is set at an angle of about 120 degrees to the rest of the bone, and since the weight of the body is entirely borne by the two femora, fracture of one of these bones close to its upper end is a common accident in old people, whose bones are becoming brittle. The femur fits, at its upper end, into the acetabulum of the pelvis, forming the hip-joint, and, at its lower end, meets the tibia and patella in the knee-joint.

FENNEL is the seed-like fruit of the *Fœniculum vulgare* used as a stimulant and to check spasms. It contains a volatile oil and is used in the form of fennel water in doses of one or more tablespoonfuls.

FERMENTS are substances which produce chemical changes in other bodies while remaining unchanged themselves. They are classified into—(1) *Organised ferments*, which have a visible organised structure, and are of the nature of bacteria, *e.g.* yeast, which produces alcohol and carbonic acid gas from sugar; the lactic acid bacillus, which produces lactic acid from milk sugar; and the various bacteria, which in the stomach and intestines produce marsh gas from the cellulose of vegetables. (*See* BACTERIOLOGY.) (2) *Unorganised ferments*, which are bodies, soluble in water and sometimes in alcohol and glycerin, secreted by the glands connected with the mouth, stomach, and bowels in order to effect digestion of the food. (*See* DIGESTION.)

It is probable that many disease-producing bacteria act upon the fluids of the body to produce ferment-like bodies, which cause disease.

FERN-ROOT is a remedy used for the expulsion of tapeworms. An ethereal extract is made from the root of the common male fern (*Aspidium filix mas*). It is taken in the following manner. After the person who harbours the tapeworm has taken a dose of castor oil in the morning, he subsists for a day upon small quantities of milk to starve the worm. He then at night takes one dram (a teaspoonful) of the extract of male fern in milk upon an empty stomach, and follows this by a second dose of castor oil or salts the following morning. The worm is often expelled entire and dead.

FERRUM is the Latin name for iron.

FESTER is a popular term used to mean any collection or formation of pus. It is applied to both abscesses and ulcers. (*See* ABSCESS, ULCER, WHITLOW.)

FESTINATION is the term applied to the involuntary quickening of gait seen in some nervous diseases, especially in PARALYSIS AGITANS and PARKINSONISM

FEVER (*ferveo*, I burn). This term, which may be defined as a condition of the body characterised by an increase in temperature, is used in medicine with a wide application. Fever is one of the most common accompaniments of diseases in general, and serves to make the distinction between *febrile* and *non-febrile* ailments.

Causes.—In many cases the fever must be regarded as only secondary to, and symptomatic of, the disordered state with which it is found associated. For example, a considerable amount of fever may arise in consequence of some nervous shock. But there is a large class of diseases in which fever is the predominant factor, and which arise from the formation in the system of something of the nature of a poison (toxin), upon which all the symptoms depend. To such diseases, the term primary or specific fevers is applied, and as examples may be mentioned typhoid fever, rheumatic fever, diphtheria. Many of these diseases have been proved to depend on the growth of bacteria in the blood or tissues of the body, the toxins being formed by the activity of these organisms.

In considering the general subject of fever regard must be had in particular to the two main features of the febrile process, viz. the abnormal elevation of temperature, and the changes affecting the tissues of the body in reference thereto.

The average temperature of the body in health ranges between 98·4° and 99·5° Fahr. It is liable to slight variations from such causes as the ingestion of food, the amount of exercise, and the temperature of the surrounding atmosphere. There are, moreover, certain appreciable daily variations, the lowest temperature being between the hours of 1.30 and 7 A.M., and the highest between 4 and 9 P.M., with trifling fluctuations during these periods. (*See* TEMPERATURE.)

The development and maintenance of heat within the body is generally regarded as depending on the destructive oxidation of all its tissues, consequent on the changes continually taking place in the processes of nutrition. In health this constant tissue disintegration is exactly counterbalanced by the introduction of food, while the uniform

normal temperature is maintained by the due adjustment of the heat thus developed, and of the processes of exhalation and cooling which take place, especially from the lungs and skin. In the febrile state, this relationship is no longer preserved, the tissue waste being greatly in excess of the food supply, while the so-called 'law of temperature' is in abeyance. In this condition the body wastes rapidly, the loss to the system being chiefly in the form of nitrogen compounds (urea, etc.). In the early stage of fever a patient excretes about three times the amount of urea that he would excrete on the same diet if he were in health—the difference being that in the latter condition he discharges a quantity of nitrogen equal to that taken in with the food, while in the fevered state he wastes the store of nitrogen contained in the tissues and the blood. The amount of fever is estimated by the degree of elevation of the temperature above the normal standard. When it reaches as high a point as 106° Fahr. the term 'hyperpyrexia' (excessive fever) is applied, and is regarded as indicating a condition of danger; while, if it exceeds 107° or 108° Fahr. for any length of time, death almost always results. Occasionally, in certain febrile diseases, the temperature may attain the elevation of 110°-112° prior to the fatal issue.

Symptoms.—The commencement of a fever is usually marked by a 'rigor' or shivering, which may exist only as a slight but persistent feeling of chilliness, or, on the other hand, be of a violent character, and, as occasionally happens with children, find expression in the form of well-marked convulsions. Although termed the *cold stage* of fever, in this condition the temperature of the body is really increased. There are, besides, various accompanying feelings of illness, such as pain in the back, headache, sickness, thirst, and great lassitude. In all cases of febrile complaints it is of importance for the physician to note the first occurrence of shivering, which in general fixes the beginning of the attack. This stage is soon followed by the full development of the febrile condition, the *hot stage*. The skin now feels hot and dry, and the temperature, always elevated above the normal standard, will often be found to show daily variations corresponding to those observed in health—namely, a rise toward evening, and a fall in the morning. There is a relative increase in the rate of the pulse and quickness of breathing. The tongue is dry and furred; the thirst is intense, while the appetite is gone; the urine is scanty, of high specific gravity, containing a large quantity of solid matter, particularly urea, the excretion of which is, as already stated, remarkably increased in fever; while, on the other hand, certain of the saline ingredients, such as chlorides, are often diminished. The bowels are in general constipated, but they may be relaxed, as is often the case in typhoid fever. The nervous system participates in the general disturbance, and sleeplessness, disquietude and delirium, more or less violent, are common accompaniments. The waste of the muscles, and corresponding loss of strength, are very marked, and continue even although considerable quantities of nutriment may be taken.

The decline of the fever takes place either by the occurrence of a *crisis, i.e.* a sudden termination of the symptoms, often accompanied with some discharge from the body, such as profuse perspiration, copious flow of thick urine, and occasionally diarrhœa, or by a more gradual subsidence of the temperature, technically termed a *lysis*. On the other hand, death may result either from hyperpyrexia or from gradual exhaustion, the patient often passing into the *typhoid state* (a condition of extreme prostration of the physical powers, with which are associated low delirium and coma, and which is an occasional mode of death in all acute diseases); or the fatal event may occur suddenly from syncope after slight exertion, in which case it is due to a softened state of the substance of the heart, one of the accompaniments of fever.

Certain well-marked types of fever are recognised. The term *continued fever* is applied to those forms in which the febrile temperature persists for a more or less definite period, uninterrupted by any distinct intermission till the crisis is reached. To this type belong typhus and typhoid fevers, and

the eruptive fevers or exanthemata, viz. smallpox, measles, and scarlet fever. *Relapsing fever* is a form of continued fever, the chief characteristic of which is the occurrence in about a week after the crisis of a distinct relapse and repetition of all the symptoms. Occasionally second and third relapses take place.

The term *remittent* is applied to those forms of fever the course of which is interrupted by a short usually daily diminution of the fever, followed by a recurrence of all the symptoms. Such fevers are chiefly met in tropical climates, but occasionally continued fevers assume this form, particularly in children. The condition known as *hectic fever*, which occurs in the course of wasting diseases, is markedly remittent in its course.

In *intermittent fever* there is a distinct periodic subsidence of the symptoms, which, according to its duration, characterises the variety as *quotidian* (where the paroxysm recurs in twenty-four hours), *tertian* (in forty-eight hours), *quartan* (in seventy-two hours). Hectic fever is also not infrequently of the intermittent type.

The term *malignant* is employed to describe forms of fever in which the blood appears to undergo rapid deteriorating changes, sometimes designated blood-poisoning. Yellow fever may be said to belong to this category, and the continued fevers, more especially typhus and the exanthemata, occasionally assume a malignant form from the beginning. The chief forms of fever will be found described in detail under separate headings.

Treatment.—It will be sufficient to refer to two methods, namely, the external application of cold, and the administration of antipyretic remedies or febrifuges. The former of these methods is accomplished by means of baths, in which the fever patient is placed, the water being somewhat below the febrile temperature and gradually cooled down by the addition of cold water till a temperature of from 60°-70° Fahr. is reached. This process, when continued for only a short time and frequently repeated, has been found to yield most valuable results in many instances of high temperature, *e.g.* in enteric fever. The relief to the patient is remarkable, the body rapidly parting with its heat, and the effect usually continues for hours. The hitherto bloodless and dry skin becomes filled and moist, and thus the irradiation of warmth goes on. The cooler the bath the longer the effect lasts. Sponging with cold water and the wet pack are other methods frequently used to re-

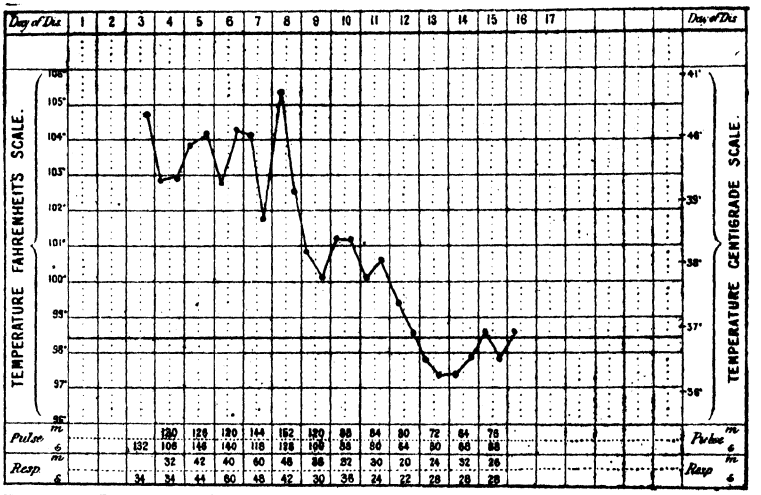

FIG. 205.—Temperature chart from a case of pneumonia, showing a high degree of fever with increased pulse and respiration. The heavy line at 98·4 shows the level of the normal temperature.

duce temperature and exert a soothing influence. (*See* COLD, USES OF.)

Certain drugs possess the power of reducing the heat of fever, and are now largely employed for this purpose. The most important of these is quinine, which, when administered in large doses (10-30 grains), has a marked effect in lowering the febrile temperature, and, if repeated, of keeping it down. It has been supposed that this effect of quinine is due to its action as an antiseptic upon the poison in the blood that gives rise to the fever; but it probably also acts as an antipyretic by retarding those excessive tissue changes with which the development of heat is connected. This opinion is strengthened by the fact that after the administration of quinine the amount of urea discharged from the body is greatly diminished. It is said that quinine acts best at those periods of the day when the febrile temperature is inclined to undergo slight remission. Many other substances are used for their antipyretic action, among which are aspirin, salicylate of soda, salicin, phenacetin, antipyrine, etc.

FIBRILLATION is a term applied to rapid contraction or tremor of muscles, especially to a form of abnormal action of the heart muscle in which individual bundles of fibres take up independent action. It is believed to be due to a state of excessive excitability in the muscle following upon a condition of stretching in dilatation of the heart. Fibrillation is distinguished as auricular (atrial) or ventricular, according as the muscle of the auricle or of the ventricle is affected. As a result, the heart-beats and the pulse become extremely irregular both as regards time and force. The condition of auricular fibrillation is responsible for more than half of all marked and persistent cases of irregular pulse.

FIBRIN is a substance formed in the blood as it clots. Its formation indeed causes clotting. The substance is produced in threads. Clotting, or coagulation, of blood is a complicated process, in the last stages of which an enzyme called thrombin converts the fibrinogen of the blood into fibrin. Thrombin is produced by the action on the prothrombin of the blood of the ferment thrombokinase, set free when tissue is injured. Calcium must be present for this action to happen. Vitamin K is necessary for the formation of prothrombin. The elaborate enzyme system in clotting is to ensure that blood does not clot when circulating. After the threads have formed a close meshwork through the blood, they contract, and produce a dense felted mass. The substance is formed not only from shed blood but also from lymph which exudes from the lymph-vessels. Thus fibrin is found in all inflammatory conditions within serous cavities like the pleura, peritoneum, and pericardium, and forms a thick coat upon the surface of the inflamed membranes. It is also found in inflamed joints, in the lung as a result of pneumonia, etc.

FIBRINOGEN is the soluble protein in the blood which is the precursor of fibrin (*q.v.*), the substance in blood-clot.

FIBROCYSTIC DISEASE, or OSTEITIS FIBROSA, is a disease characterized by the presence of cysts in bones, which thereby become weakened and may break. The cysts form because calcium salts are drained from the bone into the blood stream, the result of the action of a tumor of the parathyroid glands.

FIBROID is a term sometimes applied to tumors of the womb consisting partly of muscular and partly of fibrous tissue. (*See* UTERUS, DISEASES OF.)

FIBROID PHTHISIS is a chronic form of consumption. (*See* CONSUMPTION.)

FIBROMA is a tumor consisting of fibrous tissue. (*See* TUMORS.)

FIBROSIS means the formation of fibrous or scar tissue—for example, in the lungs, in the kidneys, in the blood-vessels, as the result of chronic disease.

FIBROSITIS is another name for muscular rheumatism. (*See* RHEUMATISM.)

FIBROUS TISSUE is one of the most abundant tissues throughout the body. White fibrous tissue consists of fibres of a substance known as 'collagen,' which yields gelatine on being boiled. Between these fibres lie flattened or star-shaped cells, by which the fibres are produced.

The fibres, like the cells, are of microscopic size, and are grouped into bundles which are held together by other fibres running round them. Yellow fibrous tissue is a rarer form, and consists of bundles of long yellow fibres, formed

FIG. 206.—Bundle of yellow elastic fibres. (Turner's *Anatomy*.)

from a substance known as 'elastin'. White fibrous tissue is very unyielding and forms sinews, ligaments, the material which binds muscle fibres together, the substance of the true skin, etc. It also is the tissue which is laid down in the repair of wounds, or as a

FIG. 207.—White fibrous tissue. The upper figure shows the delicate network formed by cells in the repair of a wound; the lower figure shows the dense, fully formed state. (Miller's *Surgery*.)

result of inflammation, and so forms the tissue composing a scar. It has the property of contracting and becoming denser as time goes on, and hence the puckering seen in scars, and the contraction resulting from burns and inflammations. Yellow fibrous tissue is highly elastic, and so is found in the walls of arteries, and in ligaments, like that on the back of the neck, which are often put upon the stretch. (*See also* ADHESIONS, SCAR, WOUNDS.)

FIBULA is the slender bone upon the outer side of the leg.

FILARIASIS (*filum*, a thread) is the name given to a group of tropical diseases in which minute Nematode worms, called filariæ, are found in the blood. Among the diseases connected with the presence of these worms are chyluria and elephantiasis.

FILTER-PASSER.—FILTER-PASSING VIRUS, FILTERABLE VIRUS. Also known shortly as VIRUS. A filter-passer is the smallest known living unit and is invisible by ordinary microscopic methods. Hence it is sometimes called ULTRAMICROSCOPIC VIRUS. It will pass through the pores of a porcelain filter of such a size as to retain ordinary bacteria. Filter-passers cause many infectious diseases, such as influenza, infantile paralysis, measles, chickenpox, smallpox.

FILTERS (*see* WATER SUPPLY).

FINGERS consist of three bones called 'phalanges' united by hinge-joints and strong ligaments. The thumb, like the great toe, differs from the others in having only two bones. These are bent or flexed, and straightened or extended by powerful sinews, two in front and two behind, which are

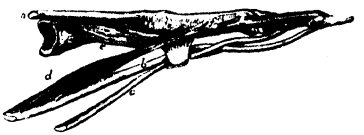

FIG. 208.—A finger with its metacarpal bone and three phalanges, showing the arrangement of the tendons. *a*, Extensor tendon; *b*, deep flexor tendon; *c*, superficial flexor tendon; *d*, *e*, small muscles in palm of hand; *f*, attachment of these muscles to extensor tendon. (Turner's *Anatomy*.)

brought into action by the contraction of muscles in the forearm. The sinews are enveloped in complicated synovial sheaths, through which they slide without friction, and are attached to the bases of the middle and end phalanges back and front.

Running up each side of each finger are two small arteries and two small nerves, which supply the various structures and especially the overlying skin. The skin of the fingers is specially strong and peculiarly sensitive, and the end of the finger has a highly specialised part, the nail. (*See* SKIN.) There is no muscle or flesh in the finger itself.

Each finger is set upon a bone, the 'metacarpal,' which lies in the substance of the hand between the finger and the carpus or wrist.

FINSEN LIGHT (*see* LIGHT TREATMENT).

FISH (*see* NITROGENOUS FOODS).

FISSURE is a term applied both to clefts of normal anatomical structure and also to small narrow ulcers occurring in skin and mucous membrane. The latter type of fissure occurs especially at the corners of the mouth and at the anus. (*See* LIPS, *and* RECTUM, DISEASES OF.)

FISTULA (*fistula*, a pipe) is an unnatural, narrow channel, leading from some natural cavity, such as the duct of a gland, or the interior of the bowels, to the surface. Or, it may be a communication between two such cavities, where none should exist, as, for example, a direct communication between the bladder and bowel.

Causes.—Sometimes a child is born with a fistula, as a result of some defect in development, for example, a fistula from the thyroid gland to the surface; but, as a rule, the cause of the formation is either disease or injury. Often, the blockage of the duct of a gland leads to a fistula and the escape of the secretion from the gland on to the surface. Thus a salivary fistula may form on the face as a result of blockage by a concretion of the salivary duct in the cheek, and saliva then runs out on the cheek instead of into the mouth. Injury may be the cause also. For example, if the pelvis be fractured, the urethra may be torn across, so that urine, instead of being properly voided, passes among the tissues, and, by a process of suppuration, gradually bursts its way out through the skin, forming a permanent urinary fistula. Fistula from the bowel or bladder occasionally arises in women as a result of injury during protracted childbirth. Disease is another cause; thus an abscess may form at the side of the lower end of the bowel, and, bursting into the bowel on one side, and through the skin on the other, forms a fistula. This 'fistula in ano' forms the best known and most important variety of fistula. The abscess which produces the fistula may be tuberculous or an acute abscess due to the ordinary causes. (*See* ABSCESS, ACUTE.) Sometimes a fish-bone or pin, which has been swallowed, travels through the whole digestive canal without doing damage, till it reaches this point, where it lodges and produces a fistula.

Treatment.—As a rule, a fistula is extremely hard to close, especially after it has persisted for some time. The treatment consists in an operation to restore the natural channel, be it salivary duct, or urethra, or bowel. This is effected by appropriate means in each locality, and when it is attained the fistula heals quickly under simple dressings.

'Fistula in ano' is a very troublesome condition, and is kept from healing by the constant entrance into it of foul material from the bowel. It is only to be cured by dividing the tissues which separate it from the bowel, and, each day, after the bowels move, packing the wound in such a way as to compel it to heal gradually from its deepest part. The process of healing is, therefore, a very tedious one.

FIT is a popular name for a sudden convulsive seizure, though the term is also extended to include sudden seizure of every sort. During the occurrence of a fit of any sort the chief object should be to prevent the patient from doing any harm to himself by the convulsive movements, so that the person should be laid flat, and the head supported on a pillow or other soft material. To prevent the tongue from being bitten, some object of moderate hardness may be placed between the teeth. (*See* APOPLEXY, CONVULSIONS, ECLAMPSIA, EPILEPSY, FAINTING, HYSTERIA, URÆMIA.)

FLAT-FOOT is a deformity of the foot in which its arch sinks down so that the inner edge of the foot comes to rest upon the ground. (*See* FOOT.) The arch of the foot is to a considerable extent an indication of character and habits, for flat-foot seldom or never occurs in active, energetic people, and its presence debars persons from the public services, or even from engagement in positions where physical activity is needed, for example, as sailors.

Causes.—Sometimes, in weakly children wearing high boots, the arch gives way a little, but this is remedied by tonics, removal of the boot-heels, and instructing the child to walk with the toes turned in. Most cases occur in growing and underfed young men and young women, who have much standing on the feet, *e.g.* errand-boys, waiters, housemaids, shop-girls. The ligaments which support the arch are in these

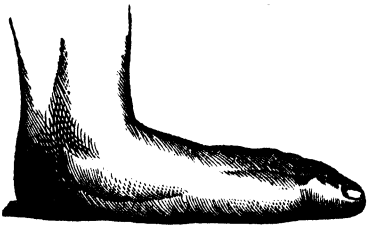

FIG. 209.—Flat-foot, showing complete loss of the arch. (Miller's *Surgery*.)

persons still soft, the four muscles (two tibial muscles on the inner side, and two peroneal muscles on the outer side) which sling it up become weak or tired, and hence the arch gradually subsides.

Symptoms.—There is pain both along the instep and beneath the outer ankle, the foot is stiff and broad, walking is tiresome, and the toes turn far out. The footprints of a flat-foot are broad, all the way from toe to heel, instead of being a mere line at the instep. The extent to which the flatness has proceeded may be tested by wetting the bare feet with inky water and causing the person to stand on a piece of clean white paper.

Treatment.—Change of occupation to one which allows of sitting is necessary. In early cases the leg muscles may be strengthened by tiptoe exercises performed for ten minutes night and morning, the legs being thereafter bathed with cold salt water and massaged. This may be enough, or a steel sole, with instep to support the arch, may have to be worn inside the boot. In other cases providing the boot with a sole, which is thicker on the inner side of the foot by ¼ to ½ an inch than it is on the outer side, may both relieve discomfort in walking and help to remedy the flat foot by throwing the weight of the body on to the outer edge of the foot. The toes should be habitually turned inwards in walking. In very bad cases of long standing it may be necessary either to wrench the foot into position under chloroform, and put it in plaster of Paris for a month, or even to remove part of the bone from its inner side, so as to shorten the instep and make a new arch.

FLATULENCE (*flatus*, a blowing) means a collection of gas in the stomach or bowels. In the former case the gas is expelled from time to time in noisy eructations by the mouth; in the latter case it may produce unpleasant rumblings in the bowels, or be expelled from the anus.

Causes.—The presence of gas in the stomach has been explained under the heading of ERUCTATION. When gas is found in large amount in the bowels its production is usually due to fermentation set up by bacteria. Marsh gas and hydrogen are formed from the cellulose of vegetables, sulphuretted hydrogen and carbon disulphide from eggs, pease and other articles of diet containing much sulphur. Many cases of flatulence are much aggravated by a bad habit of gulping mouthfuls of air.

Treatment.—Flatulence in the stomach is treated by relieving the dyspepsia which causes it. In many cases the flatulence is aggravated by a nervous condition which must receive appropriate treatment, *e.g.* by bromides. If the flatulence is due to or aggravated by the habit of swallowing air, the patient must, by taking a careful note of the occasions when he does this almost unconsciously, break himself of this bad habit. When this is done the flatulence often passes off. In cases of intestinal flatulence, articles of diet which tend to decompose, *e.g.* green vegetables and starchy foods, should be avoided, and the food should be light and quickly digestible.

FLAVINE (*see* ANTISEPTICS).

FLEXIBILITAS CEREA is the term applied to an abnormal state in which the limbs remain in any position into which they are moved.

FLEXION (*flecto*, I bend) means bending, and is a term applied either to the bending of joints or to an abnormal shape of organs.

FLIES (*see* INSECTS IN DISEASE).

FLOATING KIDNEY (*see* KIDNEY, DISEASES OF).

FLOCCITATION means the fitful picking at the bed-clothes by a delirious patient, as, for example, in typhoid fever.

FLOODING is a popular name for an excessive blood-stained discharge from the womb. (*See* MENSTRUATION.) In the majority of cases flooding is the sign of a miscarriage. (*See* MISCARRIAGE.)

FLUCTUATION (*fluctus*, a wave) is a sign obtained from collections of fluid by laying the fingers of one hand upon one side of the swelling, and, with those of the other, tapping or pressing suddenly on a distant point of the swelling. The thrill communicated from one hand to the other through the fluid is one of the most important signs of the presence of an abscess, or of effusion of fluid into joints or into the peritoneal cavity.

FLUKES are a variety of parasitic worms. (*See* PARASITES.)

FLUORESCIN is an orange powder which, dissolved in water, is dropped into the eye in order to detect scratches or ulcers of the cornea.

FLUTTER, or AURICULAR FLUTTER, is the term applied to a form of abnormal cardiac rhythm in which the auricles contract at a rate of between 180 and 140 beats a minute, and the ventricles more slowly. The abnormal rhythm is the result of a diseased heart.

FLUX (*fluxus*, a flow) means an excessive discharge from any of the natural openings of the body. 'Bloody flux' is a popular name for dysentery, 'white flux' or 'whites' for leucorrhœa.

FŒTOR OF THE BREATH (*see* BREATH, DISORDERS OF).

FŒTUS (*fœtus*), or EMBRYO, is the name given to the child while still within the womb. The human being, like the young of all animals, begins as a single cell, the *ovum*, in the ovary. After fertilisation with a spermatozoon the ovum becomes embedded in the mucous membrane of the uterus, its covering being known as the decidua. Increase in size is rapid, and development of complexity is still more marked. The original cell divides again and again to form new cells, and these become arranged in three layers, known as the epiblast, mesoblast and hypoblast. From the first are produced the cuticle, the brain and spinal cord, and the nerves; from the second the bones, muscles, blood-vessels, and connective tissues; while the third develops into the lining of the digestive system and the various glands attached to it.

The ovum produces not only the fœtus but several membranes and appendages which serve it till birth, and are then cast away. The embryo develops upon one side of the ovum, its first appearance consisting of a groove, the edges of which grow up and join to form a tube, which in turn develops into the brain and spinal cord. At the same time, a part of the ovum beneath this is becoming pinched off to form the body, and within this the hypoblast forms a second tube, which in time is changed in shape and lengthened to form the digestive canal. From the gut there grows out very early a process called the 'allantois', which attaches itself to the wall of the womb, forming later on the navel-string and afterbirth, by which nourishment is gained for growth. (*See* AFTERBIRTH.)

The remainder of the ovum, which within two weeks of conception has increased to about $\frac{1}{17}$ inch in size, splits into an outer and inner shell, from the outer of which are developed two covering membranes, the chorion and amnion, while the inner constitutes the yolk sac, attached by a pedicle to the developing gut of the fœtus. From two weeks after conception onward, the various organs and limbs appear and grow, the name of *embryo* being now applied to the developing being, while it is almost indistinguishable in appearance from the embryo of other animals, till the middle of the second month, when it begins to show a distinctly human form. After this stage it is called the *fœtus*. The property of 'life' is present from the very beginning, though the movements of the fœtus are not felt by the mother till the fifth month.

During the first few days after conception the eye begins to be formed, commencing as a cup-shaped outgrowth from the mid-brain, its lens

being formed as a thickening in the skin. It is very soon followed by the beginnings of the nose and ear, both of which arise as pits on the surface, which increase in complexity, and are joined by nerves that grow outward from the brain. These three organs of sense have pretty much their final appearance as early as the beginning of the second month.

As already stated, the body closes in from behind forward, the sides growing forward from the spinal region. In the neck, the growth takes the form of five arches, similar to those which bear gills in fishes. From the first of these the lower jaw is formed, from the second the hyoid bone, all the arches uniting, and the gaps between them closing up by the end of the second month. At this time the head and neck have quite assumed a human appearance.

The digestive canal, as already stated, begins as a simple tube running from end to end of the embryo, but it grows in length and becomes twisted in various directions to form the stomach and bowels. From this tube also the lungs and the liver arise as two little buds, which quickly increase in size and complexity. The kidneys also appear very early, but go through several great changes before their final form is reached.

The genital organs appear late. The swellings, which form the ovary in the female and testicle in the male, are produced in the region of the loins, and gradually descend to their final positions. The outward organs are exactly similar in the two sexes till the end of the third month, and the sex is not clearly distinguishable till late in the fourth month. Accordingly it has been suggested that, by some peculiarity of food, the mother can, at will, determine the sex of her future child.

The blood-vessels appear even before the embryo in the ovum. The heart, originally double, forms as a dilatation upon the arteries which later produce the aorta. These two hearts later fuse into one. (For the circulation in the fœtus, see CIRCULATION OF BLOOD.)

The limbs appear about the end of the third week as buds which increase quickly in length and split at their ends into five parts, for fingers or toes. The bones at first are formed of cartilage, in which true bone begins to appear during the third month.

The following table gives the average size and weight of the fœtus at different periods:

Age.	Length.	Weight.
4 weeks .	¼ to ½ in.	20 grains
3 months .	2 to 3 in.	1 to 2 oz.
5 months .	6 to 8 in.	5 to 7 oz.
7 months .	12 in.	2 to 3 lb.
Birth . .	18 in.	6 to 8 lb.

If a fœtus be born before the sixth month, it dies at once, but, from the sixth month onward, it may move and breathe for a little time. Children are sometimes raised, and become quite strong and healthy, if born at the end of the seventh month; for example, George III. and Sir Isaac Newton are said to have been so born. The nearer a child comes to its full term the better chance it has of surviving, though there is a popular idea that seventh-month children are stronger than those of the eighth month.

FOLIA is a Latin term for leaves, *e.g. digitalis folia.*

FOLLICLE (*folliculus*, a little bag) is the term applied to a very small sac or gland, *e.g.* small collections of adenoid tissue in the throat and the small digestive glands on the mucous membrane of the intestine.

FOLLICULAR HORMONE (*see* ŒSTRADIOL.)

FOMENTATION (*foveo*, I keep warm) is the term applied to any warm application to the surface of the body in the

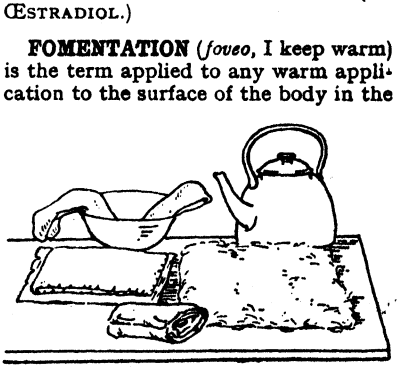

FIG. 210.—Requisites for a hot fomentation.

form of a cloth. Usually the fomentation cloth is heated by being wrung out of hot water, but the term is also applied to dry applications and to hot

cloths upon which various drugs are sprinkled. A fomentation dilates the blood-vessels of the part to which it is

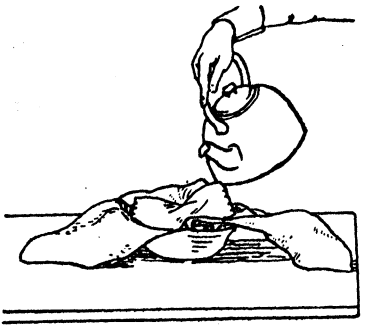

FIG. 211.—Fomentation cloth laid on towel in bottom of basin; boiling water poured on fomentation cloth.

applied and has a soothing effect upon the endings of the nerves, so that it both aids the absorption of effusions

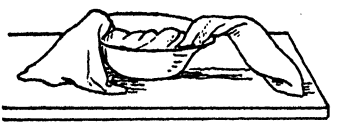

FIG. 212.—Towel twisted round fomentation cloth.

and relieves pain. In the case of superficial abscesses it softens the skin and helps the abscess to 'point'.

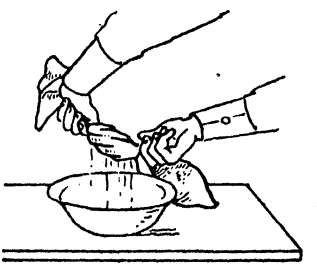

FIG. 213.—Wringing out the hot water.

Method of preparation.—HOT MOIST FOMENTATIONS are made as follows. The requisites are a piece of flannel sufficiently large when folded double to cover the part to which it is desired to apply heat, a towel, a basin, a kettle of boiling water, a piece of jaconette slightly larger than the fomentation, a layer of cotton-wool to cover the fomentation, and a binder with safety pins. The towel is placed open across the basin; the fomentation flannel is laid upon the towel and pressed down into the basin; boiling water is then poured from the kettle upon the fomentation cloth until it is well soaked; the ends of the towel are then twisted firmly in opposite directions by the hands holding its dry ends; and the hot water is thus squeezed out of the

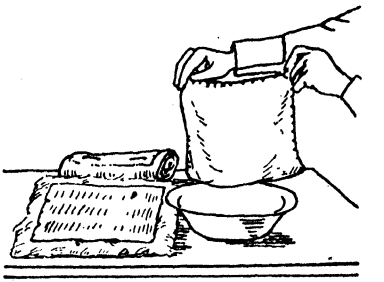

FIG. 214.—Shaking the fomentation cloth to admit air between folds.

fomentation cloth. The towel is now untwisted, the fomentation cloth is shaken out flat, so as to admit air between its folds, and laid upon the jaconette, which in turn is laid on the layer of cotton-wool. The whole is now laid upon the body with the fomentation cloth against the skin, and is fixed in place with the binder and safety pins. The preparation of the fomentation should be carried out at

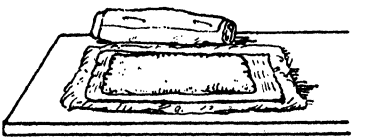

FIG. 215.—Fomentation cloth laid on mackintosh, which is laid on cotton-wool. Ready to apply and fix with flannel binder.

the bedside, so that it does not unduly cool before being applied. If the fomentation is large, it may be found more convenient to use a roller towel and to twist it up by passing a couple of sticks through each end. Instead of the cotton-wool and binder a large bath towel may be used to keep the fomentation in contact with the body. The fomentation retains its heat only a short time, and, if it is to be renewed, this should be done about every twenty minutes.

TURPENTINE FOMENTATION. — This is also known as a 'stupe'. It is prepared in the same way as the hot fomentation, but, in addition, after the boiling water is poured on the cloth and before it is wrung out, a few teaspoonfuls of turpentine are sprinkled on the cloth.

LAUDANUM FOMENTATION. — This may be prepared in the same way as the hot fomentation, with the addition that, after the cloth is wrung out and just before the fomentation is applied, two or three teaspoonfuls of laudanum are sprinkled over its surface. Another method of preparing this soothing fomentation is to take half a dozen dried poppy heads, break them up and boil them with 1½ pints of water in a saucepan for twenty minutes, and then, proceeding as before, to pour the water from the saucepan through a strainer on to the fomentation cloth as it lies on the towel in the basin.

BORIC ACID FOMENTATION. — A fomentation of boric acid is employed to allay inflammation in the case of open wounds, abscesses, or ulcers. For this purpose a double piece of lint is used instead of the flannel fomentation cloth. This is dipped into a warm saturated solution of boric acid, wrung out, and applied, after which it is covered with a piece of jaconette and cotton-wool and bandaged in place. Boric lint ready prepared may be used instead of plain lint, and all that is necessary then is to pour boiling water over it, wring it out, and apply in the same manner as the ordinary fomentation.

COLD-WATER DRESSINGS are sometimes also known as fomentations because they become gradually warmed by the heat of the body. They are prepared by dipping a piece of lint in saturated boric acid lotion or other weak antiseptic, applying to the part, and then covering with a piece of gutta-percha tissue or oiled silk which is larger than the piece of lint and projects at least half an inch beyond it all round.

DRY FOMENTATION. — This is made by toasting a piece of thick flannel in front of the fire and laying it on the part to be fomented, covering with a thick layer of cotton-wool and on the outside a hot-water bag. This does not retain its heat for long, but the heat is longer retained by a flannel bag containing salt or bran which is warmed and applied in a similar manner. Flat india-rubber bags, 'thermophores', which retain their heat for many hours are obtainable. These contain a mixture of salts which liquefies when the bag is boiled. The bag is simply boiled for a few minutes in a kettle each time it is required, and then applied and covered with cotton-wool. These dry applications are very useful for relieving the pain of colic, neuralgia, etc.

FOMITES (*fomes*, tinder) is a term used to include all articles which have been brought into sufficiently close contact with a person sick of some infectious disease to retain the infective material and spread the disease. For example, clothes, bedding, carpets, toys, books, may all be fomites till disinfected.

FONTANELLE is a term applied to areas on the head on which bone has not yet formed. The chief of these is the anterior fontanelle, situated on the top of the head between the frontal and two parietal bones. In shape it is four-sided, about a square inch in size at the time of birth, gradually diminishing until it is completely covered by bone, which should happen by the age of eighteen months. The pulsations of the brain can be readily felt through it. Delay in its closure is particularly found in cases of rickets as well as in other states of defective development. The fontanelle becomes more tense than usual in acute fevers, whooping-cough, and bronchitis, and tends to bulge in cases of hydrocephalus. It becomes unusually depressed in all cases of diminished vitality, such as that due to diarrhœa or wasting from any cause.

FOOD (*see* ADULTERATION OF FOODS, BREAD, CANNED FOODS, DIET, DIGESTION, FARINACEOUS FOODS, FEEDING, INFANT-FEEDING, MILK, NITROGENOUS FOODS, FRUIT, VITAMIN).

FOOD POISONING. — Poisoning, characterised as a rule by vomiting, diarrhœa, and abdominal pain, as a result of eating food contaminated with metallic or chemical poisons, or with bacteria, or with the toxins of bacteria; or as a result of eating

poisonous 'foods', such as poisonous mushrooms. Apples may be contaminated with arsenic or lead from insecticide sprays; antimony poisoning may occur as the result of the action of acid fruits on enamel vessels with antimony salts in the glaze.

Bacterial food poisoning is now what is commonly meant by the term 'food poisoning'. It comprises those conditions formerly and erroneously described as 'ptomaine poisoning'. The gravest, and fortunately the rarest, form of food poisoning is botulism (*q.v.*). Then there is staphylococcal food poisoning, in which certain staphylococci produce in the food they contaminate an enterotoxin which after injection makes the consumer suddenly ill with vomiting, diarrhœa, and abdominal pain. The staphylococci themselves do not act thus on ingestion: it is the preformed toxin which is noxious.

Many cases of food poisoning are caused by infection with any one of a group of bacteria belonging to the genus *Salmonella*. This genus includes the paratyphoid bacilli A and B, *B. aertrycke, B. enteritidis, B. suipestifer. B. paratyphosus A and B* cause fever of the typhoid type and not acute food poisoning, which comes on 6 to 14 hours after ingestion of the noxious food. Some of the *Salmonella* organisms are harmless to man and cause disease in animals. Some cause disease in both man and animals, and it is these which are so commonly responsible for outbreaks of food poisoning in human communities.

Foods usually so contaminated are milk and foods frequently handled—meat pies, minced meat foods, pressed beef, etc. *Salmonella* infections are common in pigs, sheep, rabbits, cattle, rats, mice, dogs, and cats. If a cow is infected with a *Salmonella—e.g. B. enteritidis*—the organism may get into the milk, and the consumer of the milk suffer from food poisoning. Food may become infected by the excreta of rats or mice. Ducks are susceptible to *Salmonella* infections, especially *B. aertrycke*, and the organism may get into the duck's egg—an occasional source of human infection.

Food poisoning is now a notifiable disease.

FOOT is that portion of the lower limb situated below the ankle-joint. Its structure is very similar to that of the hand. There are seven tarsal bones, of which the astragalus supporting the leg bones, and the calcaneum, forming the heel, are the largest. The others are the scaphoid, three cuneiform, and the cuboid bones. Then comes a row of five metatarsal bones, and finally fourteen phalanges contained in the toes, the great toe having two only, while each of the others has three. The arrangement of the arteries and nerves

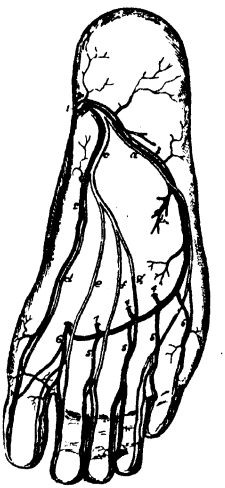

FIG. 216.—Sole of foot, showing the arteries and nerves. *a*, External plantar nerve; *b*, its deep branch; *c*, internal plantar nerve; *d, e, f, g*, its digital branches. For the numbers see under ARTERIES. (Turner's *Anatomy*.)

is similar to that found in the hand and fingers.

The arch of the foot is a most important structure. The bones are so arranged that the sole is hollow both from before back and from side to side. In walking, the outer edge only, at the middle of the sole, should touch the ground. The arch is further supported by a short plantar ligament situated in the hollow of the arch, running from the calcaneum to the cuboid bone, and by a long plantar ligament situated nearer the surface. It is also slung up by two sinews on either side, coming from muscles in the leg, the two tibial muscles on the inner side, and the two peroneal muscles on the outer side.

When this arch gives way, flat-foot is the result. (*See* FLAT-FOOT.)

For diseases of the foot see CORNS AND BUNIONS; CHILBLAINS; BONES, DISEASES OF; GOUT; NAILS; CHAFING OF THE SKIN; DROP-FOOT; CLUB-FOOT.

FORAMEN is the Latin term for a hole. It is especially applied to natural openings in bones, such as the foramen magnum, the large opening in the base of the skull through which the brain and spinal cord are continuous.

FORCED FEEDING (*see* GAVAGE).

FOREHEAD (*see* FRONTAL BONE).

FORGETFULNESS in many people is an inborn misfortune, in others it arises as the result of some disease. Memory is defined by William James as 'the knowledge of an event or fact, of which meantime we have not been thinking, with the additional consciousness that we have thought or experienced it before'. This process necessitates two things—the retention of an event and the reproduction of it, both depending upon the same process in the nervous system. In this system there are, according to Meynert, some 600,000,000 nerve-cells. These are united together by numberless nerve-fibres into countless combinations. When a sensation affects the brain it influences certain of these groups, and if the sensation be very powerful or very often repeated the groups of associated nerve-cells develop a habit of acting in concert and tend, upon future stimulation by any means, to reproduce this sensation in its entirety. This process is known as 'association', and the multitudinous fibres which connect cell with cell and group with group, forming the chief bulk of the brain, are known as 'association fibres'.

Sound memory depends upon the rational grouping of ideas of things in the mind, so that one may call up the other, and the man who thinks most over the occurrences of his daily life will, other things being equal, have the best memory. No training will make up for a deficiency of nerve-cells or association fibres, which are inborn characters.

For good memory of important facts, a certain amount of forgetfulness is necessary. Facts in the past should become 'foreshortened', so to speak, and the inability to recount an incident without going over all its petty details forms a type of mental weakness. For this purpose, mental relaxation and change of employment are just as necessary as the quiet pondering over past events that leads to their classification and orderly retention.

According to modern psychological theory forgetting is often an active process. Painful memories may be repressed out of consciousness, and, buried in the 'unconscious mind', may be the source of anxiety and neurotic behaviour.

There are certain changes in which memory becomes impaired. Chief among these is old age. (*See* AGE, NATURAL CHANGES IN.) In the old man's memory the events of yesterday are a blank, and only the events of youth, and later of childhood, forgotten in busy middle age, are again brought to light, all, however, crumbling and half rubbed away. When this defect is extreme it is due to degenerative changes in the old man's arteries and brain. Apoplexy is another cause either of permanent impairment (*see* APHASIA) or, in slighter cases, of frequent losses of memory which occur in old people, and last a few hours or a few days. Gradual failure of memory is one of the chief mental changes shown by those who are subject to frequently returning epileptic seizures. In hypnotism and various mental diseases, especially dementia, curious vagaries occur. Concussion of the brain too may produce at first total unconsciousness, followed by partial loss of memory, lasting for some time. (*See* BRAIN, DISEASES AND INJURIES OF.)

Treatment. — In cases of habitual forgetfulness, the general health, the digestion, and regularity of the bowels must first be attended to. The brain-cells will not work in full vigour when handicapped by anæmia, by dyspepsia, or by constipation. For increasing the memory there are three methods.

Judicious methods are those of classification, repeated presentation of facts to be remembered in different guises, and the formation of numerous connecting links between these facts and facts already in the mind. This method is exemplified in all the sciences, and

lies at the root of present-day school-teaching.

Mechanical methods are sometimes useful in remembering new facts. For example, little children are taught to read in unison words or figures clearly written on the blackboard, so that ideas of these entering by the channels of eye, ear, and muscular sense may form on the brain deep impressions upon which future memories can be built. Similarly, a person, hearing a new name, repeats it several times, so that it may make a lasting impression upon his brain-cells.

Artificial memories (memoriae technicae) are often constructed by persons who have either very few facts in mind with which to form new associations, or who wish in a short time, and for a special purpose, such as an examination, to remember certain facts, and then blot out the whole as a useless encumbrance of memory.

FORMALIN, or FORMIC ALDEHYDE, is a gaseous body prepared by the oxidation of methyl alcohol. For commercial purposes it is prepared as a solution of 40 per cent strength in water. It is also used to harden gelatine for making capsules, etc. Formalin is a powerful antiseptic, and has also the power of hardening the tissues. The vapour is very irritating to the eyes and nose.

Uses.—For disinfection it is largely used in the form of a spray of 2 to 10 per cent strength in water. This can be sprayed through the air and on the walls, furniture, etc., of a room to be disinfected, being free from destructive properties to metal-work, curtains, carpet, etc. It can also be vaporised by heat. In 1 per cent solution in water it forms a powerful antiseptic for hand-washing, and has the merit of being non-poisonous in small amounts.

FORMIC ACID was introduced into medicine on the quaint basis that, as it occurred naturally in such energetic and indefatigable insects as ants, it might have a stimulating effect on human beings.

FOSSA (*fossa*, a ditch) is a term applied to various depressions or holes, both on the surface of the body and in internal parts, such as the iliac fossa in each lower corner of the abdomen, and the fossæ within the skull which lodge the parts of the brain.

FOWLER POSITION.—After an operation on the abdomen the patient is placed in a semi-sitting position—known as the Fowler position—so that infective fluids do not collect in the upper part of the abdominal cavity.

FOWLER'S SOLUTION is another name for LIQUOR ARSENICALIS, which contains arsenic and is a colourless, odourless fluid. The dose is 2 to 8 minims.

FOXGLOVE (*see* DIGITALIS).

FRACTURES (*frango*, I break) are breaches in the structure of bones produced by violence.

Varieties.—The great division of fractures is into those which are simple and those which are compound.

SIMPLE FRACTURES form the commonest variety, consisting of those in which the bone is broken, with or without much laceration of the surrounding parts, but in which there is no wound leading from the fracture through the skin.

COMPOUND OR OPEN FRACTURES are those in which the skin is injured, so that a wound leads from the outer air to the broken bone, which may indeed protrude through this wound. The fact that a fracture is compound renders it very much more serious, even though there be little splintering of the bone or laceration of the soft tissues. The special dangers attending compound fractures are as follows. The injury is apt to be much more serious than in simple fracture, and a large quantity of blood may be lost. The union of the bone is delayed, repair taking place by a much slower process when there is an open wound, and a lengthy illness is the result. The greatest danger, however, is that the wound may become infected with virulent micro-organisms, so that suppuration, erysipelas, or blood-poisoning may ensue, and amputation of the limb may become necessary. The long illness, accompanied by suppuration, may also permanently impair the injured person's health. For all these reasons the greatest care is necessary

in handling a fractured limb, so that a simple fracture may not be converted into a compound one.

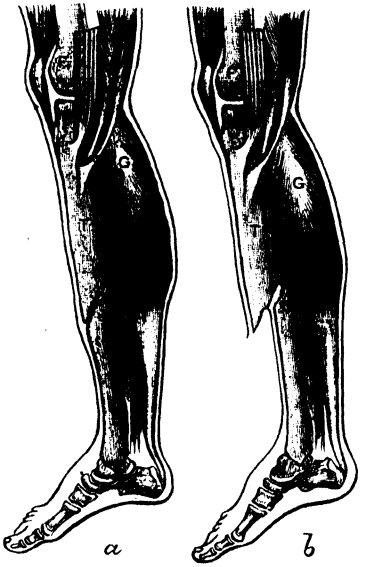

FIG. 217.—Diagram intended to illustrate the manner in which a simple fracture becomes compound through inefficient treatment. This accident is specially liable to occur in the leg. *a*, Simple fracture; *b*, compound fracture; *F*, femur; *G*, gastrocnemius muscle; *S*, soleus muscle; *T*, tibia.

COMPLETE FRACTURES are those in which the bone is broken completely across, and no connection left between the pieces.

INCOMPLETE FRACTURES are those in which the bone is broken only partly across, or in which the periosteum, the tough membrane surrounding the bone, is not torn. This variety occurs in children, whose bones contain more fibrous material and less bone earth than those of old people, a fact which renders them tougher and more pliant in earlier life. A child's bone may, like a twig, crack half-way across and then split some distance up its length, suffering in this way what is called a 'green-stick' fracture.

FISSURED FRACTURES are mere cracks in the bone, and are found commonly in the skull. A simple fissured fracture is a fairly frequent accident.

DEPRESSED FRACTURES occur generally on the skull, and consist of fractures in which a fragment of bone is forced inwards below the general level. This may give rise to interference with the brain either when the fracture is produced, or at a later date from thickening consequent on repair of the bone.

FIG. 218.—Incomplete or green-stick fracture of the femur. (Miller's *Surgery*.)

COMPLICATED FRACTURES are those in which, in addition to the fracture, some other serious injury is produced, *e.g.* a dislocation, tearing of a nerve, etc.

COMMINUTED FRACTURES are those in which there is much splintering.

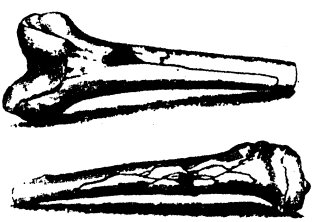

FIG. 219.—Comminuted fractures of the lower end of the femur and of the upper end of the tibia, caused by an expanding rifle bullet. (Ballingall's *Military Surgery*.)

IMPACTED FRACTURES are those in which, after the break has occurred, one

fragment is jammed inside the other, usually at an angle.

FIG. 220.—Vertical section through an impacted fracture near the upper end of the femur. (Miller's *Surgery*.)

UNUNITED FRACTURES are those in which, after the time has elapsed in which the fracture usually mends, it is found that union has not taken place. The failure to unite may be simply due

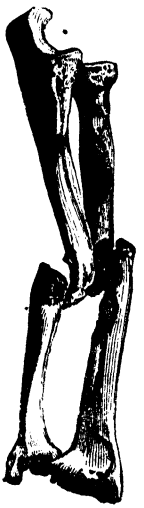

FIG. 221.—Ununited fracture of the forearm. The bones played upon each other by a new hinge-like joint. (Miller's *Surgery*.)

to 'delayed union,' in which the process of repair is proceeding slowly on account of ill-health, or of damage to the chief artery which supplies the bone with blood, or usually in consequence of the fact that the fractured limb is not kept sufficiently at rest. Or there may be actual failure of the healing process to take place. In the latter case the ends of the bone are thoroughly rubbed together under chloroform, and the fracture again set. If this produces no good effect, an operation is usually performed in order to remove any piece of muscle which may have got between the ends, or to fasten the ends with wire or with metal plates.

MALUNITED FRACTURES are those which have not been properly set, or in which displacement occurs after setting, so that the bone is twisted, or united with a neighbouring bone, as sometimes happens after fracture of the forearm, or is enlarged and shortened, or does not unite by bone, but forms what is known as a 'false-joint'. Sometimes malunion is unavoidable, owing to spasm of muscles or to production of an excessive amount of new bone.

Causes.—Certain causes render some persons more liable than others to fracture of bones. Of these far the most important is old age. The bones decrease in thickness after middle age, the fibrous tissue composing them becomes less resilient, and there is an increase of the merely earthy part—facts which all tend to produce increasing brittleness. In old age, a fall upon a hard surface, even a moderate strain like that of jumping off a moving vehicle, is apt to be followed by a fracture. Locomotor ataxia, rickets, tuberculosis of bones, osteomalacia, and malignant disease all render the bones more easily broken. Apart from these causes, fractures are due to force, which may be applied in three ways.

DIRECT VIOLENCE, as, for example, the blow of a hammer or crush of a wheel, may cause a fracture, and in such a case the fracture is apt to be a compound one, or attended by serious complications, such as damage to the brain where the skull is fractured, or to the lungs in fracture of the ribs.

INDIRECT VIOLENCE is the most common cause. In this case the violence is applied at some distance from the seat of the fracture, and whether a fracture or a dislocation occurs depends upon the point which in the circumstances is weakest and exposed to most stress. Thus a fall on the palm of the hand may cause a Colles's fracture at the wrist, or dislocation of the shoulder, or fracture of the collar-bone, according to

the position of the arm. Similarly, a twist of the foot may cause fracture of the leg, as well as other injuries.

MUSCULAR ACTION in rare cases produces fracture. The most common example is fracture of the knee-cap, which may be snapped across the end of the thigh-bone in the sudden pull given to recover the balance after missing a step on a flight of stairs. Throwing a cricket ball has also been known to fracture the arm.

Symptoms and signs.— *Uselessness of the part* is the main symptom, if the fracture affects a limb. If the lower limb be affected, it is useless for support; if the upper limb, the part beyond the fracture cannot be raised. *Pain* is a variable sign. So long as the affected part remains at rest, it is generally slight; movement is, however, apt to be painful. In fracture of the ribs, the moderate movements of tranquil respiration are free from pain, while a deep breath or squeezing of the chest causes considerable pain. *The sound of a crack* is sometimes heard, or the sensation of something giving way may be experienced by the injured person at the moment of the accident, but this is not a reliable symptom, because it occurs also when a muscle or sinew is torn. *Deformity* is found at the site of fracture. There is *shortening* of the limb in consequence of contraction of the muscles which pass over the fracture. There is also *swelling*, partly owing to the overlapping of the ends of the bone, partly in consequence of the blood and lymph which are at once poured out from the torn vessels around the injury. *Unnatural mobility* is also found, the limb giving way at a point where it should be rigid. *Crepitus* or grating is the final and only certain sign of fracture, experienced when the ends are rubbed together. It should never be felt for except by skilled hands, since much damage can be done by the sharp broken ends of bone to surrounding structures.

Healing of fractures.—When the bone breaks, many vessels both in its substance and in the periosteum are torn, and accordingly a large clot of blood forms around the ends, between them, and for some distance up the inside of the bone. Later, great numbers of white corpuscles find their way into this clot, which becomes 'organised', blood-vessels and, later, fibrous tissue being formed in it (soft callus). Next lime-salts are gradually deposited in this fibrous tissue, which thus develops into bone (hard callus). In this process a thick ring of new bone forms round the broken ends, filling up all crevices, and when union is complete this thickening is again gradually absorbed, leaving the bone as it was before the injury. When the fragments have not been properly set, but allowed to remain overlapping, a considerable thickening remains, the ring of new bone being permanent for the sake of strength.

Treatment.—After the fracture has been recognised a certain amount of temporary treatment is advisable till the broken bone can be properly fixed in place by a surgeon, and in the following descriptions the temporary treatment will be given, short reference being made to the permanent treatment where it differs from the temporary.

A compound fracture is treated first of all as a wound (*see* WOUNDS) by cleansing and by dressings, and then as a simple fracture. It is particularly necessary that the skin around should be well cleansed, and the wound itself is often very dirty. A thorough washing and scrubbing of the wound, under an anæsthetic, is usually necessary, and some surgeons fasten the fragments with silver wire or plates.

For temporary treatment the splints, etc., may be applied above the clothes in the case of simple fractures, and little padding is then necessary. But, for a compound fracture, the limb must be exposed, the wound dressed, and then the splints have to be carefully padded. In the permanent treatment the limb is bared, and the splints padded with wool.

For permanent treatment, the fracture must first of all be 'reduced', *i.e.* the broken ends must be brought accurately together; then it must be 'set', *i.e.* the ends firmly fixed in good position; and finally it must be kept at rest, with attention to the patient's general health, till union has taken place. Reduction is effected usually by one person, who pulls gently and steadily upon that part of the limb beyond the fracture (extension), so as to overcome the shortening and bring the ends a little apart from

one another, in order to prevent grating, and so avoid pain. At the same time, a second person should steady the limb above the seat of fracture (counter-extension). This they maintain while a third person applies the necessary splints, bandages, etc. For keeping the bone in position, various devices, such as bandages, plaster, cradles, splints of wood, leather, or poroplastic felt, sand-bags, and extension by weight and pulley are adopted in different cases. Splints are generally made from strips of wood, about ¼-inch thick, but they may be improvised from bundles of

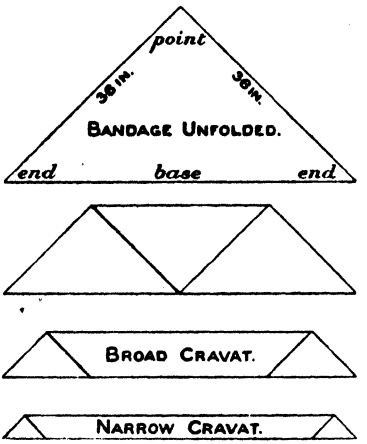

FIG. 222.—Triangular bandage. The narrow cravat is the form into which it is folded for fixing splints.

twigs, broom-handles, rifles, folded-up newspapers, and many other rigid articles. Care must be taken, especially in old people confined to bed for a fracture, that no bed sores form, and various tonics are often necessary. In the case of fracture of the lower limbs it is a general practice to keep the person in bed with the limb fixed by ordinary splints for two or three weeks, and then to apply a case of plaster of Paris to the whole limb, and allow the patient to get up and go about with crutches.

At the present day open fractures are treated by what is sometimes called the 'closed plaster technique'. The principles of this treatment are (1) excision of all dead tissue from the wound, (2) thorough cleansing of the wound, (3) drainage of the wound, (4) application of a sulphonamide powder to the wound, and (5) finally enclosure of the wound in a plaster-of-Paris case, thus ensuring complete rest to the injured tissues.

For bandages to fix splints one uses either a strip of calico bandage 3 inches wide, or an Esmarch's triangular-bandage folded narrow. The latter is a triangle made by cutting a yard of calico across from corner to corner (so as to form two pieces), and then doubling in the point of the triangle three times, so as to form a sort of flat cravat. (*See* BANDAGES.)

COLLAR-BONE.—This bone is apt to be fractured by falls on the hand, or by blows or falls on the point of the shoulder. As it supports the weight of the arm to a large extent, and gives squareness to the shoulder, when it is broken the shoulder droops downwards, forwards, and inwards towards the chest. On account of the shortness of the bone, splints are useless, and the deformity is remedied by bandages. These are applied in many different ways, of which the following is one of the simplest. A pad of cloth or wool, the size of the fist, is first placed high up in the armpit, and the elbow is bent so that the arm lies across the chest. An unfolded triangular bandage is then placed on the chest with one end over the sound shoulder, the base running down over the elbow of the injured arm, and the point of the bandage lying on the front of the chest. The other end, which is hanging down, is brought up behind the elbow of the injured arm, carried up across the back, and tied as tightly as possible to the first-mentioned end behind the neck. The point of the bandage hanging loose beneath the wrist is folded up round the wrist and pinned to the bandage above it. Finally, a triangular bandage, folded narrow, is carried round the chest and elbow of the injured arm and tied tightly, thus levering the shoulder outwards round the pad in the armpit. After this bandage is applied, there is a special necessity to feel that the pulse is not stopped by its tightness. Instead of this sling and narrow-folded bandage one may use a couple of narrow-folded bandages similarly applied with a pad.

The permanent treatment is usually carried out by a roller bandage applied in somewhat the same way, or by broad

strips of plaster, or by simply laying the patient flat on his back in bed, with a

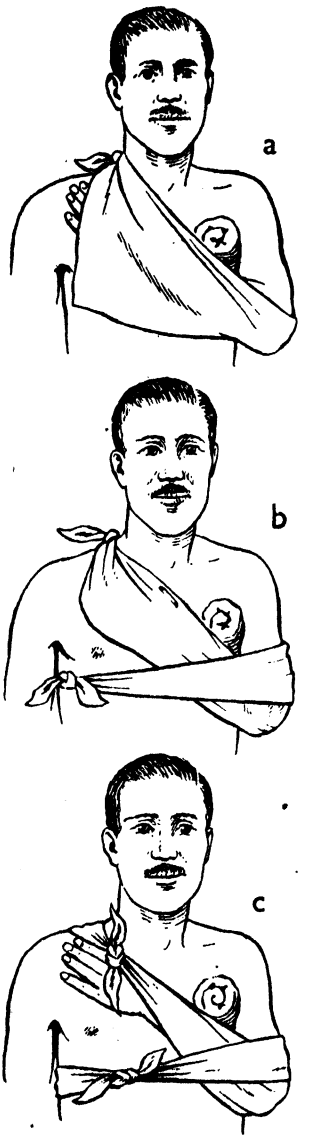

FIG. 223.—Treatment of fractured collar-bone. *a*, Sling applied; *b*, finished; *c*, second method with two triangles folded narrow.

pillow between the shoulders and the arm fixed to the side, so that the weight

FRACTURES

of the shoulder causes it to fall out and back into proper place..

The fractured bone is fairly strong in four weeks, though the arm has to be used with caution for some time.

UPPER ARM.—This fracture is usually due to a direct blow, and is easily recognised. For setting, two splints, 2 to 3 inches wide, and long enough to reach, the one from the armpit, the other from the shoulder, to beneath the elbow, are taken and well padded. The forearm being laid across the chest, one splint is applied to the front of, the other behind, the upper arm, and fixed

FIG. 224.—Treatment of fractured humerus, with two splints, two ties, and narrow sling.

by two ties, the first above, the second below, the site of fracture. A narrow sling is then applied to support the wrist.

This fracture takes six or eight weeks to mend. The permanent treatment is similar, and the elbow is often fixed by means of an L-shaped splint.

FRACTURES NEAR ELBOW.—These all cause great swelling as they implicate the joint more or less, and it is usually very difficult to recognise the precise nature of the injury. The temporary treatment of all is the same. An L-shaped, or rectangular, splint 3 inches wide, and resembling a mason's 'square', is used, one limb being long enough to reach from the tips of the fingers to the elbow, the other from the elbow to the armpit. It is fastened to the inside of the arm and forearm by one tie round the hand and round the

forearm, and one round the upper arm. A broad sling is applied to support the forearm.

FIG. 225.—Treatment of injuries near elbow, with L-shaped splint and two ties.

For permanent treatment, the same plan is very satisfactory and is often adopted. Sometimes the elbow is bent as far up as possible and tightly bandaged in this position. When the fracture consists in the chipping off of the olecranon process of the ulna, *i.e.* the point of the elbow, the fragment is drawn upwards by the triceps muscle, leaving a distinct gap behind the elbow, and, to correct this, the arm may be fixed up straight with a long splint down the front, and a complicated arrangement of adhesive plaster and elastic behind, in order to draw the fragment downwards.

When the swelling round the joint is great, the treatment is often commenced by applying an elastic webbing bandage for two or three days, from the hand up to beyond the elbow, in order to lessen the swelling.

All fractures round the joint are apt to cause some permanent stiffness, and in order to lessen the risk of this the splints are taken off every few days, and the joint is cautiously moved, in order to prevent adhesions forming.

FOREARM.—One or both bones may be broken by a blow or fall, and the condition is easily recognised. For treatment the forearm is laid across the chest with the thumb upwards. Two splints at least 4 inches wide, and long enough to reach from the elbow to beyond the tips of the fingers, are well padded (especially down the centre) and placed one behind and one in front of the forearm. The splints are fixed by one tie round the hand and wrist, and another above the fracture.

A rectangular splint, similar to that used for fractures about the elbow, is applied to prevent movement at this joint, though not absolutely essential in the temporary treatment, and finally a broad sling to support the forearm.

This fracture is put up for permanent treatment in precisely the same way. It takes about the same time to heal as a fracture in the upper arm. There is a danger that the movements of turning the hand palm up and palm down (pronation and supination) may be permanently interfered with by malposition of the bones, unless the fracture be very carefully set.

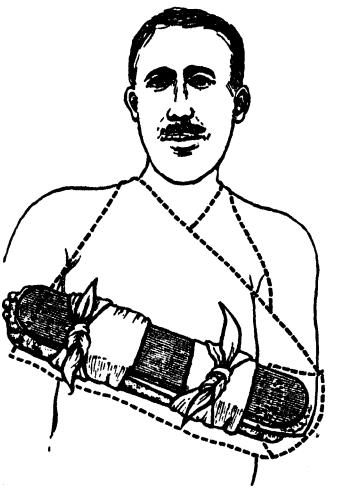

FIG. 226.—Treatment of fractured forearm, with two splints, two ties, and broad forearm sling.

WRIST.—Fracture of the radius close to the wrist, known as 'Colles's fracture', is a common result of a fall on the palm of the hand. The forearm and hand present a peculiar 'dinner-fork' bend, in consequence of the lower fragment turning upwards and backwards. The temporary treatment is similar to that for fractures of the forearm higher up. For permanent treatment, shorter splints coming only to the wrist are used, so that the hand may hang downward and by its weight remedy the distortion. Also the splint along the back of the forearm is specially padded at its lower end, that one running down the front of the forearm being specially padded in its upper two-thirds.

The danger of stiffness, after union has taken place, is even greater here than in fractures near the elbow, and is prevented by similar means.

HAND AND FINGERS.—A splint is laid along the palm reaching from the tips of the fingers to the elbow, and the hand and forearm are bandaged to it, or the fist is closed on a thick pad and tightly bandaged in this position. A sling is then applied. The fingers mend quickly.

THIGH.—In all fractures of the upper limb the person is usually allowed to go about while he is wearing the splints, but in all fractures of the lower limb he lies in bed. Fracture of the neck of the

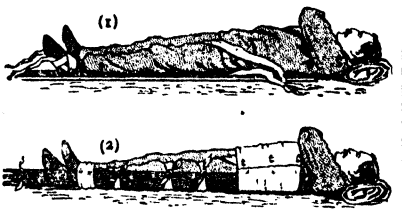

FIG. 227.—Treatment of fractured thigh with Liston's long splint. (1) shows ties by which extension is effected, the foot being secured first and the upper tie gradually tightened through two holes in the upper end of the splint. (2) shows arrangement complete.

FIG. 228.—Fractured thigh secured by means of a broom, and tying of legs together.

thigh-bone is a specially common accident in old people, following upon falls on stairs or ice, but in the young this strong bone is broken only by great violence. There are complete inability to move the limb, shortening amounting to 2 or 3 inches on comparison with the other limb, and rotation outwards of the foot. For treatment a long splint, reaching from the armpit down to below the foot, is laid along the side, and three shorter splints reaching from the groin to the knee may be laid, one in front, one on the inner side, and one behind the thigh, but are not essential for treatment. The long splint, if no regular splint be procurable, may be easily improvised from a broom-handle, plank, or rifle. These splints are fixed by the following ties. One broad band, for example a bolster case, round the chest, with or without a narrow-folded bandage round the hips; two ties round the thigh, one above and one below the fracture, fixing the short splints; two narrow ties round the leg below the knee. Finally, the feet are tied together.

For the permanent treatment a similar method is adopted, but, in addition, some means must be taken to counteract the great shortening produced by the powerful muscles of the thigh. Such measures are extension by a weight fixed with sticking-plaster and a bandage to the leg; or tying the foot down to notches in the lower end of the long splint, which is in turn prevented from sliding upwards by tying its upper end with a long band down to the fork. When the fracture is near the upper or lower end of the thigh-bone, it is sometimes necessary to use a splint which inclines upwards from the hip to the knee, so as to allow of bending at these joints. The fractured limb is often suspended in an inclined cradle. The thigh-bone takes ten or twelve or more weeks to heal, and, in old people, complete bony union often does not take place, so that permanent lameness may result. In old people, also, the confinement to bed for several months, with the old person lying on his back, is apt to bring on bronchitis and congestion of the lungs, and the attempt to unite the bone must often be abandoned as dangerous to life. (*See* LUNGS, DISEASES OF.)

KNEE-CAP.—This bone is seldom fractured. A long splint is laid along the back of the limb and fixed by ties to thigh and leg. The fragments of the

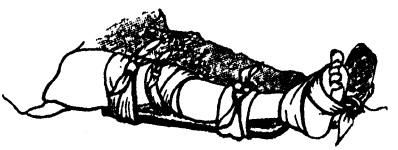

FIG. 229.—Treatment of injuries about the knee, with splint and three ties.

knee-cap may be fixed together by a bandage passing round above the knee-cap, crossing behind the joint, and then passing round below the knee-cap.

It is extremely difficult to get good bony union, and for the permanent treatment most surgeons prefer to cut

in to the fracture and unite the fragments with silver wire.

LEG.—There is particular need for care in the handling of this fracture, because the tibia, or shin-bone, which lies in its whole length just beneath the skin, usually breaks with a sharp-pointed end, like a pen-nib, that is very readily pushed through the skin, thus making the fracture compound. Two splints, about 4 inches wide, and long enough to reach from a few inches above the knee to beyond the foot, are carefully padded, above and below the knee-joint, and above and below the ankle-joint, so as to prevent them from pressing upon the skin where the bone

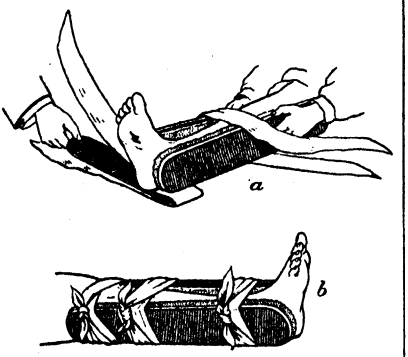

FIG. 230.—Treatment of fracture of the leg, with two splints and three ties; the two limbs are afterwards tied together, as in Fig. 229. *a*, Shows the method of pushing through the ties so as not to jerk the limb. A second pair of hands should be shown applying extension to the foot, but for clearness are omitted. *b*, Shows setting finished.

lies just beneath. They are applied one along the outer, one along the inner side of the leg, and fixed with two ties, one above and one below the fracture. A third tie is applied above the knee to fix this joint, and the feet are finally tied together.

For permanent treatment the splints are generally rolled in a sheet, so as to be joined behind the leg by a piece of sheet 4 inches wide. The leg thus lies in a kind of trough, which is further padded beneath the heel, and the foot is bandaged to it so that the toes point straight up. The leg is then laid on a pillow to bend the knee slightly and relax the calf muscles. Various special splints are also used, especially Cline's outer and inner splints, which are hollowed out for the leg, to which they are

tightly bandaged, the outer one also possessing a foot-piece, which serves to keep the limb from twisting. Macintyre's splint is a shaped metal splint with foot-piece which is also frequently used. This fracture takes eight to ten weeks to mend.

Fracture of the fibula, the slender bone on the outer side of the leg, may take place in consequence of a kick or twist of the foot, while the tibia is uninjured. The person may then be quite able to walk, though with considerable pain. Such an injury is frequently mistaken for a sprained ankle. The temporary treatment should be the same as for fracture of both bones, and the permanent treatment is very similar. This injury is known as a 'Pott's fracture', and is often accompanied by a considerable tearing of the ligaments on the inner side of the ankle-joint when it has been caused by a twist of the foot outwards.

FOOT.—The foot when fractured is put up in splints similar to those for the leg.

PELVIS.—The bones of the pelvis are broken only by excessive violence, such as a crush from the wheel of a heavily laden cart, a fall of coal in a mine, and the like. For temporary treatment, the injured person should have a broad binder fastened round the hips and be lifted on a rug or shutter. The seriousness depends upon the extent of damage done to internal organs.

RIBS are very commonly fractured by a blow or kick on the side. If only one or two be broken and the fracture be simple and uncomplicated, the accident is comparatively trivial. All that is necessary for treatment is that the movements of the chest in breathing should be restricted by a broad bandage, or by strips of sticking-plaster round the chest. The ribs heal very quickly, those above and below the broken ribs acting as splints. If the injured person spits up blood after the injury the condition is serious, this being a sign that the broken ribs have pierced the pleura and wounded the lung.

SPINAL COLUMN.—This is fractured only by great violence. Mere damage to the bone in this case also is not necessarily serious, but, as the spinal cord is often damaged in the act of fracture, or is pressed upon by a displaced fragment,

the accident may be a very serious one, the usual result being paralysis of

FIG. 231.—Fracture of the spinal column, causing injury to the cord. (Miller's *Surgery*.)

the parts of the body below the level of the injury. Therefore the higher up the spine is fractured, the more serious the consequences. The injured person should not be moved till medical assistance is at hand, or, if he must be removed, this should be done upon a rigid shutter or door, not upon a canvas stretcher or rug, and there should be no lifting which necessitates bending of the back. In such an injury an operation designed to remove a displaced piece of bone and free the spinal cord from pressure is often necessary and successful in relieving the paralysis.

SKULL.—Simple fissured fractures and depressed fractures of the skull very often follow blows or falls on the head, and are not at all serious, as a rule, apart from the damage which may have been done to the brain at the same time.

Compound fractures are attended by risk of suppuration which may spread within the skull, and if the skull be extensively broken and depressed the operation of 'trephining' is often done in order to cleanse the wound thoroughly. Another risk of fracture is that some of the small arteries on the inner surface of the skull may be torn and may bleed, thus causing 'compression' of the brain. For this reason also the skull is often trephined. Thorough cleansing of the wound, and confinement to bed in a darkened room constitute the treatment.

JAW.—The lower jaw is frequently fractured by a blow on the face. There is generally bleeding from the mouth, the gum being torn. Also there are pain and grating sensations on chewing, and unevenness in the line of the teeth. The treatment is simple, the line of teeth in the upper jaw forming a splint, against which the lower jaw is bound,

FIG. 232.—Treatment of fractured jaw, with two triangular bandages folded narrow.

with the mouth closed. One bandage is passed below the chin and tied on the top of the head; another passes in front of the chin, and is tied on the back of the neck. The two are then prevented from slipping forward and backward respectively, by tying the one to the other on the crown of the head. The patient must be fed for two or three weeks with liquid food, *e.g.* eggs and milk, poured into the corner of the mouth from a feeding-cup with a spout.

NOSE.—The bridge of the nose may be fractured by a fall. The bleeding is copious, and should be arrested by the usual means. (*See* HÆMORRHAGE.) An operation may later be performed to restore the shape of the nose.

FRAMBŒSIA, known also as YAWS and PIAN, is a disease of the tropics, especially of Africa and the West Indies, affecting both white and black races. It consists in the appearance of small tumors covered with yellow crusts, scattered over the surface of the body.

Cause.—The disease is directly contagious from person to person, and the infection is probably also carried by

flies, and certainly by clothing and by the unclean huts of the natives. The direct cause is supposed to be a spirochæte, and the occurrence of the disease in a person of unhealthy constitution, or one who is suffering from another disease, such as syphilis or tuberculosis, renders the attack very much more serious.

Symptoms.—The disease does not appear for a fortnight or more after infection, and during this time fever, malaise, pains, and itching of the skin may come on. It begins as a scaly eruption about the body and legs, in which small lumps form, and grow till they reach a size even of several inches in diameter. The surface of these is covered by a yellow crust of dried-up secretion, and in unhealthy people the tumors may break down and produce deep ulcers. After a duration of weeks or months the tumors gradually shrink and disappear.

Treatment.—The important point in treatment is to place the person in healthy surroundings, and feed him well. Various medicines, of which iodide of potash and the salvarsan preparations are chief, are given to aid the absorption of the tumors. Sea-bathing is supposed to be highly advantageous.

FRECKLES, or SUMMER-SPOTS, are small yellow or brown spots which appear on the exposed parts of the body, *i.e.* face, neck, and hands, during hot or windy weather. They appear especially in people with delicate skin and red hair. They consist of small pigmented areas in the deeper part of the cuticle, which are stimulated to increased development by exposure.

Treatment.—They are best let alone, but it is said that they may be temporarily removed by painting the skin, night and morning, with a solution of perchloride of mercury (1 grain to an ounce of water) till signs of irritation appear.

FREMITUS (*fremitus*, a low noise) is the name given to a sensation which is communicated to the hand of an observer when it is laid upon the chest in certain diseases of the lungs and heart. Friction fremitus is a grating feeling communicated to the hand by the movements of lungs or heart when the membrane covering them is roughened, as in pleurisy or pericarditis. Vocal fremitus means the sensation felt by the hand when a person speaks; it is increased when the lung is more solid than usual. The 'thrills' felt over a heart affected by valvular disease are also varieties of fremitus.

FRENKEL'S EXERCISES are a series of movements of precision intended to be performed by patients suffering from difficulty of control of the muscles, with a view to regaining lost power of co-ordination. The exercises for the lower limbs of a patient confined to bed begin with such movements as those of raising the foot and carefully bringing it down upon a particular part of the edge of a padded board. At a later stage, the patient, supported if necessary under the armpits, practises walking along a broad strip painted on the floor, later still on a narrow strip, and afterwards tracing out marked patterns with the toes and placing the feet carefully as he walks on marked positions. Similar exercises are devised for re-establishing co-ordination of the muscles in the arms by such exercises as carefully inserting pegs into small holes in a board, picking up pins from a smooth surface and similar movements.

FREUD'S THEORY is the term applied to a theory that hysteria and allied diseases are due to a psychic injury or trauma, generally of a sexual nature, which did not produce an adequate reaction when it was received and therefore remains as a subconscious or 'affect memory' to trouble the patient's mind. As an extension of this theory Freud's treatment consists in encouraging the patient to tell everything that happens to be associated with trains of thought which lead up to this memory, thus securing a 'purging' of the mind from the original 'affect memory', which is the cause of the symptoms. This form of treatment is also called 'psycho-catharsis' or 'abreaction'. The general term, psycho-analysis, is applied, in the first place, to the *method* of helping the patient to recover buried memories by free association of thoughts. In the second place, the term is applied to the body of psychological knowledge and

theory accumulated and devised by Freud and his followers. The term psycho-analyst should be applied only to those who have had a strict Freudian training, not to anyone who happens to practise psychotherapy.

FRIAR'S BALSAM (*see* BALSAMS).

FRICTION is the name given either to the fremitus felt or to the grating noise heard when two rough surfaces of the body move over one another. It is specially obtained over the chest in cases of dry pleurisy.

FRIEDREICH'S ATAXIA is a hereditary disease resembling locomotor ataxia, and due to degenerative changes in nerve tracts and nerve cells of the spinal cord and the brain. It occurs usually in children, or at any rate before the twentieth year of life, and affects often several brothers and sisters. Its chief symptoms are unsteadiness of gait, with loss of the knee jerks, followed later by difficulties of speech, tremors of the hands, head, and eyes, deformity of the feet, and curvature of the spine. The sufferer gets gradually worse, but may live, more or less helpless, for twenty or thirty years.

FRÖHLICH'S SYNDROME is the name given to a combination of bodily changes typified by the Fat Boy in the *Pickwick Papers*: obesity, physical sluggishness, and retarded sexual development. The condition is the result of disturbed pituitary function.

FRONTAL BONE (*frons*, the forehead) is the bone which forms the forehead and protects the frontal lobes of the brain. Prior to birth the frontal bone consists of two halves, and this division may persist throughout life, a deep groove remaining down the centre of the forehead. Above each eye is a heavy ridge in the bone, most marked in men, and, behind this, in the substance of the bone, is a cavity on each side, the frontal sinus, which communicates with the nose. Catarrh in these cavities produces the frontal headache characteristic of a 'cold in the head', and suppuration may occur in them producing discharge from the nose. (*See* NOSE, DISEASES OF.) Suppuration may also be due, in rare cases, to the larvæ of flies, of which the eggs may have been incautiously snuffed up from flowers, and which develop in the frontal sinuses.

FROST-BITE results from the action of extreme cold upon parts of the body for some time. Parts may be frozen for a short time, as in surgical operations, without injury; but when considerable portions, such as a whole hand, are frozen for a lengthened period, and particularly when the circulation is allowed to return too suddenly, the more outlying portions like the fingers are very apt to die, and be separated from the living parts by gangrene.

Symptoms.—The condition is particularly apt to arise in persons addicted to the use of alcohol, whose blood-vessels have lost their proper 'tone', and in whose extremities circulation is sluggish. A part may, by long exposure, be so frozen that the circulation never returns in it, and in this case the part may simply shrivel up, turn black, and undergo dry gangrene without any inflammation. If, however, the freezing process has not been so severe, circulation becomes restored as the part thaws, the vessels in it become widely dilated, and the part in consequence swollen, red, and excessively painful. If this 'reaction' be not controlled, the result is a considerable inflammation in the part, which may go on to moist gangrene and consequent death of the part.

It is said that the greater the redness which appears in the part the poorer the chance of recovery.

Treatment.—The condition is, of course, preventible by keeping the outlying parts of the body, like hands and feet, carefully wrapped up when the cold is intense, and also by maintaining the circulation in full activity by not sitting down, and by avoiding alcohol. Supposing, however, that a part has been frozen, its recovery depends upon the extent to which the reaction is controlled. The person should be put in a cold room, the frozen parts rubbed with snow or immersed in moderately cold water, and all stimulants avoided unless the general condition be very feeble. If the reaction becomes excessive and the part very red, both this and the

pain may be lessened by raising the affected limb, the person reclining on his back. After a time gentle rubbing with the hand well oiled may be commenced, but the longer the part has been exposed to the cold the longer should be the time that is spent upon its restoration. Finally, when the circulation is restored, the part should be lightly wrapped in cotton-wool or other covering. If pain persists in the part much relief is obtained by dressing with a mixture of butter, charcoal, and camphor in equal parts.

The treatment of frost-bite which has resulted in gangrene is given under GANGRENE.

FRUCTOSE (*fructus*, fruit) is another name for levulose or fruit sugar, which is found along with glucose in most sweet fruits.

FRUIT.—In recent years fruit has become much more accessible and cheap all the year round as an article of diet. Almost all fresh fruits contain about 80 per cent of water, and the nutritive material, consisting chiefly of starch and sugar, does not exceed one-fifth of the fruit. The banana is the most nutritious of the fresh fruits, followed by grapes, plums, and apples. In addition to their food value, fruits contain vegetable acids, such as tartaric, citric, and malic acids, which have an agreeable flavour, a mildly laxative action, and are beneficial to the kidneys. Oranges, lemons, and grape-fruit are specially useful in this way. The importance of fruits lies in the fact that they are the chief source of vitamin C, especially the citrus fruits and black-currants. The odour and flavour of fruits, which depend upon volatile oils and ethereal bodies, render them an agreeable article of food and improve appetite and digestion.

Dried fruits, such as apples, figs, dates, prunes, and grapes (raisins), form a highly nutritious form of diet, containing 60 or 70 per cent of starch, gum, and sugar; thus dried dates, figs, or raisins are more nourishing than an equal weight of bread.

Nuts, which consist to the extent of one-half or more of vegetable fat, form a highly concentrated kind of nourishment, and if suitably prepared, for example, by roasting to render them more digestible, become of higher nourishing value than cheese, and may to a considerable extent act as substitutes for meat. The chestnut and the almond are the most generally valuable forms of nut.

FULLER'S EARTH is a grey powder free from all grittiness. It consists mainly of aluminium silicate; but differs from kaolin in containing traces of iron. It is a valuable dusting powder for tender, moist skins, such as those of infants.

FUMIGATION (*fumigo*, I smoke) is a means of disinfection by the vapour of powerful antiseptics. (*See* DISINFECTION.) The process is also employed for the absorption of some drugs, of which mercury is the chief. In the latter case the person to be treated sits in a bath cabinet, or in a tent made of a blanket fastened round his neck, and a few grains of calomel are vaporised from a hot metal plate placed over a lamp beneath the chair on which the person sits.

FUNCTIONAL DISEASES are disorders in which some organ or system does not act properly, although after death no change can be found to account for the condition. Thus functional paralysis may come on in a limb, though the nerves, brain, muscles, etc., may apparently be quite healthy. It is in the case of nervous diseases that so-called functional disorders most abound; thus mental disorders, such as hysteria, are purely functional, and epilepsy may also be so. The contrast to 'functional' disorder is 'organic' disease, in which some definite change, such as a tumor, or diseased heart-valve, or degeneration of heart-tissue, etc., is found to account for the symptoms of the case. The treatment of functional disease is more satisfactory now that medical psychology is becoming established on the sound foundation of observed fact.

FUNGOID TUMORS are ulcerating growths which sprout rapidly and have therefore a mushroom-like appearance.

FUNGUS-POISONING. — Several diseases are due to the growth of minute

fungi in the tissues of the body; for example, actinomycosis (caused by the ray-fungus), ringworm, and Madura-foot of India. As to the large fungi, though they grow in dead and decaying material, they do not infest the living body, but many of them contain a poisonous alkaloid known as 'muscarine', others a body called 'phallin', both of which are poisons when swallowed. The number of deadly fungi is much smaller than is generally supposed, the following being accounted those most capable in small quantities of causing death: *Amanita muscaria*, *Agaricus emeticus*, *Boletus luridus*, *Amanita viridis*, *Agaricus citrinus*, and *Agaricus vitrescens*.

However, as fungi rapidly decompose when uncooked; as harmless fungi often absorb decaying animal material unchanged; and as, at the best, they form a highly indigestible kind of food, consumption of these delicacies in large quantity may produce very unpleasant indigestion and serious diarrhœa in children and weak persons.

Symptoms.—Apart from indigestion, actual deadly poisoning is attended by three symptoms. There are, first of all, vomiting and purging from irritation of the stomach and bowels; then feebleness of the heart's action, due to the muscarine, producing pallor and faintness; and, finally, unconsciousness or delirium which may, in a few hours, end in death. Fungi, therefore, act as narcotico-irritant poisons.

Treatment.—The first thing is to give an emetic in order to remove the fragments of fungus from the stomach. (*See* EMETICS.) Stimulants should be given if the pulse be weak and the person faint. If the fungi have been eaten several hours already, a powerful purgative, such as a large dose of castor oil, should be given as well as an emetic. Finally, in all serious cases atropine should be administered, since it forms a direct antidote to muscarine.

FURFURACEOUS (*furfur*, bran) is a term applied to skin diseases which produce scaliness of the surface, resembling bran.

FURUNCLE (*furunculus*, a little thief) is another name for a boil. (*See* BOILS.)

GAIT is an important sign of health and disease. Children, as a rule, begin to walk between the ages of twelve and eighteen months, having learned to stand before the end of the first year. If a good-sized child shows no ability to make movements by this time, it is probably deficient in mind, and if the power of walking is not gained by the time the child is a year and a half old, it is probably the subject either of rickets, infantile paralysis, or a malformation of the hip-joint. (*See* RICKETS, PARALYSIS.)

Infantile paralysis may be checked, but the paralysed muscles never regain their power, and consequently various peculiarities of gait ensue, depending on the group of muscles paralysed. Thus the flat-footed, or club-footed, or steppage gait may appear, or a whole limb may be useless.

Lameness in later life may be due to flat-foot, when the spring of the foot is lost and the person walks with his toes turned out at right angles; or to the stiffness following disease of the knee-joint, when the limb is carried forward like a rigid bar; or to the stiffness following hip-joint disease, when the person walks in a lop-sided manner, alternately taking a long step with the sound limb and swinging the whole pelvis round with the lame leg, as well as bending over to one side.

In **hemiplegia,** or paralysis down one side of the body following apoplexy, the person drags the paralysed leg, and carries the paralysed side as if it were, so to speak, hung upon the healthy one. There is a tendency for this walk to improve gradually, the paralysed leg regaining power almost completely even when the arm remains very helpless and bent stiffly across the body.

Steppage, or heather-step gait, is a peculiarity visible in alcoholic neuritis, lead palsy, and other conditions where the muscles that raise the foot are weak and the toes in consequence droop. The person bends the knee and lifts the foot high, so that the toes may clear obstacles on the ground, much as a person steps in going through heather or long grass.

In **locomotor ataxia** the sensations derived from the lower limbs are blunted, and consequently the movements of the legs are uncertain and the heels planted on the ground with unnecessary force. When the person tries to turn or stands with the eyes shut he is apt to fall over. When he walks he feels for the ground with a stick or keeps his eyes constantly fixed upon it.

In **spastic paralysis** the limbs are moved with jerks. The foot first of all clings to the ground (the person being very apt to trip over small objects), and then leaves it with a spasmodic movement, being raised much higher than necessary.

In **trembling palsy,** or paralysis agitans, the movements are tremulous, and, as the person takes very short steps, he has the peculiarity of appearing constantly to fall forward, being, in advanced cases, unable to stop himself till he brings up against some object of which he can lay hold.

In **St. Vitus's dance** the walk is bizarre and jerky, the affected child often seeming to leave one leg a step behind him, and then, with a screwing movement on the other heel, go on again.

GALACTAGOGUES (γάλα, milk; ἄγω, I move) are drugs which increase the flow of milk in nursing women. The normal stimulus of an infant's lips is the most powerful agent in producing milk, and a mother who has little or no milk should nevertheless hold her infant to the breast. Good food and the hormone prolactin from the pituitary gland increase the quantity and improve the quality of milk.

GALACTOCELE is the term applied to a cyst-like swelling in the breast which forms as a result of obstruction in the milk-duct draining the swollen area.

GALACTOPHORITIS means inflammation of the milk-ducts of the breast.

GALBANUM is a gum resin derived from *Ferula galbaniflua* which is used in cough mixtures having an expectorant and stimulant action.

GALENICAL PREPARATIONS are preparations of drugs sanctioned by the pharmacopœia, the list of drugs and remedies published under government regulations. The term 'official' is more commonly used in the same sense;

'officinal' (*officina*, a shop) means drugs procurable in the ordinary shops.

GALL is another name for bile. (*See* BILE.)

GALL-BLADDER AND DUCTS, DISEASES OF.—The biliary vessels begin as minute passages scattered throughout the entire liver, and lying between its rows of cells, from which they collect the bile secreted by the

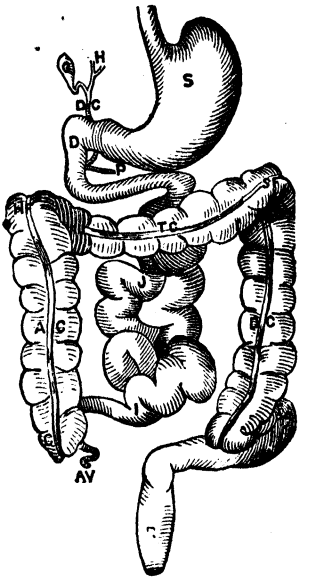

FIG. 233.—Diagram showing the connections of the biliary passages. *H*, The two hepatic ducts from the liver joining together; *G*, the gall-bladder, from which leads the cystic duct to *DC*, the common bile-duct. This opens, along with *P*, the pancreatic duct, into *D*, the duodenum. For other letters see INTESTINE. (Turner's *Anatomy*.)

latter. They unite into larger and larger vessels just as do the tributaries of a river, and finally a single, large hepatic duct emerges from the right lobe and another from the left lobe of the liver. (*See* LIVER.) The connection of these with the gall-bladder is somewhat complicated. The right and left ducts unite first into one vessel, the hepatic duct, which meets the cystic duct coming from the gall-bladder, and the two unite to form the common bile-duct, which opens into the small intestine a few inches below the outlet of the stomach. The importance of this arrangement lies in two facts: firstly, the entrance to the gall-bladder is a *cul-de-sac*, bile in entering it from the liver running down the hepatic and up the cystic duct; and, secondly, if the gall-bladder or its cystic duct becomes blocked up, the bile can still escape from the liver down the hepatic and common bile-ducts, into the bowel. The size and condition of the gall-bladder can be determined in many cases by X-ray examination. A substance which is opaque to X-rays, known as phenol-tetriodophthalein, is injected into a vein, and is quickly excreted in the bile and passed into the gall-bladder. If an X-ray photograph be taken several hours afterwards, the gall-bladder and any stones that it may contain, are seen outlined as a shadow in the plate.

CATARRH may occur in the bile passages as in other cavities lined by mucous membrane. It may either arise in the bile-ducts themselves, or may follow upon a catarrhal condition in the bowels, spreading up from the point where the common bile-duct opens into the small intestine. In the latter case the attack is an acute one, following upon some indiscretion of diet, such as an unusually heavy and rich dinner, or upon a chill. The form which begins in the small ducts in the liver, and spreads downwards, is usually chronic, and the course of the trouble is somewhat as follows. It arises particularly in persons who lead an indolent or sedentary life, and who eat too much for the small amount of exercise they take. The condition is therefore commoner in the wealthy, and four times more frequent in women than in men. It is also very often found in the insane, who take little exercise. Since the bile is expelled from the liver largely by the movements of breathing, any condition which impedes this causes stagnation of the bile, and favours catarrh. Pigments are deposited from the bile in the finer vessels, producing 'bile-sand', and thick, stringy mucus collects in these passages and in the gall-bladder, the irritation caused by these deposits still further aggravating the catarrh. Finally, this bile-sand may collect into small masses in the larger ducts or gall-bladder, and chemical changes in the mucus taking place, a crystalline substance called 'cholesterin' encrusts them in a gradually thickening layer, so that finally large 'gall-stones'

may be produced. In a number of cases the inflammation of the gall-bladder is produced by infection with a special streptococcus.

Symptoms.—An acute attack of catarrh causes, in general, pain and tenderness to touch beneath the margin of the ribs on the right side, *i.e.* over the edge of the liver and the gall-bladder. This may be followed by a certain degree of jaundice. (*See* JAUNDICE.) In chronic catarrh there is general ill-health and indigestion, associated with a dark, sallow skin, and occasional attacks of 'biliousness'. There is often, too, a vague uneasy feeling in the region mentioned above, and in advanced cases there may be recurring attacks of gall-stone colic.

Treatment.—The treatment of acute catarrh is given under JAUNDICE. The chronic form, though not of itself a severe ailment, should be treated because of its liability to produce gall-stones and because it impairs the general health. A simpler life, with not more than three meals daily, the avoidance of alcoholic beverages and highly spiced food, and the taking of more exercise together with the practice of deep breathing, are the main requisites. Horseback exercise is specially to be recommended, and regular breathing-exercises night and morning (*see* CHEST DEVELOPMENT) are also good. To cleanse the bile passages, large quantities of water should be taken with meals, and one or two tumblerfuls of warm water an hour before each meal are specially beneficial. An occasional visit to Vichy, Carlsbad, or other watering-place is advantageous for this purpose. The bowels must be carefully regulated, and great temporary benefit is derived from the occasional use of a powerful cholagogue purgative, such as a blue pill. (*See* CHOLAGOGUES.)

SUPPURATION is a rarer but much more serious condition, which occasionally appears in the course of a chronic catarrh. It may also arise as the result of an infective fever like enteric, and sometimes results from the irritation of an increasing gall-stone. Its symptoms are an exaggeration of those of catarrh along with shivering, high fever, and often delirium. The treatment necessary is an operation to drain the gall-bladder of its suppurating contents,

after which recovery often ensues, though the prospects are very serious.

GALL-STONES.—The manner of formation of these has been already described under catarrh of the bile passages. The smaller stones consist of a combination of bile-pigment with lime (bilirubin-calcium), and are deep brown in colour; the larger ones have a core of

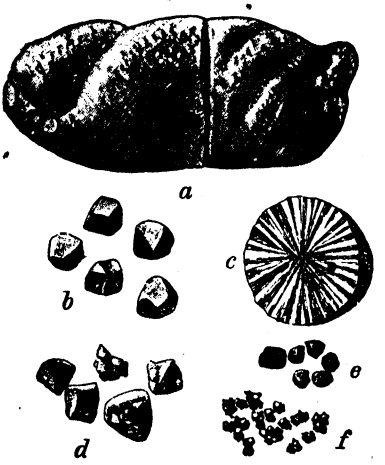

FIG. 234.—Gall-stones. *a*, *b*, *c*, Stones formed of cholesterin; *d*, composed of urates; *e*, formed of bile-pigment and cholesterin; *f*, stones of pigment and lime-salts. Three-fourths natural size. (Thoma's *Pathology*.)

this surrounded by cholesterin, and are lighter or even white in colour. The size varies from that of small gravel, in which case several hundred stones may be present, to the size of a goose egg, when the stone is single. When there are several stones, they are faceted so as to fit against one another.

Symptoms.—To begin with, there are the symptoms described under the heading of catarrh, which causes the formation of the stones. Apart from these, stones may lie for years in the gall-bladder and give no trouble, being found accidentally at an operation or after death. But as a rule they produce marked symptoms in one of three ways.

(1) The mere presence of stones in the gall-bladder may give rise to much irritation, and the tenderness and pain over the region of the gall-bladder then become very marked. These symptoms are specially liable to become aggravated during digestion, so that

the condition is taken for a form of dyspepsia, although the pain is at the right side of the body. When bacteria find an entrance from the bowel, high temperature, shiverings, and sweatings develop, and suppuration may come on.

(2) The usual way in which gall-stones show their presence is by passing out of the gall-bladder along with the bile. If the stone be small, it reaches the bowel and is voided, without attracting attention beyond perhaps passing discomfort in the upper part of the abdomen, after a meal. If the stone be large enough to stick in the cystic or common bile-duct, and particularly if it be angular, it sets up great spasm of the muscle fibres in the wall of the duct, causing the most agonising pain. This 'gall-stone colic' is felt beneath the rib margin on the right side, sometimes shooting up to the right shoulder. It comes on, as a rule, very quickly, and is accompanied by collapse, cold sweat, and vomiting. It lasts usually several hours, and often ceases quite suddenly, as the stone passes into the bowel or back to the gall-bladder. Next day there is usually some jaundice, which may last for a week or two. To discover if such an attack has really been due to a stone, it is important, for the next two days, to strain all the evacuations of the bowels carefully through a sieve or muslin.

(3) Sometimes the stone remains jammed or 'impacted' in one of the ducts, passing neither up nor down. In this case, the pain passes slowly off as the muscle fibres of the ducts become tired out, only to return again and again, till, in a milder degree, it becomes almost constant. Gradually increasing jaundice may develop till the skin becomes even a dark olive brown. At the same time loss of weight and strength, and often dropsy, progress so far that the case may be very difficult to diagnose from cancer. In this case, too, suppuration may come on.

Treatment.—To prevent gall-stones, what has been said as to catarrh holds good, and if the accompanying catarrh be cured, even after large gall-stones have been formed, they may be comparatively harmless. Many substances, which will dissolve gall-stones outside the body, have been recommended in the hope that, taken into the system for long periods, they may gradually dissolve the stones in the gall-bladder—for example, ether, turpentine, and olive oil, but they are of little use.

When an attack of gall-stone colic occurs, hot fomentations should be at once applied to the abdomen. Morphia (¼ grain) with or without atropine ($\frac{1}{150}$ grain) should be given hypodermically. If the pain be excessive, chloroform or ether may have to be given for the fifteen or twenty minutes that elapse before the morphia can take effect. A hot bath, into which the whole body can be put, gives, after a little time, great relief.

As to a surgical operation, if a person suffers from constant catarrh and repeated attacks of gall-stone colic, it is well that he should undergo the comparatively simple operation of having the gall-bladder opened, cleaned out, and drained, which may relieve both conditions. In cases where a gall-stone is impacted, an operation is certainly advisable, as the condition is a very serious one. Sometimes, as when the duct is permanently closed, a fistula follows upon operation, and the bile drains away permanently through a wound in the abdomen. In this case, the jaundice and colic at least are alleviated, and the fistula can be closed at a later operation by the surgeon, who makes an opening between the gall-bladder and adjacent bowel.

GALLIC ACID is an astringent substance prepared from tannin. It is used to check bleeding, particularly when this proceeds from the kidneys.

GALLS, or NUTGALL, is the name of an excrescence growing upon oaks and containing a large quantity of tannic acid which gives the galls a strongly astringent action. Galls are chiefly used in the form of ointment of galls and ointment of galls with opium for application to bleeding piles.

GALTON'S WHISTLE is a metallic whistle producing extremely high notes which is used in testing the sense of hearing.

GALVANISM (*see* ELECTRICITY IN MEDICINE).

GALVANOCAUTERY means cautery performed by a wire heated by a galvanic current.

GAMBOGE is a yellow gum-resin obtained from *Garcinia pedicellata*. It is a powerful irritant, and is used, in small doses, as a drastic purgative.

GAMGEE TISSUE is a surgical dressing composed of a thick layer of cotton-wool between two layers of absorbent gauze, introduced by the Birmingham surgeon, Sampson Gamgee.

GANGLION (γαγγλιον, a swelling) is a term used in two senses. In anatomy, it means a swelling upon the course of a nerve containing nerve-cells. In surgery, it means an enlargement of the sheath of a tendon containing fluid. The latter occurs particularly in connection with the sinews in front of, and behind, the wrist.

Causes.—The cause of these dilatations on the tendon-sheaths is either some irregular growth of the synovial membrane which lines them and secretes the fluid that lubricates their movements, or the forcing out of a small pouch of this membrane through the sheath in consequence of a strain. In either case a bag-like swelling forms, whose connection with the synovial sheath becomes cut off, so that synovial fluid collects in it and distends it more and more. In a few cases the production of the growth is begun by the tubercle bacillus.

Symptoms.—A soft, elastic, movable swelling forms, most often, on the back of the wrist. When noticed first it is perhaps the size of a pea, and its connection with a tendon can easily be made out. It may remain of this size for many years and occasion no trouble at all, but generally a ganglion gives a peculiar feeling of weakness to the wrist, and on account of its size or position it may be very inconvenient. A ganglion which forms in connection with the flexor tendons in front of the wrist sometimes attains a large size, and extends down the sinews to form another swelling in the palm of the hand.

If a ganglion be opened, its contents, in the shape of clear thick fluid, escape; often they are yellow in colour and contain bodies resembling melon-seeds made up of flakes of fibrin, which have become rolled up by the movements of the tendons. These occur most commonly in the ganglions found on the front of the wrist.

Treatment.—Sudden pressure with the thumbs may often burst a ganglion and disperse its contents beneath the skin, after which it should be prevented from refilling by bandaging the part tightly, a very efficient pad being made by wrapping up a large coin in a piece of lint. If it cannot be burst, counter-irritation by a blister or by painting the skin with iodine solution twice daily, followed by constant pressure with a strap or elastic bandage, will sometimes cause its gradual absorption. Such a strap also relieves the sense of weakness in the wrist which the ganglion causes. If this treatment be not successful, there only remains the opening of the ganglion, with scraping of its interior or injection of some irritating fluid to cause adhesion of the walls of the cavity. It is very apt to refill again unless this be done. In cases where a ganglion is tuberculous, the whole affected tendon sheath is carefully removed and all traces of the disease scraped away.

GANGRENE, or MORTIFICATION (γραίνω, I gnaw), means the death of a part of the body sufficiently large to be seen. When the process is slow and superficial, only microscopic parts dying in succession, the process is called 'ulceration', while the term 'necrosis' is usually restricted to the death of internal parts, particularly of bones. There are two varieties of gangrene, 'dry' and 'moist', dry gangrene being a process of mummification, in which, as a rule, the circulation simply stops, and the part, so to speak, withers up, while in moist gangrene there is inflammation accompanied by putrefactive changes. The dead part, when formed of soft tissues, is known as a 'slough', and, when part of a bone, is called a 'sequestrum'.

Causes.—Certain diseases which lessen the strength and vitality of the tissues throughout the body render them more liable to die when subjected to injury. Chief among these are Bright's disease and diabetes. Hard work with insufficient food devitalises the body in the same way. The nervous system, too, exerts an important influence over the nutrition and repair of the body, so that where it is diseased a very trifling injury may produce gan-

grene of the injured part; for example, in paralysis bed sores are apt to form, owing to the mere pressure of the body on the bed.

Direct injury is perhaps the commonest cause. If a limb be badly crushed, or frozen, or burned by heat or powerful chemicals, it may not recover.

Interference with the nutrition of a part by the gradual closure of the arteries, which may occur in old age; by their sudden closure in Raynaud's disease, or after the eating of diseased rye (*see* ERGOT POISONING); or by prolonged mechanical compression, may also cause it.

Infection by bacteria is another, and the most serious cause, though fortunately it is rare and seldom occurs save in people of very low vitality. The hospital gangrene, so much dreaded by surgeons fifty years ago, belonged to this type, but is now practically unknown, thanks to antiseptic surgery.

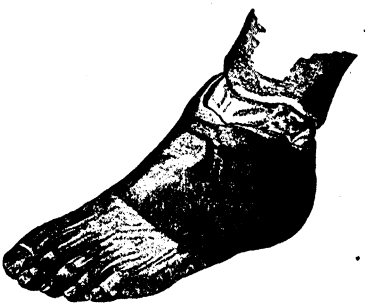

FIG. 235.—Dry gangrene due to frost-bite on the foot of a person aged twenty-five. The line of demarcation is well marked. (Thoma's *Pathology*.)

Symptoms.—DRY GANGRENE usually comes on in old people with diseased arteries, and is preceded by pain in the affected limb, which gradually becomes a dusky red colour and later brown and black. The line between the dead and living tissues is quite sharp (line of demarcation), and marked by a red ring, where a slight degree of inflammation is going on. There is some smell, especially if care be not taken to keep the foot or other affected part absolutely dry. There is little or no pain after gangrene has occurred, nor any fever, and the red ring gradually deepens till the gangrenous part drops off in the course of some months.

MOIST GANGRENE is the more common form, and is accompanied by putrefaction. The part becomes swollen, livid, and covered with blebs containing fluid later; it turns green and black in places. The smell is very offensive, and much fluid is effused from the decaying tissues, speedily soaking the dressings applied. There is not much pain, but the general symptoms are apt to be very serious, and there is then high fever. In the latter case the person may die of blood-poisoning, and in any case the 'line of demarcation' is not definite, and the gangrene is apt to extend up the limb.

GAS GANGRENE is a form which may occur when wounds are infected with soil from highly cultivated fields like those of Belgium. Gas-producing bacilli (*e.g. Bacillus Welchii* and Bacillus of malignant œdema) from the soil then grow with great rapidity in the wound, and the gas spreads along the spaces in the muscles and connective tissues. Some of these bacilli grow only in the absence of oxygen so that incisions to admit the air, together with application of oxidising agents, and use of gas-gangrene antitoxin, check their spread. In this form speedy amputation may be necessary. The war which began in September 1939 will provide an opportunity for testing the efficacy of sulphanilamide and sulphapyridine in the treatment of gas gangrene.

Treatment.—The dry form must be kept dry by wrapping in cotton-wool, and, when the line of demarcation has distinctly formed, amputation may be performed close above it. In the moist form, which is not spreading quickly, the surgeon also waits till he can see clearly how much is to become gangrenous, and an attempt is meanwhile made by cleansing the surface with boric acid or other antiseptic dressings, very frequently changed, to render the gangrene dry. In rapidly spreading cases, due for example to infection following upon diabetes, the amputation must be performed high up on the limb, so as to get well beyond the infected area. When small parts, like the fingers, become gangrenous after frost-bite, they may be treated by applying on lint some simple antiseptic

ointment, such as boric acid ointment, containing a small amount of eucalyptus or other volatile oil, to subdue the smell. (*See also* FROST-BITE.)

GARDENAL is another name for luminal, used in treating insomnia and epilepsy.

GARGLES and NOSE-WASHES (γαργαρίζω, I wash the throat).—Gargling is a process by which various substances in solution are brought in contact with the throat without being swallowed. The watery solutions used for the purpose are called gargles.

Varieties.—Gargles are used in many conditions, but fall, generally speaking, into three groups.

(1) Solvent gargles are used in cases where crusts form in the nose and throat, or where the mucous membrane of the cavities is covered with a layer of tough mucus which cannot be removed by coughing and hawking. The most commonly used substance for this purpose is chlorate of potash, in the strength of about 12 grains to a wineglassful of warm water. Singers use a gargle of one teaspoonful of common salt and one of baking soda to a tumblerful of water. Aromatic substances like thymol, or gaultheria, or myrrh can be added to these gargles. The following preparation is commonly used for a nose wash: Sodium bicarbonate 1 ounce, borax 1 ounce, sodium chloride 2 ounces; these substances are mixed and of the mixture one teaspoonful is added to half a pint of tepid water to make the nose-wash and used as required. For an aromatic gargle a frequently used formula is sodium bicarbonate 1 dram, compound thymol liquor 2 ounces, glycerin 2 ounces; a tablespoonful of this is added to a cup of warm water.

(2) Astringent gargles are used, generally with cold water, in cases where the throat is relaxed or slightly inflamed. Alum is the substance most frequently used (5 or 10 grains to each ounce of water).

(3) Antiseptic gargles are used in suppurative conditions of the throat, and in some cases of chronic tonsillitis with bad breath. Permanganate of potassium in faint pink solution is perhaps the most common. A useful gargle is boric acid, borax, and glycerin (of each one drachm), water (6 ounces), mixed with a little hot water before use.

Mode of use.—About a tablespoonful of the solution is taken into the mouth after the person has drawn a deep breath. The head is then tilted far back and a constant stream of bubbles is blown up through the fluid, so as to serve the double purpose of preventing it from running down the larynx and of sending fine drops in every direction about the throat. When the throat is much inflamed gargling is painful. The gargle is then allowed to pass back as far as possible into the throat and kept there as long as the breath can be held.

When the nose is to be washed out, a boat-douche or rubber ball-syringe may be used, or the fluid may simply be snuffed up from a cup or from the hollowed palm of the hand. The lotion must always be used lukewarm. A considerable amount of fluid should be used each time the nose is douched, and the fluids used as gargles may be employed, or those whose composition is given under NOSE, DISEASES OF. In douching, the boat or syringe should be held so as to plug up one nostril while the fluid runs in. The mouth at the same time should be kept wide open and the breath be drawn quickly backwards and forwards through it, so as to keep the soft palate raised and thus prevent fluid from running down the throat. The solution will then pass up one nostril and out of the other, or, if the second one be closed by pressure with the finger, the whole nasal cavity may be filled with the fluid. The nose is finally cleared by blowing down each nostril in turn, while the other is kept closed with the finger. Forcible syringing of the nose is to be avoided.

GAS (*see* ANÆSTHETICS, COAL-GAS, NITROUS OXIDE GAS, DAMP).

GAS-POISONING may be the result of working at some dangerous trade, as in the case of miners, or may result from accident as in escapes of coal-gas, or in many cases has resulted from discharges of chlorine or other gas by the enemy on the battlefield. The symptoms vary, but gases may be classed as those which paralyse nerve tissues, those which merely irritate the nose and

eyes, and those which cause inflammation of the bronchial tubes and stomach. The early effects gradually pass off, and, in cases which do not end fatally at the time of gassing, the final effects are not usually more than a slight amount of bronchitis or dyspepsia.

For treatment of gas-poisoning see COAL-GAS.

GASSERIAN GANGLION is an enlargement situated upon the sensory part of the fifth cranial nerve within the skull. In severe cases of facial neuralgia an operation is sometimes undertaken to cut the nerve at this point and remove the ganglion, so as to destroy the sensory portion of the nerve without affecting its motor part.

GASTRALGIA (γαστήρ, the stomach; ἄλγος, pain) means pain in the stomach. (*See* DYSPEPSIA.)

GASTRECTASIS (γαστήρ, the stomach; ἔκτασις, stretching) means dilatation of the stomach. (*See* DYSPEPSIA, STOMACH DISEASES.)

GASTRECTOMY (γαστήρ, the stomach; ἐκ, out; τέμνω, I cut) means an operation for removal of the whole or part of the stomach.

GASTRIC (γαστήρ, the stomach) means anything connected with the stomach, such as gastric ulcer, gastric catarrh.

GASTRIC FEVER is an old name for typhoid fever.

GASTRITIS means inflammation of the stomach. (*See* DYSPEPSIA.)

GASTROCNEMIUS (γαστροκνημία, the calf of the leg) is the large double muscle which forms the chief bulk of the calf, and ends below in the *tendo Achillis*.

GASTRO-ENTERITIS means inflammation of the stomach and intestines, an acute condition occurring most commonly in young children in summertime. Its main symptoms are vomiting, diarrhœa, and a general collapsed condition. (*See* DIARRHŒA.)

GASTRO-ENTEROSTOMY (γαστήρ, stomach; ἔντερον, intestine; στόμα, mouth) is an operation performed usually in order to relieve some obstruction to the outlet from the stomach, and consists in making one opening in the lower part of the stomach, another in a neighbouring loop of the small intestine, and stitching the two together.

GASTROPEXY (γαστήρ, stomach; πήγνυμι, I make fast) is a term applied to an operation by which the stomach is lifted up and stitched to the back of the abdominal wall for the relief of gastroptosis.

GASTROPTOSIS (γαστήρ, the stomach; πτῶσις, falling) means slipping down of the stomach from its attachments to the upper part of the abdomen. (*See* STOMACH DISEASES.)

GASTROSCOPE is an instrument for viewing the interior of the stomach, by means of a special arrangement of light and mirrors attached to a hollow tube, which is introduced into the stomach via the mouth and gullet. A special camera attachment also makes it possible to photograph the interior of the stomach.

GASTROSTOMY (γαστήρ, the stomach; στόμα, mouth) means an operation on the stomach by which, when the gullet is blocked by a tumor or other cause, an opening is made from the front of the abdomen into the stomach, so that fluid food can be passed into the organ.

GASTRORRHŒA (γαστήρ, stomach; ῥέω, I flow) means an excessive secretion of gastric juice.

GATHERING is a popular term applied to an abscess.

GAULTHERIA, or WINTERGREEN, is an American evergreen plant (*Gaultheria procumbens*) containing an oil with peculiar smell and aromatic taste. The oil consists almost entirely of salicylate of methyl. The action of this oil, taken internally, is almost the same as that of salicylic acid or salicylate of soda; but as the oil causes considerable irritation of the stomach, salicylate of soda is nowadays generally used instead. Externally, oil of wintergreen

is applied by rubbing to painful joints, in cases of acute and chronic rheumatism, often giving great relief.

GAVAGE means forced feeding by a soft rubber tube in cases when a person cannot swallow owing to weakness or other cause, or when an insane person refuses food. The tube, in the former case, is passed through the mouth into the stomach, and in the latter case a small tube is often simply passed through one nostril into the back of the throat, from which the person must automatically swallow food. By this means only liquid food, like strong soup, whipped eggs, or milk, can be administered.

GEL is the term applied to a colloid substance which is firm in consistence although it contains much water; *e.g.* ordinary gelatin.

GELATIN is the name applied to various albuminoid materials derived from animal tissues. It forms a colourless transparent substance hard and brittle when dried, and becoming jelly-like when moistened. It is much used both as a food and in pharmacy. Mixed with about two and a half times its weight of glycerin, it forms a soft substance used as the basis for many pastilles and suppositories. It is added to many fluid forms of food to give them a semi-solid consistence. Strong soups owe their nutritious character mainly to this substance.

Gelatin of zinc is a mixture of gelatin, glycerin and zinc oxide used after warming to pour over ulcers, which it protects after solidifying.

GELSEMIUM is the root of the yellow jasmine, *Gelsemium sempervirens*, a climbing plant of the Southern United States. Its action upon the body is to dull the central nervous system. Accordingly, in painful or spasmodic conditions, especially those associated with the head, such as neuralgia, headache, migraine, and eye-strain, it gives relief in small doses. It must be used with caution, because in larger doses it is a dangerous poison. It is generally used for neuralgia, etc., in the form of tincture of gelsemium combined with other drugs.

GENERAL PARALYSIS OF THE INSANE, also known as G.P.I., GENERAL PARALYSIS, GENERAL PARESIS, PARETIC DEMENTIA, DEMENTIA PARALYTICA, is a disease in which both bodily and mental powers degenerate; though in one case the bodily symptoms are for a time most marked, in another the mental change appears first.

Causes.—Although this disease is now regarded as being a late manifestation of syphilis, several factors are recognised as of great importance in at least predisposing persons to be affected by it. When a person dies in an advanced stage of the disease, certain very marked changes are found in the brain and its membranes. There is inflammatory thickening of the latter, and they are more or less adherent to the brain, in the superficial part of which the blood-vessels show various signs of chronic inflammation, while the proper brain tissue of nerve cells and fibres has to a great extent disappeared. The cells of the neuroglia or supporting tissue of the brain are found increased in size ('spider cells') and numbers, on microscopic examination. Degenerated bacteria resembling the diphtheria bacillus have been found in the tissues, and a certain amount of responsibility in the production of the disease has been assigned to these by some authorities. Among the predisposing factors to the disease are the following: The habitual abuse of alcohol is generally regarded as an important factor. First in importance comes syphilis, and as this is held to be the chief cause of tabes or locomotor ataxia, which sometimes precedes or occurs along with general paralysis, and is due to the same degenerative processes in the nervous system, a causal connection between syphilis and these two diseases is manifest. Some authorities attach importance to the use of a too highly nitrogenous diet, while head-injuries, sunstroke, great physical and mental strain, or various excesses, sometimes precede the onset of the disease, though it is doubtful if these do more than hasten its appearance in persons already liable. The disease is extremely rare in childhood (though it may be due to congenital syphilis) or among the aged, being commonest in the prime of life and among men.

GENERAL PARALYSIS

Symptoms come on very insidiously, as a rule, and the disease is often far advanced before it is recognised, though, on the other hand, it may now and then be ushered in by convulsive seizures, by a sudden maniacal attack, or by a rapid nervous breakdown.

The first stage is characterised by slight physical symptoms, which generally escape the notice of the affected person's friends. These are tremors of the tongue and facial muscles in speaking, transient paralysis of eye muscles producing slight squint and double vision for a time, stammering over difficult words like ' British Constitution ' or ' hippopotamus ', and, later on, increasing feebleness in walking and disinclination for exertion of all sorts. Furthermore, the handwriting degenerates greatly, and this is often the first symptom that excites remark. All these physical signs are apt to be masked by the peculiar state of mental exaltation which sometimes ushers in the disease. The person often feels himself to be stronger and better than usual, and is never tired of stating that he is ' all right ', or ' as strong as an elephant ', or that he ' could jump over a house '. But these are delusions, and, if he be actually put to the proof, his weakness is discovered. Often these delusions go further, and he believes himself to be very rich, or embarks upon great commercial schemes, or identifies himself with some well-known personality; but however grand his dreams be, there is in them an element of foolishness. Sometimes the first sign of the malady is a squandering of money on useless trifles; or foolish and criminal actions may be done which bring the incipient general paralytic into conflict with the law. In other cases the first mental symptoms consist of depression with delusions of poverty or of personal unfitness, the type of delusion being largely a matter of temperament. Great emotionalism is another feature, and the affected person is excited to tears by very little pathos, or to laughter with equal facility, while the memory at the same time fails greatly, and the patient gets notably absent-minded. Slight temporary attacks of feverishness also form a very constantly occurring symptom. Important early signs, which are discovered on examination, in addition to the mental excitement or mental enfeeblement, are diminished reaction of the pupil of the eye to light, and alteration of the knee-jerks and other reflexes.

In the second stage the physical weakness becomes more and more marked, and in accord with his passiveness the patient may at first become stout, though he loses this appearance as his digestive powers fail. The sight grows bad, the emotions, from being very facile, become dulled, and the affected person loses his power to feel pleasure or sorrow. Gradually, too, all his senses become blunted, and he loses feeling for actual physical pain, so that he is liable to get bruised and cut. The mind, too, becomes quite clouded, and unfit to sustain the simplest exercise.

In the third stage the mental failure is profound, and the sufferer cannot recognise even his nearest relatives. Speech degenerates to a series of meaningless noises. The paralysis becomes complete, and the person lies oblivious to all around him, and unable even to control his bladder and bowels. In this stage he becomes a ready prey to any infectious disease, and large bed sores form readily on the devitalised frame. If, by careful nursing, these be prevented, death gradually approaches and takes place from weakness.

The whole course of the disease lasts usually only two to three years, and, though occasional remissions take place, which may prolong life to ten years or more, a genuine case of general paralysis must be regarded as affording little ground for hope.

Treatment.—The first essential in treatment is to remove the person from the chance of indulging in those excesses which are often the cause of, and which certainly aggravate, the malady. The delusions generally render the person unfit to transact business, and even dangerous to his friends. For all these reasons, treatment is best carried out in an asylum, where care is taken that the person lives a well-regulated life, with sufficient exercise and suitable food. In the later stages, careful and skilled nursing is indispensable.

Recognition of general paralysis at a very early stage is of the greatest importance for two reasons. In the first place, the person suffering from an early

stage of this disease is liable through mental weakness to transact his business affairs badly and lose his means, although still regarded by his friends as merely slightly peculiar or eccentric. In the second place, treatment at this stage affords considerable prospect of stopping the progress of the disease. For the latter purpose a prolonged course of antisyphilitic treatment is essential until the blood and the fluid surrounding the central nervous system show no sign of the disease, as indicated by the Wassermann reaction and other tests.

It has been found that an acute infectious disease in the course of general paralysis is often beneficial. As this was thought to be due to the high fever, malaria was deliberately given to patients with G.P.I. and brought to an end with quinine. Good results have been obtained. Fever can also be induced by electrical methods.

GENETICS (γεννάω, I beget) is the science which deals with the origin of the characteristics of an individual or the study of heredity.

GENTIAN is the root of the yellow gentian (*Gentiana lutea*), a European plant. Preparations made from it are very bitter, and it is one of the most commonly used bitters in dyspepsia and loss of appetite.

GENTIAN VIOLET is a dye belonging to the rosaniline group. These dyes are derived from triphenyl methane. Gentian violet is a good superficial antiseptic. It is much used in the treatment of burns either alone or in conjunction with brilliant green and acriflavine. Applied to a burn gentian violet forms a tough pliable film. It is also given internally for the treatment of threadworms.

GENU VALGUM is the medical term for knock-knee.

GENU VARUM is the medical term for bow leg.

GERANIUM is the root of *Geranium maculatum*, and as it contains much tannic and gallic acid, infusions of the root in milk or water are used in the United States as an astringent in diarrhœa.

GERIATICS is that branch of medicine which treats of the disorders and diseases associated with old age.

GERMAN MEASLES is an acute infectious disease of a very mild type which resembles both measles and scarlatina, and which is known also by the following names—rubella, rœtheln, epidemic roseola, hybrid measles, and hybrid scarlet fever.

Cause. — It is highly infectious, though the cause of infection, whether of bacterial nature or otherwise, has not been discovered. Previous attacks of measles and scarlatina give no protection against it, and it frequently attacks adults. As the stage of incubation after infection is long, quarantine must also be long, and a child from an infected household must be isolated for about three weeks.

Symptoms are very mild, and the disease is not at all serious. On the day of onset there may be shivering, headache, slight catarrh with sneezing, coughing and sore throat, very slight fever, not above 100° Fahr., and at the same time the glands of the neck become enlarged. These symptoms are usually slight. Within 24 hours of the onset a pink, slightly raised eruption appears, first on the face or neck, then on the chest, and the second day spreads all over the body. The appearance of the rash is intermediate between that of measles and scarlatina, being less blotchy, and remaining more as minute pink spots than the rash of measles, and the spots being more definite than the fairly uniform redness of scarlatina. The rash is very bright on some parts of the body, while other parts are almost entirely free. The duration of the rash is variable. It may last for the greater part of a week, and, as it disappears, fine branlike scales separate from the surface. The most distinguishing feature of this disorder is a well-marked but transient enlargement of the glands in the neck.

Treatment. — The only treatment necessary is confinement to bed at first, and isolation from other children. The child may be considered free of infection when the scales have ceased to separate,

or in about ten days after the eruption has appeared.

GERMANIN, or BAYER 205, is the proprietary name of a drug that has been much used, and with success, in the treatment of trypanosomiasis. The *British Pharmacopœia* name for it is SURAMIN.

GERMS (*see* BACTERIOLOGY).

GESTATION (*gero*, I bear) is another name for pregnancy.

GIDDINESS (*see* VERTIGO).

GIN is an alcoholic beverage made from rye or barley with the addition of juniper berries and hops. It is useful as a diuretic in cases where the urine is scanty, and where no serious inflammation of the kidneys is present. Its habitual use is supposed to be particularly liable to cause cirrhosis of the liver. (*See* ALCOHOL, CIRRHOSIS.)

GINGER is the root of *Zingiber officinale*, a plant which grows in India, Jamaica, and other tropical countries. In the case of black ginger the bark is left on, while white ginger is the root minus bark. Its properties are due to a hot volatile oil and an aromatic resin. The tincture and syrup of ginger act like preparations of other volatile oils, and are given in doses of about a teaspoonful. They are used in cases of flatulence to stop griping, and are added to purgative medicines for the same purpose. Strong tincture, or essence of ginger, is used in doses of 5 to 10 minims.

GINGIVITIS (*gingivæ*, the gums) means inflammation of the gums. (*See* TEETH, DISEASES OF.)

GLANDERS (*glans*, an acorn), or EQUINIA, is a specific infectious disease to which certain animals, chiefly those possessing an undivided hoof—such as horses, asses, and mules—are liable, and communicable by them to man. The term 'farcy' is also used to designate a variety of the disease in which the lymphatic glands are first and chiefly affected.

Causes.—Glanders is happily a rare form of disease in man. It occurs chiefly among those who from their occupation are frequently in contact with horses, such as grooms, coachmen, cavalry soldiers, veterinary surgeons, etc., and seems always produced either by direct inoculation of the virus from a diseased animal into the broken skin, or by the respiration.

The direct cause of glanders is an organism, the *Bacillus mallei*, which was discovered in 1882 and has been demonstrated to be the cause by artificial production of the disease, through its means, in animals.

Symptoms.—After a period of incubation lasting from three to five days, the first symptoms are a general feeling of illness, accompanied with pains in the limbs and joints resembling those of acute rheumatism. If the disease has been introduced by means of an abraded surface, pain is felt at that point, and inflammatory swelling takes place there and extends along the neighbouring lymphatics. An ulcer is formed at the point of inoculation, which discharges an offensive fluid, and blebs appear in the inflamed skin, along with diffuse abscesses. Sometimes the disease stops short with these local manifestations, or over the whole surface of the body there appear numerous red spots or pustules, which break and discharge a thick purulent or sanguineous fluid. Besides these, there are larger swellings lying deeper in the subcutaneous tissue, which at first are extremely hard and painful, and to which the term farcy 'buds' or 'buttons' is applied. These ultimately open and become extensive sloughing ulcers. Similar changes may take place in the mucous membranes of the nose, mouth, throat, eyes, and bronchial tubes.

The general constitutional symptoms are then exceedingly severe. In the acute form of the disease recovery rarely occurs, and the case generally terminates fatally in a period varying from two or three days to as many weeks.

A chronic form of glanders and farcy is more common, in which the symptoms, although essentially the same as those above described, advance much more slowly, and are attended with relatively less constitutional disturbance. Cases of recovery from this form are on record; but, in general, the disease ultimately proves fatal by exhaustion of the patient, or by a sudden supervention, which is apt to occur, of the acute form.

Treatment.—In the treatment of this malady the main reliance is to be placed

on the maintenance of the patient's strength by strong nourishment and tonic remedies. The opening of abscesses antiseptically, as well as the use of antiseptic lotions for the affected mucous membranes, is recommended. In all cases of the outbreak of glanders it is of the utmost consequence to prevent the spread of the disease by the destruction of affected animals, and the cleansing and disinfection of infected localities. A preparation known as mallein is made from the bacilli causing the disease, which is used in animals for the purpose of diagnosis similarly to the use of tuberculin.

GLANDS are divisible into several classes. In the first place, the term is

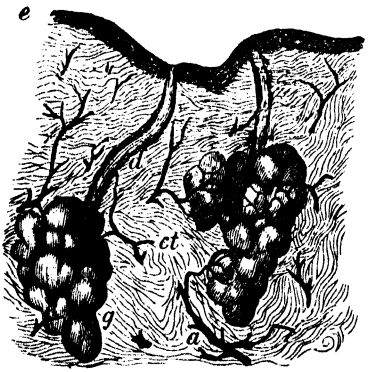

FIG. 236.—Section through the mucous membrane of the throat to show two of its mucous glands. *e*, Epithelium of surface; *ct*, connective tissue; *g*, gland; *d*, its duct; *a*, artery ending in capillaries round the gland. Magnified by 40. (Turner's *Anatomy*.)

applied vaguely to organs like the liver, pancreas, and kidneys, which produce a secretion; but in general the term is limited to smaller structures concerned in the production of some excretion from the body, or of some substance needful to its working. These latter are divided into two very distinct groups: (1) glands which produce some formless secretion or excretion; (2) lymphatic glands.

(1) SECRETING AND EXCRETING GLANDS comprise glands in almost all parts of the body, which vary much in appearance, in size, and in the character of the substances they produce. The skin, for example, is richly supplied with sebaceous glands, which secrete

an oily material, and with sweat glands, which are placed in rows whose openings can be seen with a weak magnifying lens upon the ridges of the palms and soles. The lining membrane of the stomach is made up of long tubular glands set as closely as possible side by side, and in these the gastric juice is formed. The structure of the mucous membrane in the intestine is much the same. In all these mucous membranes there are situated other glands, generally formed each of a small mass of twisted tubes, which secrete a clear shining fluid known as mucus, that gives to these membranes their soft, smooth appearance and their name. The glands so far mentioned are all of microscopic size, but there are many of large dimensions. The parotid gland, situated just in front of the ear; the submaxillary gland, which can be easily felt, of the size of a chestnut beneath the jaw; and the sublingual gland, which can be seen beneath the tongue, are occupied in producing saliva, and known as salivary glands. The breasts or mammary glands are a pair of large glands situated in the skin over the

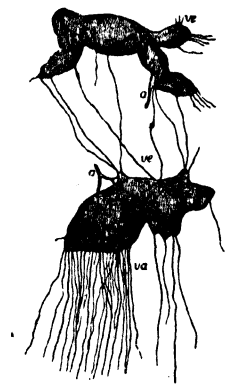

FIG. 237.—Cluster of lymphatic glands from the groin. *va*, Afferent vessels; *ve*, efferent vessels; *a,a*, small arteries. Two-thirds natural size. (Turner's *Anatomy*.)

front of the chest, and secrete milk. The thyroid gland, situated in front of the neck, has no outlet to the exterior, but produces a very important secretion which is absorbed by the blood and carried throughout the body. The suprarenal glands situated immediately above the kidneys act under similar conditions. Many of the glands also,

which have an outlet through which one secretion comes, such as the pancreas and testicles, seem to produce what is called an 'internal secretion' that is absorbed by the blood, and exerts a profound effect upon general nutrition.

Glands which produce an internal secretion are known as endocrine glands (*see* ENDOCRINE GLANDS).

(2) LYMPHATIC GLANDS are scattered all through the body in connection with the system of lymphatic vessels. They vary much in size, from that of microscopic masses to that of large beans,

FIG. 238.—Part of a lymphatic gland magnified. *ks*, Fibrous capsule, from which run in trabeculæ or bands *t,t*; *p,p*, passages for the lymph; *f,f*, collections of lymph corpuscles; *ve*, efferent vessel; *a*, artery. (Turner's *Anatomy*.)

but they have essentially the same structure everywhere. Round each gland is a fibrous tissue capsule, from which partitions and bands run into the gland to join one another and give it cohesion. In the meshes of these lie enormous numbers of lymph corpuscles, which ultimately form white corpuscles in the circulating blood. These corpuscles are arranged in masses round which the lymph circulates freely. Numbers of lymph-vessels (afferent vessels) pierce the capsule of the gland, and the lymph, after passing from them, percolates through the gland and leaves its central part, carrying with it many corpuscles, by a few larger lymph-vessels (efferent vessels). The vessels leaving one gland pass on to enter another, the glands being, as a rule, arranged in chains.

In the limbs the lymph-vessels pass from the foot and hand up to the knee and elbow respectively before they encounter glands. A few glands are situated in the bend of each of these joints, and the vessels passing from these reach large chains of glands in the groin and armpit respectively. The chains of glands beneath the jaw and down each side of the neck are known to every one from the frequency with which they become inflamed and swollen. Inside the abdomen small lymph vessels known as 'lacteals' collect certain parts of the food from the intestine, and pass their contents through 'mesenteric glands', situated deep in the abdominal cavity. Deep in the chest, too, lie many large

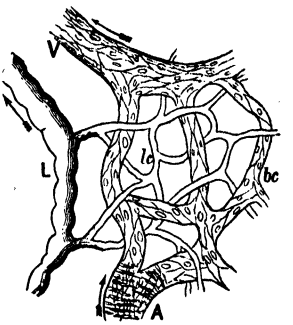

FIG. 239.—Diagram of the relation of the blood and lymph streams among the tissues. *A*, Small artery; *bc*, blood capillaries; *lc*, lymph capillaries; *V*, vein; *L*, lymphatic vessel; the arrows show the direction of the streams. (Turner's *Anatomy*.)

'bronchial glands', receiving lymphatics from the lungs. The lymph-vessels from the lower limbs and abdomen, after passing through numerous glands, unite into a single trunk, about the size of a quill, called the 'thoracic duct', which passes upwards through the chest, collecting the lymphatics of the chest, left arm, and left side of the neck, to open into the veins on the left side of the neck. A shorter lymphatic vessel collects the lymphatics from the right side of the chest, right arm, and right side of the neck, opening into the veins of the right side. The point where the lymphatic system on each side opens into the venous system is at or close to the point of union of the subclavian vein with the internal jugular vein. By means of these connections the lymph corpuscles formed in the glands may

reach the blood. Beyond forming these corpuscles, the glands have another function, acting as a species of filters upon the lymph circulation, and keeping back organisms and other dangerous impurities from entering the blood circulation.

GLANDS, DISEASES OF.—The diseases of the chief secreting glands are described under various headings, and reference is made here only to diseases of the lymphatic glands. Most of the diseases which affect these glands are of an inflammatory nature, various poisonous substances lodging in them in the attempt to pass through the system by way of the lymphatic vessels. (*See also* ENDOCRINE GLANDS.)

SIMPLE ENLARGEMENT AND SUPPURATION OF A GLAND is the commonest condition. This is generally the result of a wound or other source of infection in the area drained by the lymphatic vessels going to the gland. For example, any source of irritation about the head, such as lice or eczema, is apt to produce swelling of the glands behind the ear and down the neck; or a wound of the foot or hand to cause inflammation of the glands in the groin or armpit respectively.

Treatment.—The object at first is to prevent suppuration of the enlarged and inflamed gland. For this purpose the source of irritation must be removed by opening the gumboil, cleaning the head, dressing the wound of the foot, etc. The gland itself is best let entirely alone, or at most kept supported and at rest by a pad and flannel bandage. Later, as the inflammation subsides, various counter-irritants (*see* BLISTERS) may be applied to assist in its reduction to a natural size. If the swelling becomes soft and the skin over it reddened, suppuration is taking place, and the condition must be treated as an acute abscess. (*See* ABSCESS, ACUTE.)

GLANDULAR FEVER, or INFECTIOUS MONONUCLEOSIS, is an acute infection which occurs in little epidemics, especially in autumn, among children living in one household or at school together. The glands of the neck, especially of the left side, become, in the course of a day or two, much enlarged and tender, and at the same time there is fairly high fever, and the child loses all appetite for food. The infecting agent is not known. One of the characteristics of the disease is the presence in the blood of a large number of mononuclear, non-granular white cells. The child remains ill for about a week and then the glands slowly subside.

Treatment.—The child should, at first, be confined to bed, and as constipation is generally present a dose of castor oil may be given. For the rest, the neck should be kept warm and still by a flannel bandage and cotton-wool, but no further application is necessary, as the glands rarely suppurate. Tonics and careful feeding are necessary afterwards.

TUBERCULOUS GLANDS OR SCROFULA is a common disease of childhood, especially in the neck. It appears as if in many cases the glands become infected by the tubercle bacillus through the tonsils. The chain of glands under the jaw and that running up and down the neck become affected in most cases, while in others the glands inside the abdomen are diseased, producing the condition of wasting known as 'tabes mesenterica'. The condition progresses very slowly, as a rule, the glands enlarging for some months, then becoming matted together, to form an irregular mass, which softens, reddens here and there, and finally bursts through the skin to produce sinuses, which may go on discharging for years, healing finally with red, puckered, unsightly scars.

Treatment.—Tuberculous glands are often the result of infection with the bovine tubercle bacillus. Therefore, one of the most important preventive measures is to see that no child drinks raw milk but only milk that has been pasteurised. In the first stage, while the glands are simply enlarging, general treatment to improve the constitution is required. The child must stop attending school and should spend all his time in the open air; a change to the seaside being apparently of special benefit. (*See* CLIMATE.) The diet should be constructed upon the same principle as that for other tuberculous conditions. (*See* CONSUMPTION.) Various tonics, bitters, and aids to digestion are given, of which the chief are arsenic, syrup of the iodide of iron, cod-liver oil, and

malt extract. A bandage or other appliance is often used in order to keep the part where the enlarged glands are situated more effectually at rest. This form of treatment may be persevered with so long as the glands are not becoming matted together. When the latter change takes place it is usually best to have the whole mass removed by operation, after which healing is, in general, immediate, and a narrow, barely visible scar is left. When a chronic abscess has formed but has not burst, it is treated like a chronic abscess in other sites. (*See* ABSCESS, CHRONIC.) If suppuration be allowed to take place, and the abscess to burst of itself, it is almost impossible to avoid an unsightly scar. When this accident has occurred, and a discharging sinus is present, the best that can be done, in general, is for the surgeon to aid healing by scraping the sinus out and dressing it frequently in such a way that it may heal from the bottom. Treatment by heliotherapy or by ultra-violet rays is very valuable in all stages of this condition. (*See* LIGHT TREATMENT.)

CANCER, when it is present in any organ, sooner or later affects the neighbouring lymphatic glands. It is by way of the lymphatic system, indeed, that cancer usually spreads to parts at a distance, and glands in a part of the body far removed from the original cancer may become affected, while the intervening tissues remain healthy. This is the chief reason for the recurrence of cancer after apparently complete removal. As an example of this, it may be noted that the glands on the left side of the neck are very prone to be diseased as a result of cancer in the stomach; those in the armpit become affected early in cancer of the breast.

OTHER CONDITIONS which produce enlargement of glands are the venereal diseases, leucæmia, and a disease known as lymphadenoma, or Hodgkin's disease.

GLAUBER'S SALT, or SULPHATE OF SODA, is used as a saline purgative in doses of a quarter of an ounce to half an ounce, dissolved in a wineglassful of water.

GLAUCOMA (γλαυκός, greenish-grey) is a disease of the eye, occurring most commonly after the age of fifty years, in which the pressure within the eye rises and destroys the visual nerve fibres.

Causes.—The disease occurs in elderly people, particularly in those who possess small eyeballs, and it is said that an attack often follows upon great anxiety or sorrow. The manner in which it arises is as follows. It has been explained (*see* EYE) that a sharp angle exists all round the ring of junction between the iris and cornea, and in this angle the fluids of the eye filter out and into the blood-vessels situated in the neighbouring ciliary body. Sometimes in old age, owing to increasing size of the lens or to some inflammatory change in the eye, the iris becomes pushed forward at its outer margin against the cornea, and thus the angle where filtration occurs is shut up. Accordingly fluid collects in the hinder part of the ball, and the pressure inside the eyeball rises, causing damage, especially to the optic nerve fibres.

Symptoms.—Very often glaucoma appears so slowly, and with so little pain, that the condition is far advanced before it attracts special attention, but sometimes a series of well-marked acute attacks gives warning that a serious condition is present and allows it to be averted or lessened by early treatment. An acute attack usually begins at night with great pain in one eye, shooting through one side of the head, and this pain may be so severe as to produce sickness and vomiting at first. In more prolonged cases coloured halos are seen round lamps and candles, and there are various other peculiarities of vision. The veins on the surface of the eye are distended, giving it a bloodshot appearance, and the pupil is often wide and oval in shape instead of small and round like that of the sound eye. The peculiar grey-green haze which gives the disease its name may or may not take the place of the absolute blackness shown by the healthy pupil. When the eye is closely examined by a specialist, the tension of the ball is found to be increased, so that the eye is harder than usual; the anterior chamber lying between iris and cornea is shallow, and both the latter appear hazy; the field of vision is much restricted; and on examination with the ophthalmoscope the optic disc is found to be deeply indented or 'cupped'

if the disease has been present any length of time. The severe pain may last for two or three days, gradually decreasing, but if the condition be not recognised and treated, it reappears in a few weeks. Attacks become more and more frequent as time goes on, and the vision gets steadily worse. In chronic glaucoma the eye becomes gradually blind without these acute attacks.

Treatment. — Prior to 1857 the disease was incurable, but in this year von Graefe introduced the operation of iridectomy for glaucoma. This operation is performed by making an incision into the anterior chamber of the eye along the line where the cornea merges into the sclerotic, grasping the iris, and partly by cutting, partly by pulling, removing a segment of it, so as to free the angle of filtration at one point. A more modern operation is that of sclerotomy, in which a wide incision is made in the same situation as for iridectomy, or a small circle bored out of the sclerotic coat (trephining) but no part of the iris removed. The fluids in the eye can then filter out through the scar, and thus the pressure within the eyeball is lessened.

When the condition is very slowly progressing, or when, for any reason, operation is inadvisable, a solution containing 1 per cent or less of eserine is dropped into the eye night and morning, and since this drug powerfully contracts the pupil the iris is drawn away from the cornea and the angle between them opened up for filtration. This treatment may be continued daily for months or years.

GLEET means a chronic form of gonorrhœa.

GLENOID (γληνοειδής) is the term applied to the shallow socket on the shoulder-blade into which the humerus fits, forming the shoulder-joint.

GLIOMA (γλία, glue) is the name given to a tumor which forms in the brain or spinal cord, composed of neuroglia, which is the special connective tissue that in these organs supports the nerve-cells and nerve-fibres.

GLOBULIN is the term applied to a class of proteins which are insoluble in water and alcohol and soluble in weak salt solution.

GLOBUS is a term applied generally to any structures of ball shape, but especially to the sensation of a ball in the throat causing choking, which forms a common symptom of hysteria.

GLOMERULONEPHRITIS is the term applied to inflammation of the kidney that chiefly affects the glomeruli.

GLOMERULUS (*glomus*, a ball) is the term applied to a small knot of blood-vessels about the size of a sand grain, of which an immense number are found in the kidney, and from which the excretion of fluid out of the blood into the tubules of the kidney takes place.

GLONOIN (*see* NITRO-GLYCERIN).

GLOSSITIS (γλῶσσα, the tongue) means inflammation of the tongue.

GLOSSOPHARYNGEAL (γλῶσσα, the tongue; φάρυγξ, the throat) nerve is the ninth cranial nerve, which in the main is a sensory nerve, being the nerve of taste in the hinder third of the tongue and nerve of general sensation for the whole upper part of the throat and middle ear. It also supplies the parotid gland and one of the muscles on the side of the throat.

GLOTTIS (γλωττίς) is the narrow opening at the upper end of the larynx. (*See* AIR PASSAGES, CHOKING, LARYNX.)

GLUCONEOGENESIS means the formation of sugar from amino acids in the liver.

GLUCOSE is the form of sugar found in honey and in grapes and most other fruits. It is also the form of sugar circulating in the blood stream and the form into which all sugars and starches are converted in the small intestine before being absorbed. Glucose is a yellowish-white crystalline substance soluble in water and having the property of turning the ray of polarised light to the right. For patients unable to take food by the mouth on account of ulcer or other conditions of the stomach, glucose is administered in the form of an enema consisting of 5 per cent of glucose in normal saline fluid, or one ounce of glucose to the pint of water. The same fluid, when carefully

sterilised, may be injected by a hollow needle beneath the skin or directly into the veins, and is quickly absorbed. (*See* SUGARS, URINE.)

GLUCOSIDE. — A compound of a sugar and a non-sugar residue. Glucosides are widely distributed in the plant kingdom, and are crystalline, bitter, and sometimes poisonous. They include the saponins, the anthocyanin pigments that give the colour to flower petals, tannins, strophanthin, and digitalin. The aglucone or non-sugar part of digitalin has a structure closely similar to that of bile acid, vitamin D, and the sex hormones.

GLUTAMIC ACID is an amino-acid with the formula $C_3H_5(NH_2)(COOH)_2$. It has been used in the treatment of epilepsy.

GLUTEAL (*γλουτός*, buttock) is the name applied to the region of the buttock and the structures situated in it, such as the gluteal muscles, arteries, and nerves.

GLUTEN (*gluten*, glue) is the constituent of wheat-flour which forms an adhesive substance on addition of water, and therefore permits of the 'raising' of bread. It can be separated from the starch of flour, and being of a protein nature is used to make bread for those diabetics who are debarred from starchy and sugary foods.

GLYCERIN, or GLYCEROL, is an alcohol, $C_3H_8O_3$, which occurs naturally in combination with organic acids in the form of fats or triglycerides. It is a clear, colourless, thick liquid of sweet taste, obtained by decomposition and distillation of fats. It dissolves many substances, and it has a great power of absorbing water, in consequence of which, in the pure state, it diminishes congestion in surfaces with which it is brought in contact.

Uses.—Glycerin has many varied uses. Numerous substances, such as carbolic acid, tannic acid, alum, borax, boric acid, starch, are dissolved in it for application to the body. It is frequently applied along with other remedies to inflamed areas for its action in extracting fluid and thus diminishing inflammation.

Mixed with an equal quantity of water it forms a useful mouth-wash when the tongue and gums are furred or dry, and is useful for application to the skin in order to prevent chapping in cold weather, and to protect and heal all sorts of small abrasions.

Internally, pure glycerin in doses of 1 or 2 teaspoonfuls acts as a purgative, administered either by the mouth or as an injection. For its pleasant taste it is added to various medicines, and to the food of diabetics. It is mixed with gelatin to form a basis for pastilles, etc. (*See* GELATIN.)

GLYCERITE is a mixture of glycerin with a medicinal substance. The principal glycerites are those of alum, borax, boric acid (known as boroglycerin), gallic acid, subacetate of lead, carbolic acid, starch and tannic acid. These are used as applications especially to the mucous membrane of the mouth and throat for the action of the various medicinal substances contained.

GLYCEROL is another name for glycerin.

GLYCEROPHOSPHATES of lime, iron, etc., are compounds of glycerin and phosphates, supposed by some to be specially beneficial as tonics in debility, because glycerophosphoric acid is a constituent of nerve tissue.

GLYCO- (*γλυκύς*, sweet) is a prefix meaning of the nature of or containing sugar.

GLYCOGEN (*γλυκύς*, sweet; *γεννάω*, I beget), or ANIMAL STARCH, is a carbohydrate substance found specially in the liver as well as in other tissues. It is the form in which carbohydrates taken in the food are stored in the liver and muscles before they are converted into glucose as the needs of the system require.

GLYCOSIDE (*see* GLUCOSIDE).

GLYCOSURIA (*γλυκύς*, sweet; *οὐρέω*, I make water) means the presence of sugar in the urine in *Diabetes mellitus* (*see* DIABETES), and in some other states. It may occur, for example, after eating large quantities of fruit or sugar, after an attack of epilepsy, whooping-cough, or asthma,

during the course of exophthalmic goitre and other glandular diseases, and after severe nervous shock.

GOA POWDER (*see* CHRYSAROBIN).

GOITRE (*guttur*, the throat), also known as BRONCHOCELE or DERBYSHIRE NECK, is a term applied to a swelling on the front of the neck caused by an enlargement of the thyroid gland. This structure, which lies between the skin and the front of the windpipe, and which in health is not large enough to give rise to any external prominence, is liable to occasional variations in size, more especially in females, a temporary enlargement of the gland being not uncommon at the menstrual periods, as well as during pregnancy. The gland is liable to fluctuations in function as well as in size. When its functions are lessened, either by wasting of the gland (atrophy) or by failure of secretion in a gland either of ordinary size or in an enlarged state, the general name of hypothyroidism is applied; when the functions are increased, which may happen in a gland of ordinary size or more commonly accompanies certain types of enlargement, the name hyperthyroidism is given. Atrophic conditions of the gland are considered under the heading MYXŒDEMA. Here we shall consider conditions in which the gland is enlarged, although it must be noted that the symptoms depend not so much upon enlargement as upon the fact of whether the gland is acting sluggishly or in excess. Two main forms of enlargement are recognised, (*a*) *Simple goitre* and (*b*) *Exophthalmic goitre.*

SIMPLE GOITRE occasions a swelling which is well marked, and is not only unsightly, but may by its growth occasion much discomfort, and even give rise to serious symptoms from its pressure on the windpipe and other important parts in the neck.

Causes.—Simple goitre is a marked example of an endemic disease. There are few parts of the world where it is not found prevailing in certain localities, these being for the most part deep valleys in mountainous districts. For example, in Germany it occurs in the Black Forest, it is also found in Styria, in the Italian Alps, and, above all, is common in parts of Switzerland. In India it is common among the Himalayas, in China it affects the dwellers in various hill districts, and in England it is so frequent in the Peak district that the disease has received for one of its titles the name of Derbyshire neck. It is also very common in certain places far removed from the sea and supposed to have a deficiency of iodine in the soil, *e.g.* in the Middle States of America, especially Michigan. The widespread nature of the disease has naturally led to inquiry and speculation as to its origin. The most generally accepted view has been that which ascribes the malady to the use of drinking water impregnated with the salts of lime and magnesia, in which ingredients the water of goitrous districts appears often to abound. Although this view is supported by the fact that goitre has been much decreased in whole districts by the expedient of obtaining a new water supply, it would appear from various facts, such as that certain wells in districts are known to be goitre-producing, while neighbouring wells with apparently the same water are safe, or that the water is rendered innocuous by boiling—from such facts it appears that the cause is hardly so simple as formerly supposed. It has been recently suggested that it may be due to a micro-organism or other parasite infesting particular waters. It has also been suggested that want of sunlight, etc., combine with the effect of the drinking water in developing the disease. It is noteworthy that goitre can often be cured by removal from the district where it prevails, as also that it is apt to be acquired by previously healthy persons who settle in goitrous localities. It is only in such places that the disease shows any hereditary tendencies. It is noteworthy also that women are far more often affected than men.

Symptoms.—In districts where the disease prevails, the goitre usually appears in early life, often from the eighth to the twelfth year. Its growth is at first slow, but, after several years of comparative quiescence, a somewhat sudden increase occasionally occurs. In the earlier stages of the disease, the condition of the thyroid gland is simply an enlargement of the gland, which re-

tains its normal, soft consistence, and is distended by colloid material. But in the course of time other changes supervene, and the gland may become the seat of cystic formations, or acquire hardness from increase of fibrous tissue or calcareous deposits. Occasionally the enlargement of the gland is uniform, but more commonly one of the lobes, generally the right, is the larger. The growth is unattended by pain, and is compatible with ordinary health. Sometimes, when the goitre becomes large, the voice grows hoarse and toneless, but only when the gland becomes very large is there any interference with breathing or swallowing.

Treatment.—The first step is usually the removal of the person from the affected locality, and attention to general hygienic rules. In young persons a slight enlargement may simply show an increased demand of the system upon the functions of the thyroid gland, and this may be satisfied by administration of extract of sheep's thyroid, when the swelling subsides. The employment of burnt sponge as a cure for goitre was formerly much in vogue. The value of this remedy depended upon the iodine that it contained, and iodine and its preparations have been uniformly adopted as a remedy in this disease. Iodide of potassium appears to be one of the best modes of administration. The external application of iodine to the goitre has also proved of great use, and was a method of treatment adopted with success in India. Surgical treatment is necessary in certain cases, where a distinct tumor or large cyst occupies the gland, or where the gland causes pressure symptoms by its size or is considered unsightly. Removal of the whole thyroid, which is the seat of goitre, is, however, inadvisable, since it plunges the patient into the condition of myxœdema, and it is therefore usual for the surgeon to leave a small piece of the gland behind. (*See* MYXŒDEMA)

EXOPHTHALMIC GOITRE is the name applied to another form of enlargement of the thyroid gland, in which marked constitutional changes occur. In this disease, the goitre is one of several symptoms which form the most noticeable features of the disease, viz. extreme nervousness, muscular tremors, palpitation of the heart and throbbing of the great vessels, enlargement of the thyroid gland, and protrusion of the eyeballs. This group of symptoms is often known also by the names of Graves's disease, Parry's disease, and von Basedow's disease, in reference to the physicians by whom the disease was first recognised and described.

Causes.—The exact nature of exophthalmic goitre is still uncertain, but its symptoms are due either to an increase of the normal secretion of the thyroid gland, or, in other cases, to perversion in quality of this secretion. Many of the symptoms produced are due to the action of this secretion on the sympathetic nervous system, and a number of the symptoms are also caused by changes in the other endocrine glands related to the thyroid.

This type of goitre is not more common in the districts where simple goitre occurs than it is elsewhere. Women are more frequently affected than men, in the proportion of 6 to 1, or even higher. The age of onset is usually between sixteen and forty years, and, after the latter age, goitres already present tend to subside. The predisposition to the disease seems to occur in certain families, and cases which previously were slight are often greatly aggravated by fright or anxiety or mental strain, especially if these are combined with physical exertion, as in the case of soldiers. The general appearance of the disease, apart from the goitre, shows a great similarity to the characters of intense fear. Sometimes the disease first attracts attention after the patient has suffered from some infectious disease, or it may be preceded by anæmia, or by various nervous or hysterical manifestations.

Symptoms.—The first of the symptoms to appear are generally the nervousness and the palpitation of the heart, which is aggravated by the slightest exertion and may be very severe. The rate of the pulse is much increased, commonly to 120 per minute or more. An uncomfortable sensation of throbbing is felt throughout the body, and many of the larger blood-vessels are seen to pulsate strongly like the heart. There are marked tremors of the muscles and limbs, especially after any exertion. The enlargement of the thyroid gland

generally comes on gradually ; it rarely increases to any great size, thus differing from simple goitre.

Accompanying the goitre a remarkable change is observed in the appearance of the eyes, which attract attention by their prominence and by the fact that a space of the white of the eye is left exposed all round the iris (exophthalmos). A startled or frightened expression is thus given to the countenance. In extreme cases the eyes protrude from the sockets to such a degree that the eyelids cannot be closed, and injury may thus arise to the constantly exposed eyeballs. Apart from such risk, however, the vision is rarely affected in this disease. Much difference of opinion prevails as to the immediate cause of the protrusion of the eyes, but it is generally ascribed to the increase of the fatty tissue and distension of the blood-vessels of the orbits. The eyelids show a characteristic sign (von Graefe sign) by failing to descend along with the eyeball as the person glances downwards. It occasionally happens that in undoubted cases of the disease one or other of the above-named characteristic phenomena is absent, generally either the goitre or the exophthalmos. The palpitation of the heart is the most constant symptom. Sleeplessness, irritability, disorders of digestion, diarrhœa, uterine derangements, muscular tremors, and an unusual readiness to perspire freely are common accompaniments. All the bodily activities are carried on at high pressure, and there is consequent wasting of the fatty and muscular tissues with increasing thinness. If the basal metabolism be measured, this is found to be 50 or 100 per cent higher than it is in the normal individual.

Exophthalmic goitre is not often a directly fatal malady, but the nervousness, palpitation, and muscular weakness may render the patient unfit for even the slightest exertion. Heart failure and auricular fibrillation are grave risks. Partial improvement and relapses occur from time to time, especially after periods of rest, and, as age progresses, the goitre and the symptoms tend to abate and disappear. In some cases, the patient, in old age, passes into the opposite condition of myxœdema, the thyroid gland appearing to be completely worn out.

THYROTOXIC ADENOMA is a variety of exophthalmic goitre, in which a simple goitre containing one or more large hard nodules, which may have been present for some time, suddenly takes on the characters of exophthalmic goitre with the symptoms of this condition. The symptoms in such a case are, however, not so marked. Further, a simple goitre occasionally develops gradually into a case of exophthalmic goitre.

Treatment. — Many patients with slight symptoms recover when placed under conditions of rest and freedom from worry, these being the most important factors of treatment in every case. Iodine is helpful, especially for putting the patient into a suitable state for operation. Irradiation of the thyroid gland with X-rays will bring the disease under control for the time being. Another attempt at control is to ligate the arteries to the gland. Surgical treatment, by removal of varying proportions of the gland, is in suitable hands the most successful way of bringing the condition of hyperthyroidism under control. In 1943, however, a number of drugs were tried which hold out high promise of success. Patients suffering from extreme hyperthyroidism have been brought into a normal condition after taking thiourea or thiouracil. These drugs apparently interfere with the formation by the thyroid gland of its specific secretion, thyroxine. It is yet to be seen whether drugs will be able to replace operation in the treatment of this serious condition.

GOLD SALTS have been used to a considerable extent recently in medicine, especially in the treatment of tuberculosis and of chronic rheumatic disorders. Gold may be administered in various forms such as gold sodium thiosulphate; or may be used as one of many proprietary preparations including sanocrysin, myocrysin, solganal, crisalbine, etc. It is injected in minute doses either intramuscularly or intravenously, and produces a reaction in the affected tissues which leads to their scarring and healing. If gold is administered in too large quantities skin eruptions, albuminuria, metallic taste in the mouth, jaundice, and feverishness may be produced, so that it is necessary

to prolong a course of this remedy over many months in minute doses.

GOLDEN OINTMENT is another name for yellow oxide of mercury ointment, which is much used for inflammation of the eyelids.

GONAD is a gland which produces a gamete ; an ovary or a testis.

GONADOTROP(H)IC HORMONE is the hormone produced by the anterior lobe of the pituitary gland which acts upon the gonads (*i.e.* testes and ovaries), stimulating them to activity.

GONAGRA means an attack of gout affecting the knee. (*See* GOUT.)

GONORRHŒA is an inflammatory disease affecting especially the mucous membrane of the urethra in the male and that of the vagina in the female, but spreading also to other parts.

Causes.—The disease is directly contagious from another person already suffering in this manner, but occasionally it is conveyed by the discharge on sponges, towels, or clothing as well as by actual contact. The infecting agent is the gonococcus or *Diplococcus gonorrhœæ*. This is found in the discharge expressed from the urethra, which may be spread as a film on a glass slide, suitably stained, and examined under the microscope ; or a culture from the discharge may be made on certain bacteriological media and films from this similarly examined under the microscope. Since discharges resembling that of gonorrhœa accompany other forms of inflammation, the identification of the special organism is of great importance.

Symptoms.—These differ considerably according to whether the disease is in an acute or a chronic stage. In *men*, after an incubation period of between two and ten days, irritation in the urethra, scalding pain on passing water, and a viscid yellowish-white discharge appear; the glands in the groin often enlarge and may suppurate. The urine when passed is hazy and is often found to contain yellowish threads of pus visible to the eye. After some weeks, if the condition has become chronic, the discharge is clear and viscid, there may be irritation in passing urine, and various forms of inflammation in neighbouring organs may appear, the testicle, prostate gland, and bladder becoming affected. At a still later stage the inflammation of the urethra is apt to lead to gradual formation of fibrous tissue around this channel. This contracts and produces narrowing, so that the passage of water becomes difficult or may be stopped for a time altogether (the condition known as stricture). Inflammation of some of the joints is a common complication at this or an earlier stage, the knee, ankle, wrist, and elbow being the joints most frequently affected, and this form of ' rheumatism ' is very intractable and liable to lead to permanent stiffness. The fibrous tissues elsewhere may also develop inflammatory changes, causing lumbago, pain in the foot, etc. In occasional cases, during the acute stage, a general blood-poisoning results with inflammation of the heart-valves (endocarditis) and abscesses in various parts of the body. The infective matter occasionally is inoculated accidentally into the eye, producing a very severe form of conjunctivitis. In the newly born child this is known as *ophthalmia neonatorum* and is one of the chief causes of blindness. (*See* EYE DISEASES.)

In *women* the course and complications of the disease are somewhat different. It begins with a yellow vaginal discharge, pain on passing water, and very often inflammation or abscess of ' Bartholin's glands ' situated close to the opening. The chief seriousness, however, of the disease is due to the spread of inflammation to neighbouring organs, the uterus, Fallopian tubes, and ovaries, causing permanent destructive changes in these, and leading occasionally to peritonitis through the Fallopian tube, with a fatal result. Many cases of prolonged ill-health and sterility or recurring miscarriages are due to these changes.

Treatment.—In the acute stage the general regimen is of great importance. The patient should subsist on a low diet and avoid all kinds of sauces and condiments, as these have generally an irritating effect upon the inflamed urinary passages. Above all, alcohol in every form is prohibited. The patient should lead a quiet life during treatment, or, in the early stage, remain in bed, and should avoid violent forms of exercise

at a later period. Warm sitz baths are also beneficial. As regards internal remedies, in severe cases alkalies such as citrate of potassium, soothing substances such as belladonna and hyoscyamus, and urinary antiseptics such as sandalwood oil, copaiba, and hexamine are sometimes administered. The sulphonamide drugs have completely revolutionised the treatment of gonorrhœa. To begin with, sulphanilamide, then sulphapyridine, sulphathiazole, and sulphadiazine (in ascending order of merit) have successfully inactivated the gonococcus. Those patients who do not respond to this treatment—who are infected with sulphonamide-resistant strains of gonococcus—are now being cured with penicillin. As a rule some astringent and antiseptic substance is used locally in the form of a douche, though the manner and frequency of its application depend to a great extent upon the extent of the disease. Potassium permanganate in varying strengths from 1 part in 3000 to 1 in 1000 of water is one of the most frequently employed. Many other substances are also used, such as salts of mercury, salts of zinc, nitrate of silver, protargol, argyrol, etc. Vaccine treatment is in many cases adopted, a 'detoxicated' vaccine of gonococci being especially employed. The rheumatic joints are treated as in other forms of rheumatism, especially by applications of heat. Strictures are treated by dilatation with bougies, instruments of tapered shape resembling catheters. In severe cases it may be necessary to have the stricture dilated in this way every few months throughout many years. When cure of the discharge has apparently taken place, all treatment should be suspended for a few days and a careful bacteriological examination should be carried out before the patient can consider himself free of the disease.

GORSE EXTRACT.—An extract of gorse (*Ulex gallii*) has been made (1943) which has a specific action on the muscle of the uterus, causing it to contract.

GOSSYPIUM is the Latin word for cotton.

GOULARD'S WATER is the popular name for the dilute solution of subacetate of lead, which is extensively employed in the treatment of sprains, bruises, and localised inflammations. It is commonly mixed with laudanum in the proportion of 1 dram of laudanum to 1 ounce of the Goulard's water, and the mixture, known as 'lead and opium lotion', is applied on a piece of moist, warm flannel, and covered with waterproof cloth.

GOUT is a constitutional disorder connected with excess of uric acid in the blood, and manifesting itself by inflammation of joints with deposition therein of urate of soda, and also by morbid changes in various important organs.

The term gout, which was first used about the end of the thirteenth century, is derived through the French *goutte* from the Latin *gutta*, a drop, in allusion to the old pathological doctrine (which in the present case seems to be essentially the correct one) of the dropping of a morbid material from the blood within the joints. The disease was known and described by the ancient Greek physicians under various terms, which, however, appear to have been applied by them alike to rheumatism and gout. The general term *arthritis* (ἄρθρον, a joint) was employed when many joints were the seat of inflammation: while in those instances where the disease was limited to one part the name referred to such locality; hence *podagra* (from πούς, the foot, and ἄγρα, a seizure), *chiragra* (χείρ, the hand), *gonagra* (γόνυ, the knee), etc.

Chalk-stones have been found in the feet of Egyptian mummies. Hippocrates (460–375 B.C.) in his *Aphorisms* speaks of gout as occurring most commonly in spring and autumn, and mentions the fact that women are less liable to it than men. Celsus gives a similar account of the disease. Galen regarded gout as an unnatural accumulation of humours in a part, and the chalk-stones as the concretions of these, and he attributed the disease to over-indulgence and luxury. Gout is alluded to in the works of Ovid and Pliny, and Seneca, in his ninety-fifth epistle, mentions the prevalence of gout among the Roman ladies of his day as one of the results of their high living and debauchery. Lucian, in his *Trago-podagra*, gives an amusing account of the remedies used for the cure of gout.

Sydenham, the famous English

physician of the seventeenth century, wrote an important treatise on the subject, and his description of the gouty paroxysm, all the more vivid from his having himself been afflicted with the disease for thirty-four years, is still quoted by writers as the most graphic and exhaustive account of the symptoms of gout. Garrod, one of the most eminent recent authorities on gout, adopted a division into *regular gout*, which affects the joints alone, and is either acute or chronic, and *irregular gout*, affecting non-articular tissues, or disturbing the functions of various organs.

Causes.—Most authorities agree in connecting gout closely with an altered state of the blood, more particularly with the presence of an excessive amount of uric acid, and its subsequent deposition in the joints in the form of urate of soda. Uric acid is formed in the system in the processes of nutrition, and is excreted by the kidneys, the amount passing off in the urine being estimated at about 8 grains daily. In the healthy human subject the blood contains at most a mere trace of this acid; but in gout it may be detected in abundance in the blood-serum, both prior to and during the acute attack, while in chronic gout it becomes a constant constituent of the blood and of other fluids of the body, both natural and morbid. The gouty paroxysm appears to rid the system to a certain extent of the accumulated uric acid, although such relief is generally of but temporary duration.

Other theories with regard to the deposit of uric acid in the tissues have been advanced. Thus Ord in 1872 proposed the view that inflammatory changes in the affected parts are the primary cause of gout, and that the urate of soda is produced as the result of degeneration in these tissues, being purely an effect, not a cause, of the gout. Again, Ebstein in 1882 suggested that gout results from degenerative changes in the fibrous textures of the body, one of the effects of which is the deposition of urates in the affected parts, whence they pass into the blood. Duckworth's theory supposed that the waste products are not sufficiently broken down, but left in the form of uric acid.

The most important theory, since Garrod propounded his views, was advanced by Roberts in 1892, as the result of chemical investigations on uric acid and its compounds. He holds that

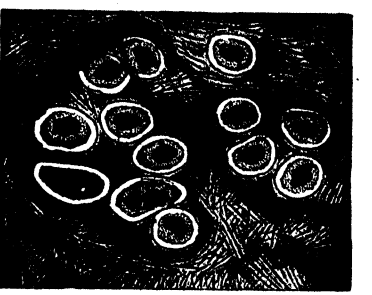

FIG. 240.—Deposit of sharp crystals of bi-urate of soda in the joint cartilage of the knee. The rounded structures are ordinary cartilage cells. Magnified by 600. (Thoma's *Pathology*.)

there are three compounds of uric acid. These compounds are the neutral urate of soda ($Na_2\bar{U}$), the bi-urate of soda ($NaH\bar{U}$), and the quadri-urate of soda ($H_2\bar{U}$, $NaH\bar{U}$). Of these, the neutral urate is never found in the body, while uric acid itself is only occasionally deposited in the urine. In health the quadri-urate circulates in the blood, and its elimination from the body proceeds with sufficient speed and completeness to prevent any undue retention. In the gouty state, however, either on account of defective action of the kidneys or from excessive introduction of urates into the circulation, the quadri-urate accumulates, and gradually uniting with the sodium carbonate of the blood is transformed into the much less soluble bi-urate, which accordingly is deposited in the tissues. This can be prevented by the presence of potassium or lithium salts in the blood, the bi-urate of these metals being much more soluble, and salts of these metals are accordingly much used as remedies.

It is beyond dispute that gout is in a marked degree hereditary, fully more than half the number of cases being, according to Scudamore and Garrod, of this character. But it is no less certain that there are habits and modes of life which may induce the disease even where no hereditary tendencies can be traced. Gout is said to affect the sedentary more readily than the active,

but this cannot be taken as a very constant rule. If, however, inadequate exercise be combined with a luxurious manner of living, with habitual over-indulgence in animal food and rich dishes, and especially in alcoholic beverages, then undoubtedly the chief factors in the production of the disease are present.

The stronger wines, such as port, sherry, and madeira, are much more potent in their gout-producing action than the lighter class of wines, such as hock, moselle, etc., while malt liquors are fully as hurtful as strong wines. The comparative absence of gout in countries where spirituous liquors are chiefly used, such as Scotland, is cited as showing their relatively slight effect in encouraging that disease; but it is to be noticed that in such countries there is on the whole a less marked tendency to excess in the other pleasures of the table, which, to an equal degree with alcohol, are chargeable with inducing the gouty habit. Gout is not a common disease among the poor and labouring classes, and, when it does occur, may often be connected even in them with errors in living.

Gout is more common in mature age than in the earlier years of life. It may occasionally affect very young persons, but such cases are generally in a marked degree hereditary. After middle life, gout rarely appears for the first time. Women are much less the subjects of gout than men, and it most frequently appears in them after the cessation of the menses. Persons exposed to the influence of lead-poisoning, such as plumbers, painters, etc., are apt to suffer from gout; and it would seem that impregnation of the system with this metal markedly interferes with the uric acid excreting function of the kidneys.

Attacks of gout are readily excited in those predisposed to the disease. Exposure to cold, disorders of digestion, fatigue, and irritation or injuries of particular joints will often precipitate the gouty paroxysm.

Symptoms.—An attack of gout may appear without warning, or there may be premonitory symptoms. Among the more common of these may be mentioned marked disorders of the digestive organs, with a feeble and capricious appetite, flatulence and pain after eating, uneasiness in the right side in the region of the liver, and irritation in the urinary organs. Various forms of nervous disturbance also present themselves in the form of general discomfort, extreme irritability of temper, and various perverted sensations, such as that of numbness and coldness in the limbs. These symptoms may persist for many days, and then undergo amelioration immediately before the paroxysm. On the night of the attack, the patient retires to rest apparently quite well, but about two or three o'clock in the morning is awakened by a painful feeling in the foot, most commonly in the ball of the great toe, but it may be in the instep or heel, or in the thumb. With the pain there often occurs a distinct shivering, followed by feverishness. The pain soon becomes of an agonising character; in the words of Sydenham, 'now it is a violent stretching and tearing of the ligaments, now it is a gnawing pain, and now a pressure and tightening; so exquisite and lively meanwhile is the part affected that it cannot bear the weight of the bed-clothes, nor the jar of a person walking in the room'.

When the affected part is examined it is found to be swollen and of a deep red hue. The skin is tense and glistening, and the surrounding veins are more or less distended. After a few hours there is a remission of the pain, slight perspiration takes place, and the patient may fall asleep. The pain, however, returns next night, and these nocturnal exacerbations occur with greater or less severity during the continuance of the attack, which generally lasts for a week or ten days. As the symptoms decline, the swelling and tenderness of the affected joint abate, but the skin over it pits on pressure for a time, and with this there is often associated slight desquamation of the cuticle. During the attacks the patient is restless and extremely irritable, and suffers from cramp in the limbs, and from dyspepsia, thirst, and constipation. The urine is scanty and high-coloured, with a copious deposit, consisting chiefly of urates. After the attack is over, the patient feels quite well, and fancies himself better than he had been for a long time before; hence the once-popular notion that a fit of

GOUT

the gout was capable of removing all other ailments. It is rare that the first is the only attack of gout, and another is apt to occur within a year, although by care and treatment it may be warded off. The disease, however, undoubtedly tends to take a firmer hold on the constitution and to return. In the earlier recurrences, the same joints as were formerly the seat of the gouty inflammation suffer again, but in the course of time others become implicated, until in advanced cases scarcely any articulation escapes, and the disease thus

FIG. 241.—Gouty hand. Large chalk-stones are seen in the thumb and fingers; over the first joint of the index finger is seen a small opening through which a chalk-stone has ulcerated.

becomes chronic. When gout assumes this form, the frequently recurring attacks are usually attended with less pain, but chalk-stones or 'tophi' are gradually formed round the affected joints. These deposits, which are highly characteristic of gout, at first take place in the form of a semi-fluid material, consisting for the most part of bi-urate of soda, which gradually becomes more dense, and ultimately quite hard. The extent of stiffness, which results from this, depends of course on the amount of the deposits. In some cases of chronic gout the deposit is so slight as to be barely appreciable externally, but on the other hand it occasionally causes great enlargement of the joints, and fixes them in a flexed or extended position which renders them entirely useless. Any of the joints may be thus affected, but most commonly those of the hands and feet. The deposits take place in other structures besides those of joints, such as along the course of tendons, underneath the skin and periosteum, in the sclerotic coat of the eye, and especially on the cartilages of the external ear. When bi-urate of soda is largely deposited in joints the skin sometimes gives way, and the concretion is exposed. Sir Thomas Watson quotes a case of this kind, where the patient when playing at cards was accustomed to chalk the score of the game upon the table with his gouty knuckles.

The recognition of what is termed irregular gout is less easy than that form above described. The diagnosis may often be made in cases where in an attack of ordinary gout the disease suddenly leaves the affected joints and some new series of symptoms arises. It has been often observed, when cold has been applied to an inflamed joint, that the pain and inflammation in the part ceased, but that some sudden and alarming seizure referable to the stomach, brain, heart, or lungs supervened. Further, the gouty nature of some long-continued internal, ophthalmic, or cutaneous disorder may be rendered apparent by its disappearance on the outbreak of the paroxysm in the joints. Gout, when of long standing, is often found associated with degenerative changes in the heart and large arteries, the liver, and especially the kidneys, which are apt to assume the granular contracted condition already alluded to as one of the forms of Bright's disease. (*See* BRIGHT'S DISEASE.) A variety of urinary calculus—the uric acid—formed by concretions of this substance in the kidneys is a not infrequent occurrence in connection with gout; hence the well-known association of this disease and gravel. (*See* ACIDITY, KIDNEY DISEASES.)

Treatment.—In the treatment of attacks of gout, the greatest variety of opinion and practice has prevailed, from the numerous quaint nostrums detailed by Lucian to the 'expectant'

or do-nothing system recommended by Sydenham. The usual plan of treatment is somewhat as follows: During the acute attack the affected part should be kept at perfect rest, and have applied to it warm opiate fomentations or poultices, or, what answers fully better, be enveloped in cotton-wool covered with oil-silk. The diet should be light, without animal food or stimulants. The use of some laxative, such as calomel (3–5 grains), followed by a saline purge, is of service, as well as the free administration of bicarbonate or acetate of potash. (*See* ALKALIES.) The medicinal agent upon which most reliance is placed is colchicum. This drug, believed to correspond with the hermodactyl of the ancients, was introduced as a remedy for gout over a century ago, and is so efficient that, in the words of Garrod, 'we may safely assert that colchicum possesses as specific a control over the gouty inflammation as cinchona barks or their alkaloids over intermittent fever'. The mode of action of colchicum is uncertain, but it is probable that it has simply a special sedative action upon the gouty inflammation without affecting the excretion of uric acid. It is usually administered as wine of colchicum (10–30 drops every four or six hours) or extract of colchicum in pill (½ to 1 grain).

When gout has become chronic certain drugs which increase the excretion of uric acid can be given; these are the salicylates, aspirin, and cincophen (also known under the terms 'atophan', 'agotan', 'phenoquin', and 'quinophan').

The diet and regimen to be employed in the intervals of the gouty attacks are of the highest importance. Restriction must be laid upon the amount and quality of the food, and still more upon the alcoholic stimulants. Regular but moderate exercise in the form of walking or riding, in the case of those who lead sedentary lives, is of great advantage, and all overwork, either physical or mental, should be avoided. The effect upon the gouty constitution of certain mineral waters and baths is well known, the alkaline waters being the favourite.

GRAFT is the term applied to a small piece of skin or other tissue removed from one person or animal and implanted in another or the same in order by its growth to remedy some defect. Skin grafts are the tissues most commonly used. If a large piece of skin is required for covering an old ulcer or wound, the operation of grafting is usually done in two stages, the piece of skin to be grafted being first raised from its bed but allowed to remain attached at one end so that it may be nourished by its own blood-vessels while it is establishing connections with the tissues of the gap which it is desired to fill. After one or two weeks the graft is cut away from its original position and firmly fixed in the new one. Bone grafts are also frequently used when it is desired to supply the place of bone which has been lost by disease, for example a portion of rib is sometimes removed in order to furnish support for a spine weakened by disease after the disease has been removed. Also the bone of young animals is frequently used to afford additional growth and strength to a limb bone which it has been necessary to remove in part on account of disease or injury. Portions of glands, such as the thyroid gland and testicle, are also sometimes grafted for the sake of obtaining the action of the substances they secrete. (*See* SKIN GRAFTING.)

GRAIN POISONING (*see* ACTINOMYCOSIS, ERGOT POISONING),

GRAM, or GRAMME, is the unit of weight in the metric system and is equal to a little over 15·4 grains. For purposes of weighing food, 30 grams are usually taken as approximately equal to 1 ounce.

GRAMICIDIN is the term given to an extract of a sporing Gram-positive bacillus, *B. brevis*, shown by Dubos in the U.S.A. to be highly bactericidal to staphylococci, pneumococci, and other Gram-positive disease-producing micro-organisms. The composition of gramicidin is as yet unknown and it cannot yet be produced on a commercial scale. But it seems as if it and penicillin will eventually prove to be of far-reaching importance in the treatment of disease.

GRAND MAL is the name applied to a convulsive epileptic attack, in con-

trast to 'petit mal', which includes the milder forms of epilepsy.

GRANULAR KIDNEY is the name given to the state of the kidney in chronic interstitial Bright's disease (*see* BRIGHT'S DISEASE), which often occurs in association with gout.

GRANULATIONS are small masses of formative cells containing loops of

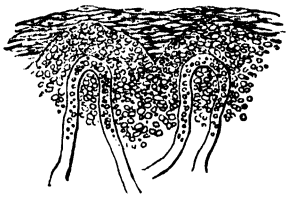

FIG. 242.—Section of an ulcer, showing two granulations. The capillary loops are surrounded by corpuscles, of which those next the surface are engaged in the formation of delicate fibrous tissue.

newly formed blood-vessels which spring up over any raw surface, as the first step in the process of healing of wounds. (*See* ULCER, WOUNDS.)

GRANULOMA is a term applied to a tumor or new growth made up of granulation tissues. This is caused by various forms of chronic inflammation, such as syphilis and tuberculosis.

GRAVEL is the name applied to any sediment which falls down in the urine, but particularly to small masses of uric acid. It produces various unpleasant symptoms. (*See* BLADDER DISEASES, URINE.)

GRAVES'S DISEASE is another name for exophthalmic goitre.

GRAVID means pregnant.

GREEN SICKNESS is a popular name for chlorosis. (*See* ANÆMIA.)

GREENSTICK FRACTURE is the term for describing any fracture of rickety bones, which break like green sticks.

GREGORY'S MIXTURE or POWDER is a powder of light-yellow colour containing rhubarb, magnesia, and ginger. In doses of 10 to 60 grains it is widely used as an antacid and purgative.

GREY POWDER is a powder composed of mercury and chalk, which is used for administration to young children in cases where the use of mercury seems desirable. It is much used as an ingredient of powders intended to check the infantile diarrhœa which results from conditions of fermentation within the bowels. To young children it is generally given in doses of 1 grain, or less if repeated.

GRINDELIA is an American plant used as an asthma cure. The leaves are generally used soaked in nitre, dried, and then either burned on a plate, from which the fumes are inhaled, or rolled in a cigarette and smoked.

GRINDER'S ROT is the term applied to a disease of the lung in steel-grinders caused by inhaling particles of the metal.

GRIPES is a popular name for the colic of infants, generally due to irregular feeding. (*See* COLIC.)

GRIPPE is a popular name for influenza. (*See* INFLUENZA.)

GROIN is the name applied to the region which includes the upper part of the front of the thigh and lower part of the abdomen. A deep groove runs obliquely across it, which corresponds to 'Poupart's ligament', and divides the thigh from the abdomen. The principal diseased conditions affecting this region are enlarged glands, or 'bubos' (*see* GLANDS), and hernia. (*See* HERNIA.)

GROWING PAINS occur in children during the course of development. They occur most commonly in the legs and back. It is now believed that growing pains are often a manifestation of rheumatism in children—they must therefore not be neglected. The pains are treated by ensuring that the child has a sufficiency of rest. Severe pains in young children are occasionally due to actual disease in a bone, either of tuberculous nature or caused by acute inflammation, and special attention is required in such cases.

GROWTH is a popular term applied to any new formation in any part of

the body. (*See* ANEURYSM, CANCER, CYST, GANGLION, TUMOR.) For growth of children, etc., see WEIGHT AND HEIGHT.

GRUEL is the name given to a thin paste or thick fluid made of oatmeal or maize meal and milk or water. Gruel is made by mixing 3 tablespoonfuls of meal with 1 pint of cold milk or water, allowing to stand for 15 minutes, then straining and boiling for 15 minutes, and finally flavouring with salt and, if desired, with sugar.

GUAIAC is a resin obtained from the wood of *Guaiacum officinale* or *Lignum vitæ*, a West Indian tree. It is largely used in rheumatism and in acute tonsillitis in the form either of the tincture or the ammoniated tincture of guaiac. These are generally taken in warm milk in doses of about a teaspoonful. Guaiac lozenges are very useful when sucked by persons suffering from commencing tonsillitis, and will often cut short a threatened attack of inflammation.

GUAIACOL is a light-coloured, yellowish fluid of pleasant smell, obtained from beechwood creosote, of which it forms 60 to 90 per cent. Its use is mainly restricted to the treatment of consumption, partly because it is supposed to stay the action of the poisons produced by the tubercle bacilli, partly because it reduces feverishness. It may be given in spirits or in cod-liver oil in doses of 1-15 drops, or it may be inhaled from a jug of hot water, but it seems to act most powerfully when painted on the skin and covered over with oil-silk to aid absorption.

Carbonate of guaiacol, a white, crystalline powder, has been used for the same purpose administered by the mouth.

GUINEA-WORM (*see* PARASITES).

GULLET, or ŒSOPHAGUS, is the tube down which food passes on its way from the throat to the stomach. It passes through the regions of the neck and chest, lying close in front of the spinal column, and its length is about 10 inches.

GUM is a complex viscid substance which exudes from the stems and branches of various trees, and consists principally of arabin or bassorin. The two best-known gums are gum acacia and gum tragacanth. Gum-resins such as asafœtida, galbanum, and myrrh also contain resin. For gum-saline see ACACIA.

GUMBOIL is a condition of inflammation, ending generally in abscess, situated about the root of a carious tooth.

Symptoms.—One tooth becomes a little painful and seems a little raised above the others, but the pain is at first relieved by clenching the teeth tightly, though after a day or more the affected tooth becomes extremely tender. A thickening forms at the side of the tooth, which is also at first relieved by pressure, as by holding a pad of cotton-wool, or a fig, or similar soft mass between gum and cheek. After some days the pain lessens, and either the swelling gradually subsides, or an abscess forms and bursts, generally between gum and cheek, but, it may be, on the cheek.

Treatment.—If there be any cavity in the tooth it should be stopped with cotton-wool soaked in pure carbolic acid, or in a volatile oil, such as oil of cloves, and, if the pain and swelling do not speedily abate, the tooth should be pulled. Relief to the inflammation in early stages is often gained by painting the gum freely with tincture of iodine. If the swelling be considerable, immediate relief is often gained when the gum is scarified down to the bone on the outer side between gum and cheek. If the skin is getting red over the swelling, this should be done as soon as possible, for, otherwise, the abscess is likely to burst through the cheek, leaving an unsightly scar.

GUMMA (*gummi*, gum) means a hard swelling situated usually in connective tissue, though it may be in internal organs, muscle, or brain, and resulting from syphilis. The swelling is usually painless, but it may produce very marked symptoms by interference with the organ in which it is situated. A gumma generally disappears speedily when its nature is recognised, and the treatment appropriate to syphilis administered.

GUMS, DISEASES OF (*see* MOUTH, DISEASES OF, *and* TEETH, DISEASES OF).

GUTTA-PERCHA is used in the preparation of some varieties of sticking-plaster, but its main use is, rolled out in thin films, known as gutta-percha tissue, to keep surgical dressings moist by preventing evaporation.

GYMNASTICS (*see* EXERCISE *and* CHEST DEVELOPMENT).

GYNÆCOLOGY (γυνή, a woman; λόγος, a discourse) means that branch of medical science which deals with diseases peculiar to women.

GYNÆCOMASTIA is the term used for describing an abnormal increase in size of the male breast.

GYRUS (γῦρος, a ring) is the term applied to a convolution of the brain.

H

HABITS (*see* DRUG HABITS, *also* CHILDREN, PECULIARITIES OF).

HÆMATEMESIS (*αἷμα*, blood ; *ἐμέω*, I vomit) means vomiting of blood. Blood brought up from the stomach is generally dark in colour, and is often so far digested as to form small brown granules resembling coffee grounds. Vomiting of blood is one of the chief symptoms of ulcer of the stomach, but it may also occur in gastritis, especially when this is due to the action of irritant poisons or alcohol. It should always be remembered that the blood may come from the nose or throat, and, after being swallowed, provoke vomiting. (*See* HÆMORRHAGE.)

HÆMATOCELE (*αἷμα*, blood ; *κήλη*, a tumor) means a cavity containing blood. Generally as the result of an injury which ruptures blood-vessels, blood is effused into one of the natural cavities of the body, or among loose cellular tissue, producing a hæmatocele.

HÆMATOCOLPOS is the term applied to the condition in which menstrual blood is held up in the vagina as a result of an imperforate hymen.

HÆMATOCRIT is a graduated capillary tube for estimating the concentration of red corpuscles in the blood. The blood, made non-coagulable, is drawn into the tube ; this is placed in a centrifuge and revolved at a speed of 3000 revolutions per second for 30 minutes. The red corpuscles will then congregate at the end of the tube. Above this will be a clear layer of plasma. Normally, plasma occupies 55 divisions of the tube, and the red corpuscles 45 divisions.

HÆMATOIDIN and HÆMIN are crystalline bodies derived from the blood when it is allowed to clot and dry up. The former is produced where blood is effused in internal hæmorrhages and then partly absorbed, for example, in cases of apoplexy. Chemical analysis proves it to be the same substance as bilirubin, the chief colouring matter of the bile. It produces the yellow colour noticed in a bruise as the blood is being absorbed and the bruise fading away. *Hæmin* is of great importance, because it can be obtained from long-dried stains on clothing, wood, knives, etc., its discovery proving such stains to be due to blood. To obtain it, one scrapes off a few particles of the stain upon a microscopic slide, adds a drop of strong acetic acid, and a small crystal of common salt. One then heats the drop till it dries up, and examines it under the microscope. Hæmin appears as minute, dark brown plates and prisms.

HÆMATOMA (*αἱματόω*, I make bloody) means a collection of blood forming a definite swelling. It is found often upon the head of new-born children after a protracted and difficult labour. It may occur as the result of any injury or operation.

HÆMATOTHORAX (*αἷμα*, blood ; *θώραξ*, the chest) means an effusion of blood into the pleural cavity.

HÆMATOXYLON, or LOGWOOD, is the wood of *Hæmatoxylon campechianum*, which has a mildly astringent action, and is consequently used in pills and mixtures for checking diarrhœa

HÆMATOZOA (*αἷμα*, blood ; *ζῶον*, animal) is a general name, including the various parasites which infest the blood. The best known are those which produce malaria and sleeping sickness. (*See* MALARIA, PARASITES, SLEEPING SICKNESS.)

HÆMATURIA (*αἷμα*, blood ; *οὐρέω*, I make water) means the condition of blood in the urine. (*See* URINE.) The blood may come from any part to the urinary tract, and is in some cases a sign of serious disorder, while in others it is of little importance. When the blood comes from the kidney or upper part of the urinary tract, it is usually mixed throughout the urine, giving the latter a brownish or 'smoky' tinge. This condition is usually the result of acute or subacute Bright's disease, or it may be present in persons when suffering from a dropsical condition due to weakness of the circulation

from defective action of the heart. Blood may also appear in the urine from time to time in considerable quantities when a stone or gravel is present in the pelvis of the kidney setting up irritation, especially when the person undergoes unwonted exercise. The blood may also originate from the bladder in cases where this is inflamed, and is then present in smaller quantities as a rule. The presence of a stone in the bladder is also productive of blood, and in either of the latter cases the urine is generally turbid from admixture with pus. A condition which leads to the passage of bright red blood at occasional intervals is the presence of a species of warty growth (papilloma) on the wall of the bladder. Blood may also be derived from the urethra following some inflammatory condition in this passage, or injury to it as by a fracture of the pelvic bones. In some cases blood is passed at intervals in the urine without any morbid change in the kidneys or urinary tract being discoverable on operation or after death. In such cases the blood is probably derived from congestion leading to the rupture of minute veins in the pelvis of the kidney.

The recognition of the site of the hæmorrhage is important in relation to the measures to be adopted for its treatment. This can often be made out by the character of the blood, whether intimately mixed with the urine or in the form of clots, also by the shape of the clots, and by the presence of other abnormal constituents in the urine. For the final diagnosis, examination of the interior of the bladder by the cystoscope and the passage of fine catheters up the ureters to the kidneys is often of importance. (*See* CYSTOSCOPE.)

HÆMIC MURMUR (*αἷμα*, blood) is a term applied to unusual sounds heard over the heart and large blood-vessels in consequence of the watery condition of the blood. These are found in anæmia, and disappear as the condition is recovered from. Murmurs of this type are to be distinguished from 'organic murmurs', which are due to some disease of the heart-valves or vessel walls.

HÆMOCHROMATOSIS, or BRONZED DIABETES, is the name of a disease in which cirrhosis of the liver, enlargement of the spleen, pigmentation of the skin, and diabetes are associated with the abnormal and excessive deposit in the organs of the body of the iron-containing pigment hæmosiderin.

HÆMOCYTOMETER (*αἷμα*, blood; *κύτος*, cell; *μέτρον*, measure) is an instrument for counting corpuscles in the blood.

HÆMOGLOBIN is the colouring material which produces the red colour of blood. It is a chromoprotein, made up of a protein called globin and the iron-containing pigment hæm. When separated from the red blood corpuscles that contain it, it is crystalline in form. It exists in two forms, simple hæmoglobin, found in venous blood, and oxyhæmoglobin, which is a loose compound with oxygen, found in arterial blood after the blood has come in contact with the air in the lungs. This oxyhæmoglobin is again broken down as the blood passes through the tissues, which take up the oxygen for their own use. In simple anæmia there is a marked deficiency of hæmoglobin in the blood.

HÆMOGLOBINURIA means the presence of blood pigment in the urine caused by the destruction of blood corpuscles in the vessels or in the urinary passages. It produces in the urine a dark red colour or a brown colour resembling porter. In some persons this condition, known as intermittent hæmoglobinuria, occurs from time to time, especially on exposure to cold. It also is produced by various poisonous substances taken in the food, and it forms in malarious districts the condition known as blackwater fever.

HÆMOLYSIS (*αἷμα*, blood; *λύσις*, setting free) means the breaking up of blood corpuscles by the action of poisonous substances, usually of a protein nature, circulating in the blood, or by certain chemicals. It occurs, for example, gradually in some forms of anæmia and occurs rapidly in poisoning by snake venom.

HÆMOLYTIC DISEASE OF THE NEWBORN (*see* ICTERUS GRAVIS NEONATORUM).

HÆMOPHILIA (*αἷμα*, blood; *φιλία*, affection) is a hereditary disease, confined almost entirely to members of the male sex who are called 'bleeders',

and in whom uncontrollable bleeding is apt to follow upon very slight wounds.

Causes.—The defect is in the blood and is one of coagulation. The blood may not have started to clot one hour or more after removal from the body. Why this is is not known. The most peculiar feature of the disease is its manner of hereditary transmission, this being through the mother, who is not a bleeder, though her brothers may have been In other words, the males of the affected family are bleeders but do not transmit the disease to their offspring, while the females are not bleeders but

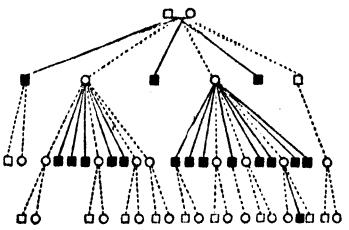

FIG. 243.—Genealogical tree of the family M. □, Healthy males; ○, healthy females; ■, bleeders who are all males. (Thoma's *Pathology*.)

their male children bleed. This is well exemplified in the history of a German family Mampel, and also in that of a family of Reading, Mass., in which there have been cases for over 200 years through seven generations. The affected families are very fertile, and this agrees with the fact that the disease is said to be specially common among the Jews.

Symptoms.—The disease shows itself within the first year or two of the boy's life by excessive bleedings, when small wounds are sustained, and by large bleedings under the skin or into joints where parts of the body are bruised. The bleeding is a general slow oozing from the capillary vessels, and even small operations like the removal of a tooth may be dangerous. Sometimes a person dies during a bleeding, but as a rule after much blood is lost the flow ceases, and the person gradually recovers from the resulting anæmia. The tendency to bleed generally passes off as age advances.

Treatment.—The usual rules for the treatment of bleeding from the particular locality affected hold good, but they have little effect at first (*see* HÆMORRHAGE), the oozing proceeding in spite of the soft clots which may form. When a hæmophiliac bleeds, this may be arrested by a blood transfusion and by local application of snake venom (from Russell's viper) to the bleeding point.

HÆMOPTYSIS (*αἷμα*, blood; *πτύω*, I spit) means the spitting up of blood from the lower air passages. The blood is usually coughed or gently hawked up, it may be in mouthfuls at a time, and is bright red and frothy, thus differing from the blood brought from the stomach. Generally the condition results from some disease of the heart or lungs. It should be remembered, however, that in elderly people hæmoptysis is usually due to a varicose condition of the small veins in the throat, not to hæmorrhage in the lungs; while in young people this condition is often due to bleeding from the nose, in which, owing to the position of the head, the blood happens to run backwards instead of forwards through the nostrils. (*See* CONSUMPTION, HÆMORRHAGE.)

HÆMORRHAGE (*αἱμορραγία*) means any escape of blood from the vessels which naturally contain it. It may occur from a wound of the skin, in which case it escapes externally, or into some internal cavity such as the stomach or bowels, or may simply be poured out into the tissues in consequence of a blow or similar injury; but, in all cases alike, the blood escaping from the vessels is lost to the circulation. Hæmorrhage is classified according to the vessel or vessels from which it occurs, as (*a*) *arterial*, in which case the blood is bright and appears in jets or spurts, corresponding to the heart-beats; (*b*) *venous*, when it comes from veins, is dark, and wells up gradually into the wound; (*c*) *capillary*, when it flows merely from torn capillaries, and comes into a gentle ooze out of the general surface of the wound. The immediate result of a severe hæmorrhage is great anæmia, so that in extreme cases the bodily organs may be unable to continue their functions, and the person dies in consequence, with symptoms of shock.

In general, arterial hæmorrhage is the most serious, and if a large artery, such as the femoral, be wounded, the person concerned may bleed to death in a few

HÆMORRHAGE

minutes. Venous hæmorrhage is so easily checked by slight pressure, and the valves in the veins so effectively prevent blood from running backwards in these vessels, that this form is not dangerous to life except in the case of ruptured varicose veins of the leg, or when a serious internal injury is received. Capillary hæmorrhage stops so quickly, that only in the case of the disease known as hæmophilia is it of serious import. The following terms are applied to hæmorrhage from special sites: *hæmatemesis*, bleeding from the stomach; *hæmoptysis*, bleeding from the lungs; *epistaxis*, bleeding from the nose; and *hæmaturia*, bleeding from the kidney or urinary passages. (See these headings.) Hæmorrhage is also classed as primary, reactionary, and secondary. (*See* WOUNDS.)

Natural arrest.—When an artery of small size is cut across, the bleeding stops in consequence of changes in the

FIG. 244.—Contraction of a cut artery shown. *a*, The orifice of a dead artery; *b*, the same vessel in the living body after being severed. (Miller's *Surgery*, after Sir C. Bell.)

wall of the artery on the one hand, and in the constitution of the blood upon the other. Every artery is surrounded by a fibrous sheath, and, when cut, the vessel retracts some little distance within this sheath, in consequence of the shortening of its muscle fibres; and further, by the same process the end contracts so as to form an opening of smaller size than the rest of the vessel. In the space between the end of the vessel and its sheath, and afterwards for some distance up the interior of the narrowed artery, blood-clot quickly forms by the following process, and rapidly blocks the open end of the vessel. When blood is shed so as to come in contact with any surface other than the smooth lining of blood-vessels, the fibrinogen which is dissolved in its fluid becomes suddenly converted into threads of fibrin through combination with the lime salts of the blood, and the action of a ferment given off probably by the blood platelets. These threads of fibrin slowly contract and develop into a dense felt-work, in the meshes of which the corpuscles are held, and in this way a blood-clot of increasing hardness is produced, within and round

FIG. 245.—Diagram of the natural arrest of hæmorrhage in a cut artery. *a*, External clot; *b*, internal clot, extending up to *c*, the first side branch of the artery. The contraction of the end of the vessel is also shown. (Miller's *Surgery*, after Jones.)

the ends of the injured vessels. When an artery is only partially severed it is evident that 'contraction' and 'retraction' within the sheath cannot take place, and accordingly bleeding is apt

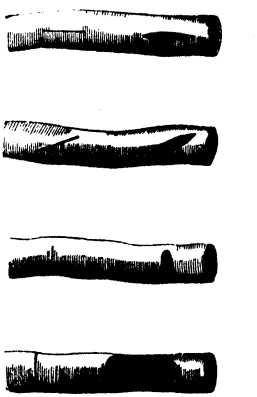

FIG. 246.—Diagram of arteries wounded in different ways, but not completely severed, to show how gaping openings result. On the left in each case is the wound, and on the right is shown the form of gap it makes. (Miller's *Surgery*, after Liston.)

to be more serious than when the vessel is completely cut across. Again, if an artery be torn across or twisted instead of cut, the opening at its end is still

more narrowed, and the blood clots more rapidly on the ragged surface than it would do upon a clean cut, so that hæmorrhage from a torn or bruised wound is in general much smaller in amount than from a stab or cut. The natural arrest of bleeding is usually described therefore as depending upon four factors: (*a*) the retraction, and (*b*) the contraction of the cut artery; (*c*) the external, and (*d*) the internal clot formed by the blood. For the means by which circulation is subsequently carried on after an artery is cut, see ANASTOMOSIS.

Control of external hæmorrhage.—Four main principles are applicable in the control of a severe external hæmorrhage, viz. (*a*) direct pressure on the bleeding point or points; (*b*) elevation of the wounded part; (*c*) pressure on the main artery of supply to the part; and (*d*) application of substances known as 'styptics', which contract the vessels or aid the coagulation of the blood.

(*a*) DIRECT PRESSURE may be made with the finger, which is the best method, when a definite bleeding point is seen in a gaping wound. This is the method adopted at an operation by the surgeon, who places his finger at once upon any bleeding point, afterwards seizing the cut artery with forceps and

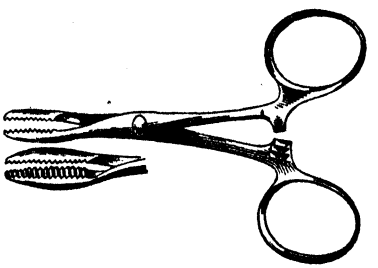

FIG. 247.—Artery forceps, with jaws shown enlarged.

tying a piece of silk or catgut tightly round its end. If the artery lie between the skin and a hard surface, as in the case of scalp wounds, a wedge-shaped pad and tight bandage (known as a 'graduated compress') may be substituted for pressure with the finger, the edges of the wound being compressed between the pad and skull.

(*b*) ELEVATION of the bleeding member is an important method, the blood running off more readily by the veins, and a smaller quantity being driven into the limb the higher it is raised.

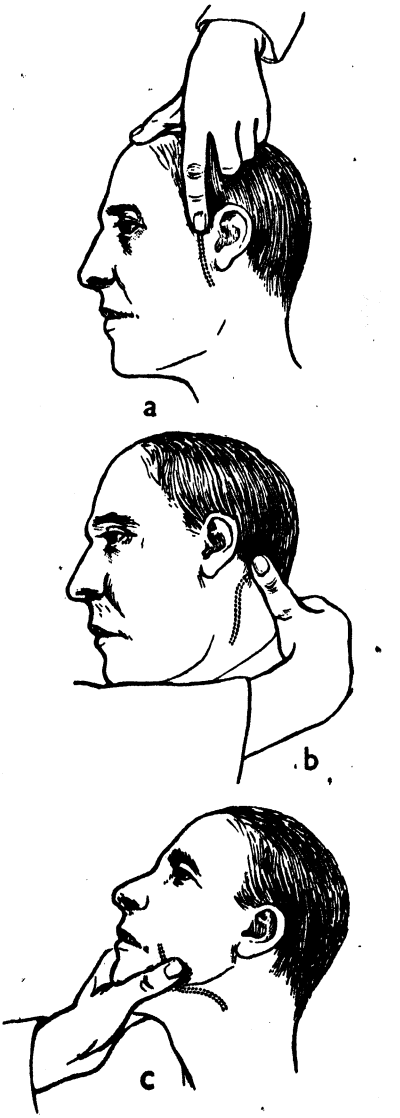

FIG. 248.—Compression of arteries about the head and face. *a*, Temporal artery, for bleeding from front of scalp; *b*, occipital artery, for back of scalp; *c*, facial artery, for face.

This method is applicable, of course, only in cases of bleeding from the hand or foot.

(*c*) PRESSURE UPON THE MAIN ARTERY of supply to the injured limb is a

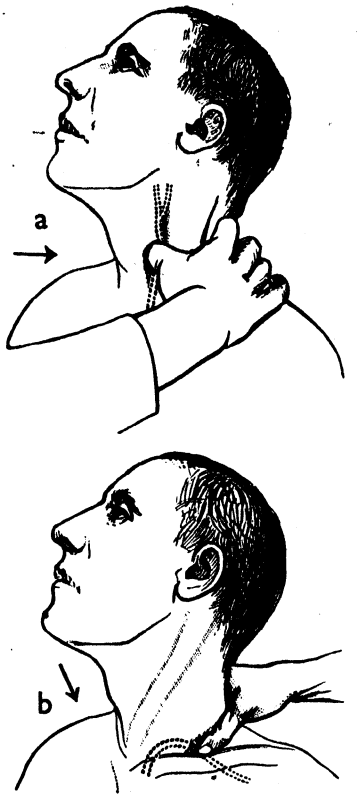

FIG. 249.—Compression of arteries in the neck. *a*, Carotid artery, for bleeding from head or neck; *b*, subclavian artery, for bleeding from upper limb. The arrow in each case shows the direction in which pressure should be exerted.

certain method of stopping the circulation and consequently all bleeding, much after the manner of stopping the water supply of a district by closing the main pipe. At certain points where the arteries lie close to bones and near the surface, the pulsation of the vessel may be felt, and *pressure with the finger* over the artery serves to obliterate it against the bone, the points where this may be adopted being as follows: In cases of bleeding from the upper part of the scalp, the temporal artery may be felt and compressed immediately in front of the upper part of the ear, while for wounds at the back of the head the occipital artery can be felt and compressed a short distance behind the mastoid process, the bony prominence at the back of the ear.

Bleeding from the face may be checked by pressure on the facial artery, which passes on to the face about an inch in front of the angle of the jaw, across the jaw-bone, against which it is to be pressed.

All bleeding from the head and neck may be lessened by pressure upon the common carotid artery in the neck a short distance below the prominent Adam's apple, and between it and the edge of the large sternomastoid muscle. In this groove the artery is pressed

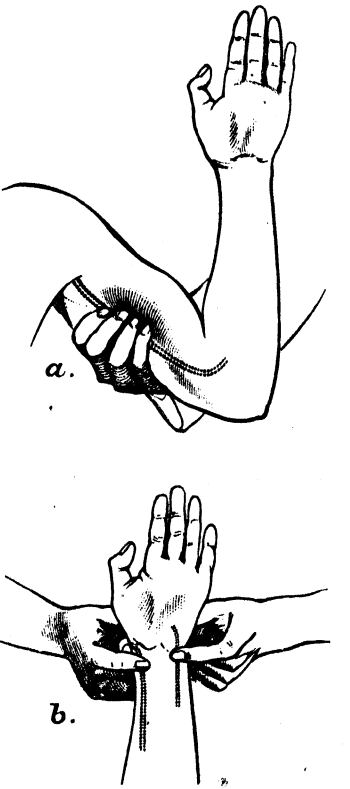

FIG. 250.—Compression of arteries for bleeding from forearm or hand. *a*, Brachial artery; *b*, radial and ulnar arteries.

straight back against the transverse processes of the spinal column.

Bleeding from the region of the

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shoulder and armpit is checked by pressure on the subclavian artery, the pressure being applied with the thumb directly downwards in the hollow behind the middle part of the collar-bone, so as to press the artery down upon the first rib.

Bleeding from the region of the elbow or forearm may be controlled by feeling for the brachial artery on the inner side of the upper arm, behind the biceps muscle, and pressing it against the humerus.

Bleeding from the hand is checked by pressure on the radial artery, where it lies between the skin and radius in front of the wrist, and on the ulnar artery just before it enters the hand near its inner margin.

In the lower limb the arteries lie deeply among the muscles, but bleeding from any part of the limb may be checked by pressure backwards on the femoral artery, which is to be felt pulsating in the centre of the groin, and

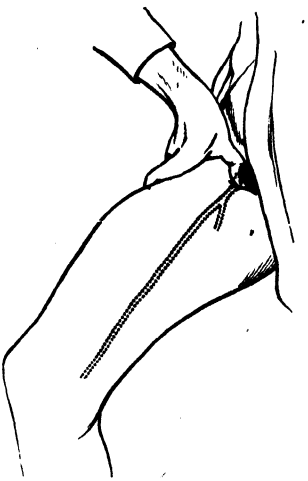


FIG. 251.—Compression of femoral artery, for bleeding in lower limb.

which is compressed backwards against the head of the thigh-bone.

Bleeding from the sole of the foot may be controlled by pressure on the posterior tibial artery, which lies about half an inch behind the inner ankle.

A second method for applying pressure on the main artery consists in *forced flexion* at the elbow, hip, or knee, as the case may be. A pad is placed in the bend of the joint, which is then flexed as completely as possible and firmly bound in this position, the artery being thus sharply bent upon itself.

A third method for control of the main blood supply is by the *tourniquet*,

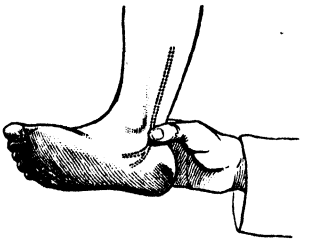


FIG. 252.—Compression of posterior tibial artery, for bleeding in sole of foot.

which consists of an elastic band or ligature passed round a fleshy part of any of the limbs, and pulled or twisted tight. A surgical tourniquet consists of an india-rubber cord or band with an arrangement for fixing the ends together, or of a strap with buckle and a screw appliance for tightening it up. A tourniquet may, however, be 'improvised' from a piece of rope, or a handkerchief folded cravatwise, tied round the limb and then twisted up tight by a piece of wood, large key, or similar object

FIG. 253.—Method of stopping bleeding from the forearm or hand by forced flexion at the elbow, the limb being firmly flexed over a pad placed in the bend of the elbow. The same method may be applied to compress the femoral artery at the groin or popliteal artery behind the knee, by forced flexion with a pad at hip or knee.

introduced beneath it. The handle of such a tourniquet is prevented from untwisting by passing a second band round the limb and including the end of the handle within it before tying. A tourniquet may be applied to the fleshy part of thigh, leg, upper arm, or

forearm. It is most important to note on a label the time of application of a tourniquet. No tourniquet should ever be left on longer than an hour, and generally it should be loosened after having been on for fifteen minutes, to be tightened again if bleeding recommences.

Occasionally, when bleeding is continuous or when it occurs from a deep-seated wound like a stab, or injury to the root of the tongue, it is impossible to get at the bleeding point, and permanent control of the bleeding is only to be achieved by the surgeon, who cuts down upon the main artery of supply and ties a ligature round it.

(*d*) STYPTICS are applied when the bleeding is a general ooze from a wound, or when the bleeding comes from an inaccessible position, such as the interior of the nose or a wound in the side. The most important styptics are heat and cold. Though moderate warmth greatly increases bleeding, ice-cold water and also water between 115° and 120° Fahr. (*i.e.* a temperature which the hand can hardly bear) both favour clotting and contract the blood-vessels. Heat is much more effectual than cold, if applied directly to the wound. Various drugs, such as perchloride of iron (steel drops) and hazeline, act similarly. Adrenalin has a powerful local action in contracting vessels and stopping bleeding.

Control of internal hæmorrhage is not to be so certainly achieved as in the case of bleeding from the vessels of the limbs. There are certain general principles to which it is most important to adhere. Chief among these is the maintenance of the recumbent position, since the heart beats less forcibly and the blood-pressure is consequently lowered as soon as the injured person lies down. For the same reason, all excitement must be avoided, and the mind of the sufferer quieted as far as possible. Stimulants must, above all, be avoided; and if the person shows a disposition to faint, this is a salutary symptom, as the circulation during a faint becomes still weaker, and the bleeding therefore slackens. Ice-bags or compresses wrung out of cold water may be laid over the chest or stomach, according to the origin of the hæmorrhage. Various drugs are administered, such as morphia, by hypodermic injection, for its quieting effect; gallic acid when the bleeding is from the kidneys, the organs by which this drug is excreted; adrenaline when the bleeding is from the stomach, into contact with which the drug comes at once; and volatile oils, like turpentine and camphor, which are said to favour clotting by rapidly increasing the white corpuscles of the blood, when the hæmorrhage is from the lungs. Styptics are of special use in bleeding from the bowels or womb. In the former case, tannic acid or perchloride of iron is given by the mouth, or injected into the bowel if the site of the bleeding is low down. In the hæmorrhage which sometimes follows childbirth, vaginal douches of hot water form one of the usual means employed, or plugs of absorbent cotton-wool steeped in tincture of perchloride of iron or adrenaline solution are introduced, and these, combined with pressure, seldom fail to arrest the bleeding. The arrest of bleeding is also helped by injection of pituitary extract after the labour.

It should be mentioned that in operations on internal organs or other highly vascular tissue, in the case of which bleeding would be very hard to stop, the cautery is often used instead of the knife, and not only removes the part desired, but, by its heat, prevents all bleeding.

Treatment of bleeding from special sites.—NOSE.—Keep quiet, lying or sitting; loosen collar; no blowing of nose; cold key or sponge to neck; if these be not successful, plugging of nostrils with lint soaked in tincture of perchloride of iron or adrenaline.

TONGUE.—Ice to suck; pressure with the fingers; if serious, compression of carotid artery.

FACE OR SCALP.—Direct pressure with fingers or bandage and pad on wound; if bleeding be severe, pressure in addition on facial, temporal, or occipital artery.

NECK.—Pressure on carotid artery.

ARMPIT OR SHOULDER.—Pressure on subclavian artery.

FOREARM. — Pressure on brachial artery by fingers, tourniquet, or forced flexion at elbow.

HAND.—Elevation and direct pressure with pad and bandage; if bleeding

severe, pressure on radial and ulnar arteries, or tourniquet to forearm.

THIGH.—Pressure on femoral artery at groin; tourniquet, if low down.

LEG.—Tourniquet to thigh, or forced flexion at knee. In the case of ruptured varicose veins, a pad and bandage round leg extending above and below wound with elevation of limb suffice.

FOOT.—Direct pressure and elevation; if bleeding severe, forced flexion at knee, or pressure on posterior tibial artery.

HÆMORRHAGIC DIATHESIS (*see* HÆMOPHILIA).

HÆMORRHOIDS (*αἱμορροΐδες*) (*see* PILES).

HÆMOSTATICS (*αἷμα*, blood; *ἵστημι*, I cause to stand) are any means, whether of the nature of mechanical appliances or drugs, used to control bleeding. (*See* HÆMORRHAGE.)

HÆMOTHORAX (*αἷμα*, blood; *θώραξ*, chest). (*See* HÆMATOTHORAX.)

HAIR (*see* SKIN).

HAIR DISEASES (*see* BALDNESS, SKIN DISEASES).

HAIR, REMOVAL OF (*see* DEPILATION).

HALISTERESIS is the term applied to softening of a bone resulting from the disappearance of lime salts from it.

HALITOSIS (*halitus*, exhalation) is another term for offensive breath. (*See* BREATH, DISEASES OF.)

HALLUCINATIONS (*hallucinor*, I blunder) are errors in perception, affecting some sense organ to such an extent that a person imagines he perceives something for which there is no foundation. For example, a person may fancy he hears himself called during perfect stillness, or may see lights in pitch darkness. *Illusions* are misinterpreted sensations; for example, a person may constantly mistake an article of furniture for the figure of some friend, or of an animal. Both these errors occur in sane people, and may indicate some slight brain derangement, due to sleeplessness, overwork, feverishness, or other cause. They are usually, however, a symptom of insanity.

HALLUX (*hallux*) is the anatomical name of the great toe.

HALO is a coloured circle seen round a bright light in some eye conditions. When accompanied by headache it is specially likely to be caused by glaucoma. (*See* GLAUCOMA.)

HAMAMELIS (*see* WITCH-HAZEL).

HAMMER TOE (*see* CORNS AND BUNIONS).

HAMSTRINGS is the name given to the tendons at the back of the knee, two on the inner side and one on the outer side, which bend this joint. They are attached to the tibia below.

HAND is the section of the upper limb below the wrist. The hand of man is more highly developed in its structure and in its nervous connections than the corresponding part in any other animal. Indeed the possession of a thumb which can be 'opposed' to the other fingers for grasping objects is one of the distinguishing features of the human race. Of all the parts of the body, the hand, which is connected with a large area on the surface of the brain, is capable of the highest degree of education, and in cases where the brain degenerates, as in general paralysis, the uses of the hand deteriorate particularly early; while in those cases where part of the brain is destroyed by apoplexy, the hand is apt to suffer more permanently than either face or leg.

In structure, the hand has a bony basis of eight small 'carpal' bones in the wrist, five metacarpal bones in the fleshy part of the hand, and three phalanges in each finger, two only in the thumb. From the muscles of the forearm run in front of the wrist twelve strong tendons or sinews. Of these, nine go to the fingers and thumb and are bound down by a strong band, the 'annular ligament', in front of the wrist. They are enclosed in a complicated 'synovial' sheath, and pass through the palm and down the fingers. (*See* FINGER.) Behind the wrist twelve

tendons likewise cross from forearm to hand.

Forming the ball of the thumb and that of the little finger, and filling up the gaps between the metacarpal bones, are other muscles, which act to separate and bring together the fingers, and to bend them at their first joints (knuckles).

Deep in the palm, the ulnar artery makes an arch across the hand, giving

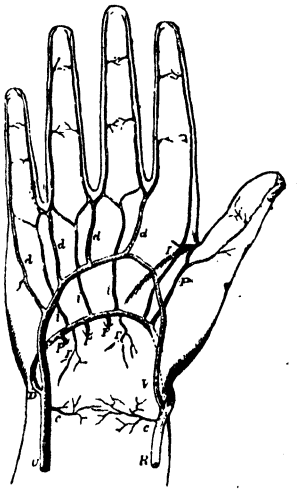


FIG. 254.—Diagram showing the position of the important arteries in the hand. For lettering see under ARTERIES. The nerves lie, in the main, alongside of the arteries. (Turner's *Anatomy*.)

off branches which run down the sides of the fingers; while the radial artery makes an arch across at a still deeper level, lying in close contact with the bones.

The skin of the hand is richly supplied with nerve filaments, in accordance with its highly specialised sense of touch, the outer three and a half digits being supplied in front by the median, behind by the radial nerve, while the inner one and a half fingers have their nerve supply both back and front from the ulnar nerve.

In addition to the diseases mentioned above, certain nervous diseases affect the hand early. Thus in disseminated sclerosis and in chorea there are tremors; in alcoholic neuritis and in lead-poisoning, wrist-drop; in progressive muscular atrophy one of the first signs is wasting of the small muscles belonging to the thumb and little finger; in syringomyelia there is loss of sensation for pain and for change of temperature in the fingers.

Deformities of the hand, in the shape of chalk-stones, may occur in gout; rheumatism may cause stiffness or even forward bending of the fingers; rheumatic gout often causes great distortion of the small joints and twisting of the fingers toward the inner side of the hand; and acromegaly is characterised by great enlargement of the hands. Swellings on the back or front of the wrist are usually due to collection of fluid in the tendon sheaths. (*See* GANGLION.) Deep abscesses on the front of the fingers are serious, because of the ease with which the infection spreads up the synovial sheaths of the tendons into the palm of the hand. (*See* WHITLOW.) A condition in which the fingers, especially the ring and little fingers, are gradually drawn up into the palm follows sometimes on a severe strain of the palm or long-continued pressure of a tool. (*See* DUPUYTREN'S CONTRACTION.)

Several special terms are applied to deformities of the hand. 'Claw hand' or *main en griffe* is applied to a condition in which the hand is atrophied and the fingers bent in paralysis of the ulnar nerve; 'monkey hand' or *main en singe* is applied to a condition in which the muscles of the thumb are wasted; 'obstetrician's hand' is a condition in which the thumb and fingers are held together in a kind of cone in shaking palsy and other conditions; and 'skeleton hand' is a condition in which the muscles of the hand are generally wasted, as in progressive muscular atrophy. (*See also* DROP-WRIST.)

HANGING is a form of death due to suspension of the body from the neck, either suddenly, as in judicial hanging, so as to damage the spinal column and cord, or in such a way as to constrict the air passages and the blood-vessels to the brain. Death is in any case speedy, resulting in two or three minutes, if not instantaneous, though in bygone days criminals who were 'shored-up', or supported by their friends, have come round after half an hour's suspension. The mark of the

noose on the neck is oblique in hanging, which serves to distinguish this form of death from strangling, in which the mark is circular. The question as to accident, suicide, or murder does not generally arise in cases of hanging, which, apart from judicial hanging, and in the absence of any signs of a struggle, is due to suicide. The recovery of persons found hanging is similar to that for drowning. (*See* DROWNING.)

HANG-NAIL means a splitting of the skin at the side of the finger-nail. It is often a painful condition and difficult to heal. This is best effected by wearing constantly for several days a wet boracic dressing covered by a rubber finger-stall.

HARDNESS is a term applied to water that contains a large amount of calcium and magnesium salts (lime salts) which form an insoluble curd with soap and thus interfere with the use of the water for purposes of washing. Hard water is especially found in districts where the soil is chalky. The same salts have a strongly astringent action when the water is drunk, and thus produce constipation and other troubles. Temporary hardness, which is due to the presence of bicarbonates of lime, can be remedied by boiling, when the lime is precipitated as carbonate of lime. Permanent hardness is not remedied by boiling, and is due to the presence of a large amount of sulphate of lime.

HARE-LIP (*see* PALATE, MALFORMATIONS OF).

HARTSHORN is a popular name for ammonia. (*See* AMMONIA.)

HASHIMOTO'S DISEASE is a condition in which the whole of the thyroid gland is diffusely enlarged and firm. The enlargement is due, not to increase of colloid, but to diffuse infiltration of lymphocytes and increase of fibrous tissue. This form of goitre appears in middle-aged women, does not give rise to symptoms of thyrotoxicosis (thyroid 'poisoning'), and tends to produce myxœdema.

HAUNCH-BONE is the name of the bone which encloses the lower part of the abdomen on each side. (*See* PELVIS.)

HAUSTUS is the Latin word for a draught.

HAY FEVER, otherwise known as HAY ASTHMA, SUMMER CATARRH, and in America as AUTUMN CATARRH, means a peculiar inflammatory condition of the mucous membranes of the eyes, nose, and air passages, which year after year affects certain individuals from the middle of May till the end of July, and in America is also troublesome during the latter part of August and September. It has a close connection with one type of asthma.

Causes.—This malady seems to a certain extent to run in families, heredity playing a part in about 30 per cent of cases. It is about twice as common in men as among women, and seems especially to affect persons of active temperament and high mental development. Occasionally it appears to be associated with gout. Hay fever is associated in some cases with structural defects in the nose, and when these are removed the hay fever is usually benefited to some extent. The popular idea, which has long attributed attacks of hay fever to the pollen from hay-fields, has been shown to be correct, though behind this there must be some predisposing constitutional sensitiveness that renders some persons liable to attacks while the majority of people are quite immune. The old theory that the inflammation results from the pollen sending down its pollen-tubes into the mucous membrane of the nose and throat is now known to be incorrect, the cause being in all probability almost always some poisonous substance or toxin contained in the pollen. A toxin capable of producing hay fever has been found in the pollen of twenty-five different grasses and of many other plants. Most cases occurring in spring and summer are due to the pollen of grasses, while autumn cases are commonly due to pollen of various rag-weeds. The toxin can be extracted by means of water and alcohol, and when applied to the eye or nose of susceptible people brings on quickly an ordinary attack of hay fever. Injection of the toxin into sheep, goats, and other animals produces antitoxic serum which is sometimes

capable of preventing or of curing these attacks.

Symptoms.—The malady recurs with regularity during the summer months in those susceptible to it. It begins with an itching of the eyes and nose, followed by symptoms of a severe cold or influenza, such as headache, violent sneezing, and profuse watery discharge from the eyes and nose, together with dry, hard cough, and occasionally severe asthmatic paroxysms. The attack usually runs a course of several weeks, and, in addition to making the person miserable, or even incapacitating him for work while they last, repeated attacks may lay the foundation for serious chest disease. If rainy weather come on, the symptoms may abate, and susceptible persons, who betake themselves early in May to the seaside or a place where vegetation is scanty, rarely suffer. A railway journey through a country district in the heat of summer seems specially apt to be followed by a bad attack.

Treatment. — The most effectual method of treatment in hay fever is to avoid the exciting cause, namely, the neighbourhood of grass fields, during the summer season. Removal to the seaside often succeeds in putting an end to an attack, and many persons who are liable to the complaint make such a change annually before its expected onset, and thus escape. For those who are unable to accomplish this, and must remain exposed to the noxious emanation, the interior of the nose may be sprayed with adrenaline. In cases complicated by hay asthma, the remedies for ordinary bronchial asthma are applicable. (*See* ASTHMA.) In cases where there is some nasal defect, cauterisation of the turbinate process or an operation to straighten a distorted nasal septum sometimes helps.

Susceptible persons living in the country should sleep with their bedroom windows shut; and it has been found that the application to the eye or nose, every morning, of antitoxin (known as *Pollantin*), will in many cases prevent attacks. Ionization of the nasal mucosa with zinc sulphate may help. Perhaps the best results are obtained by inoculation with dilute extract of the pollen to which the patient is susceptible.

HAZELINE, or LIQUOR HAMAMELIDIS, is an extract made from the leaves or bark of *Hamamelis virginiana*, the witch-hazel. It has a powerful action in checking bleeding and excessive mucous discharges. The dose is about one teaspoonful of either liquor or tincture of hamamelis. (*See* WITCH-HAZEL.)

HEAD (*see* BRAIN, FACE, SKULL, *and* SCALP).

HEADACHE is a condition of great importance, because it is common and often severe enough to be incapacitating. Moreover, it may be an early symptom of serious disease — for example, the common fevers of childhood, meningitis, brain tumor, kidney disease, eye trouble. Headache is oftenest due to some condition of the brain, and the great fluctuations in size and amount of contained blood which the vessels of the brain constantly undergo, coupled with the fact that the rigid skull allows only very slight changes in the volume of its contents, bulk very largely in the cause of many headaches. Often, however, the skull, the scalp, the nerves of the head and face, or the membranes of the brain, constitute the real seat of pain.

NERVOUS HEADACHE is one of the most severe types. It affects, in general, persons of a nervous temperament in whose family various nervous diseases, like epilepsy, hysteria, insanity, are found, and is apt to occur at times when the general health is poor, when the mind has been occupied by severe business worry, or brooding over some unpleasant thought. These headaches are also associated with the hurry and noise of town life, disappearing very quickly on a change to country residence, and in many people they appear to depend upon electrical changes of the atmosphere. In women, severe nervous headache associated with pains and flushings in various parts of the body may be a sign of the approach of the climacteric. *Clavus*, a pain as of a nail being bored into some part of the head, is one form taken by nervous headache, generally attributed to neuralgia. (*See* NEURALGIA.) *Migraine* is a very severe variety, which affects particularly women and men of high intellectuality, Wheatstone and Herschel the

astronomer affording examples of men who have suffered from it. In general it affects only one side of the head, as its name implies. An attack of migraine is generally brought on by some of the above-mentioned causes, and begins by a feeling of depression, or vague sense of being out of order, though no system seems particularly affected. A warning sign in some people is an extreme sensibility of the nervous system to external sensory impressions; for example, to sounds, so that a clock may be heard ticking in the next room or downstairs, where it is usually quite inaudible. In some people a characteristic symptom appears after an hour or two, connected with the eyes. A bright spot is seen in one corner of the field of vision, and rapidly spreads across it, so that the sight becomes partially obscured; this spot may spread by bright flashes or by angles and projections resembling a plan of fortifications; or it may begin in the centre of the field and spread outwards. This temporary defect of vision is very characteristic of migraine, but it may be quite absent, and in its place great nausea and vomiting may come on, after which the headache appears and becomes gradually worse. The headache may be trifling in some persons, but it shows all degrees of severity up to a state of great collapse, in which the face becomes pallid, the hands and feet cold, and the heart very feeble. Vomiting and a constant feeling of sickness are generally very marked, and the presence of these symptoms has gained for this type the name also of *Sick Headache*. The whole is over in a day or two days in general, but severe cases may last a week, and leave the sufferer quite broken-down in health. An attack comes on first in early life, before the age of twenty-five, and may be repeated at intervals of months or years, ceasing as a rule entirely between fifty and sixty.

Treatment.—As this form of headache depends to a large extent upon debility, it is essential that the sufferer should, between his attacks, have light, nourishing diet, should take a full allowance of sleep, and should, as far as possible, avoid the forms of worry and mental strain which he finds bring on the headache. The tonics usually prescribed for these persons consist, amongst others, of arsenic, cod-liver oil, and quinine. During the headaches the drugs which seem to be of most use are antipyrine, valerian, bromides, butyl-chloral, gelsemium. In cases in which headache follows excessive work or anxiety, massage of the scalp may help, as the scalp muscles may be over-tense.

SYMPATHETIC HEADACHE is closely allied to the last type. It occurs in persons of delicate nervous organisation, especially women, as the result of disorder in some distant part of the body, the pain of which is referred to the head, affecting usually the forehead. (*See* PAIN.) Carious teeth, wax in the ear, inflammation of the ovaries, and dyspepsia are the most frequent causes. Atonic dyspepsia (*see* DYSPEPSIA), in persons who are out of health, who take little exercise, and who are afflicted with constipation, is the commonest form, and the drinking of iced water is said to be specially provocative of headache in these people. In children, far the most common cause, almost the only cause, indeed, of this headache, is eye-strain, due to some error in accommodation, which is banished after the child is fitted with suitable glasses. Other eye diseases, of which the chief are glaucoma and iritis, are now and then responsible for this type of headache in older persons.

ANÆMIC HEADACHE occurs in girls and others who suffer from general anæmia; in persons who have any form of heart disease, which prevents the brain from getting its full supply of blood; in the subjects of Bright's disease; and, above all, in old people whose arteries are thick-walled and narrow, and in whom the headache comes on especially at night in association with insomnia. This type of headache is generally in the back of or right on the top of the head, and is very often worse when the sufferer stands or walks about, but relieved when he lies down.

The special symptoms of this headache are depression of spirits, irritability of temper, timid fear of events not likely to happen, sometimes sleeplessness, but sometimes also drowsiness during the day, when the person should be awake, and very often coldness of the hands and feet with pallor of the

face. There is, for persons subject to this type of headache, a great liability to contract the alcoholic habit, because alcohol gives great temporary relief.

Treatment.—Iron and good food are necessary in some cases, cardiac stimulants in those where the heart is feeble. In other persons the stoppage of any weakening discharge which may be present, and in old people the use of small quantities of alcohol, especially at night, form the requisite treatment.

CONGESTIVE HEADACHE is one of the most painful forms, and is generally accompanied by flushing of the face and throbbing in the vessels of the head and neck. It is sometimes closely associated with the nervous type, occurring in hard and constant brain-workers, who eat irregularly, and particularly in those who are too much addicted to the use of alcohol. Not infrequently it is allied in these cases with gout. This type of headache may be very severe for a day or two after a surgical operation. People who have suffered from any head injury, such as sunstroke or concussion of the brain, are liable to have such a headache brought on at any time by excitement, or by alcohol even in small quantities. The headache which follows on the morning after a debauch of eating or drinking is of this type, so is that which sometimes precedes an attack of apoplexy or follows one of epilepsy. In young women, suppression of the menses in consequence of exposure to cold may result in headache till relief is obtained by bleeding at the nose or some other site.

Treatment. — If the person takes alcohol to any extent, this should be abandoned entirely. Coffee, tea, and similar stimulants should be sparingly taken. The diet should be a light one, of fish, white meat, puddings, and fruit; and it is important to keep the action of the bowels regular, as by taking some aperient water every morning. Bromides and chloral are useful when the headache is combined with sleeplessness. In very severe cases, cloths wrung out of iced water applied to the head and renewed every two or three minutes, or ice-bags to the head and to the sides of the neck, often give great relief.

TOXÆMIC HEADACHE is that form due to the circulation of some poison in the blood, which affects the functions of the brain and causes a general aching all through the head, and feelings of mental dullness. Most fevers, particularly smallpox, typhus, and typhoid fever, begin with severe headache, and even a simple cold in the head or an attack of influenza early shows this symptom. In malaria, headache is often one of the most troublesome symptoms; but the condition in which this type is most marked is the chronic form of poisoning which occurs in Bright's disease, known as 'uræmia'. This headache also affects persons who suffer from habitual constipation, owing to absorption of the products of putrefaction from the bowels.

Treatment.—The cause of poisoning must, as the first essential, be removed. If Bright's disease be present it must be treated, and the bowels in every case attended to. Smelling-salts, or eau-de-Cologne applied to the nose, may bring relief in slight cases, and in severer cases, phenacetin or antipyrin taken in the evening generally soothes the pain.

GOUTY HEADACHE may be associated with an acute attack of gout, or sometimes takes the place of acute attacks. It is generally situated low down in the forehead or behind the eyes. Another form of gouty headache is a more or less constant pain due to the toxæmic headache of chronic Bright's disease, which is often an accompaniment of gout. In addition to the pain, there are various other symptoms of gout, and great irascibility of temper. The treatment is the same as for other manifestations of gout.

RHEUMATIC HEADACHE usually affects the scalp, in consequence of exposure of the uncovered head to cold. It has this peculiarity, that the scalp is extremely tender, and brushing the hair may cause such pain that women may have to leave the hair undone. It is treated by wearing some woollen covering round the head, and by taking various anti-rheumatic remedies, such as salicylate of soda or aspirin.

ORGANIC HEADACHE includes pains of various nature and in various parts of the head, due to some gross change in the substance of the brain or its coverings. Meningitis in children

is one of the chief of these. In old people, thickening of the arteries of the brain, softening of the brain, or apoplexy, may produce constant dull headache. Tumors of the brain produce pain associated with giddiness and apparently causeless vomiting.

Treatment.—For meningitis, see MENINGITIS; for the headache of old people, see ANÆMIC HEADACHE. The headache due to a tumor is often relieved by the operation of trephining the skull, so as to reduce the pressure in its interior. Potassium iodide, bromides, and morphia are also useful for relief.

HEALING (*see* WOUNDS).

HEALTH.—The state of health implies much more than freedom from disease, and good health may be defined as the attainment and maintenance of the highest state of mental and bodily vigour of which any given individual is capable. People vary in the degree of strength and activity to which they are capable of attaining, and some persons must be content with leading a life on a lower plane of physical or mental activity than others. For the maintenance of this individual standard it is essential that each person should recognise his capabilities and limitations, and also that he should be aware of any defects of body or mind to which he is liable, either as the result of heredity or of previous disease. The recognition of and allowance for these in the conduct of daily life is of immense importance in maintaining health in other respects. Many persons have some inborn hereditary defect or tendency, *e.g.* a neurotic temperament or a liability to disease of some special organ of the body, such as the heart or lungs, and the maintenance of health in such persons should be particularly directed towards avoiding conditions which lead to disorders common in their family. (*See* HEREDITY, HEART DISEASES, LUNG DISEASES, etc.) Persons with a tendency to consumption, for example, have in numerous instances by care in regard to the general conduct of life and place of residence attained a fair measure of general health and been able for many years to conduct a quiet but strenuous intellectual life of high productivity.

Environment is another matter with a very important bearing upon health. This involves such considerations as the choice of an occupation suited to the individual's capabilities and temperament and the avoidance in dangerous occupations of the influences which are specially deleterious to health (*see* TRADE DISEASES). The social surroundings also involved in environment play a very important part with many persons in the development of nervous affections (*see* NEURASTHENIA). Speaking generally, it may be said that the great majority of persons, long before middle life is reached, have contracted some defect of body or constitution arising from their surroundings, and the maintenance of health depends largely upon making appropriate allowance for this.

The care of the health should begin with the earliest life, and as infants are more prejudicially affected by improper feeding than by any other influence, the care of the child in this respect is of the greatest importance (*see* INFANT FEEDING). Children display at an early age peculiarities and tendencies which, if unchecked, sometimes develop into undesirable habits, and these form a matter for careful education. (*See* CHILDREN, PECULIARITIES OF; SCHOOL CHILDREN; *and* MENTAL DEFECTIVENESS.)

At a later stage the most important factor in the due care of body and mind consists in attention to the natural functions of the body. Of these the question of food that is proper in quality and in amount is one of the most important (*see* DIET). Careful attention to the functions of the bowels (*see* CONSTIPATION) and proper care of the teeth (*see* TEETH, DISEASES OF) are subjects of the utmost importance in which children especially should be carefully instructed. In regard to the care of the skin and the maintenance of its functions, see SKIN, BATHS, and CLOTHING. A due maintenance of the relation between the exercise of the body and the amount of rest is of great importance (*see* EXERCISE, FATIGUE, *and* SLEEP), while the correction of bad habits in regard to the posture of the body, especially whilst at work, is of immense importance in maintaining good health (*see* CHEST DEVELOPMENT *and* SPINE, DISEASES OF). Various habits in regard to eating and drinking and the practice of

smoking, which has become almost universal, require to be carefully studied in order that due moderation may be exercised in regard to them. (*See* CORPULENCE, ALCOHOL, TOBACCO.)

Despite all the ordinary precautions that may be taken in regard to matters of everyday life, such as those already mentioned, people become, especially in the earlier years of life, exposed to accidents and diseases which may, however, with care be avoided to a large extent. (*See* INFECTION *and* SANITATION.) Certain diseases and influences are particularly liable to affect the health in different parts of the world. For the influences exerted by climate upon health see CLIMATE IN RELATION TO DISEASE, and for reference to the diseases which are liable to be contracted by persons in tropical countries see references under TROPICAL DISEASES.

Many persons from middle life onwards make a practice of being medically examined, as if for life insurance, at regular yearly intervals or oftener. This is an excellent routine to adopt, for by its means defects in constitution can be discovered at an early stage, while they are still capable of treatment.

HEARING (*see* DEAFNESS, EAR).

HEART is a hollow muscular pump with four cavities, each provided at its outlet with a valve, whose function is to maintain the circulation of the blood. The two upper cavities are known as atria or auricles, from their resemblance to a dog's ears (*auricula*, a little ear), the two lower ones as ventricles (*ventriculus*, a little stomach). The term auricle is sometimes reserved for the ear-shaped tip of the atrium on each side. Owing to the fact that the heart has important connections with the nervous system, and that its action is liable to be increased or diminished by influences which powerfully affect the latter, the heart was regarded in olden times, and is still metaphorically spoken of, as the seat of the emotions.

Position.—The heart lies in the chest between the two lungs, but projecting more to the left side than to the right. On the left side its apex reaches out (in the adult between 3½ and 4 inches) almost to the nipple, and lies beneath the fifth rib, while its right border extends only a short distance, at most an inch, beyond the margin of the breastbone. Its lower border rests upon the

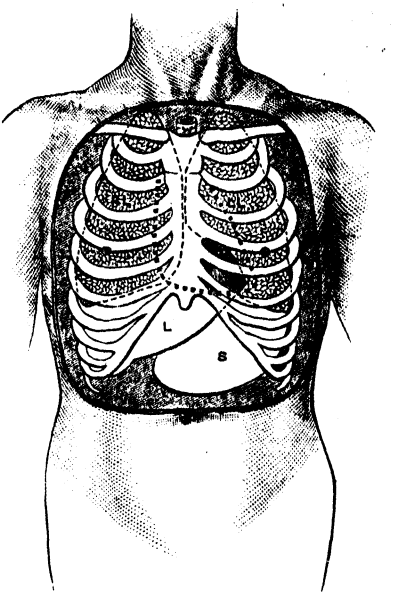


FIG. 255.—Diagram of the contents of the chest from the front. The position of the heart is shown by a dotted line. *H*, The part of the heart exposed in front of left lung; *LL*, left lung; *RL*, right lung; *L*, liver; *S*, stomach; *W*, windpipe.

diaphragm by which it is separated from the liver and stomach, and this close connection has an important influence upon the heart in several disorders of

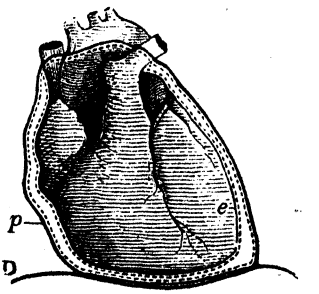


FIG. 256.—Heart lying within the pericardium, *p*; *e*, epicardial layer; *D*, diaphragm. (Turner's *Anatomy*.)

the stomach. Above, the heart extends to the level of the second rib, where the great vessels, the aorta on the right side

and the pulmonary artery on the left, lie behind the breast-bone.

Shape and size.—The heart of any individual was described by Laennec as, roughly, of the size and shape of the clenched fist. One end of the heart is pointed (apex), the other is broad (base), and is deeply cleft at the division between the two atria. One groove running down the front and up the back shows the division between the two ventricles; a circular, deeper groove marks off the atria above from the ventricles below. The capacity of each cavity is somewhere between three and six fluid ounces.

Structure.—The heart lies within a strong fibrous bag, known as the pericardium, and since the inner surface of this bag and the outer surface of the heart are both covered with a smooth, glistening membrane faced with flat cells and lubricated by a little serous fluid, the movements of the heart are accomplished almost without friction. The main thickness of the heart wall

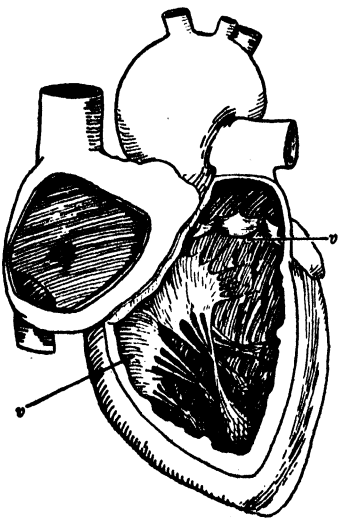


FIG. 257.—Heart from right side. The flaps at v, v, show two of the valves.

consists of bundles of muscle fibres, which run, some in circles right round the heart, others in loops, first round one cavity, then round the corresponding cavity of the other side. Within all the cavities is a smooth lining membrane continuous with that lining the vessels which open into the heart. The investing smooth membrane is known as 'epicardium', the muscular substance as 'myocardium', and the smooth lining membrane as 'endocardium'.

For the regulation of the heart's action there are important nervous connections, especially with the vagus nerve and with the sympathetic system. In the hinder part of the auricles lies a collection of nerve cells and connecting fibres, known as the sino-auricular node, which forms the starting-point for the impulses that initiate the beats of the heart. In the groove between the ventricles and the auricles lies another collection of similar nerve tissue, known as the auriculo-ventricular node. This is connected by muscle fibres with the sino-auricular node above, and from it there runs downwards into the septum between the two ventricles a band of special muscle fibres, known as the auriculo-ventricular bundle of His. This splits up into a right and a left branch for the two ventricles, and the fibres of these distribute themselves throughout the muscular wall of the ventricles and control their contraction.

Openings.—There is no direct communication between the cavities on the right side and those on the left; but the right auricle opens into the right ventricle by a large circular opening, and similarly the left auricle into the left ventricle. Into the right auricle open two large veins, the superior and inferior venæ cavæ, with some smaller veins from the wall of the heart itself, and into the left auricle open two pulmonary veins from each lung. One opening leads out of each ventricle, to the aorta in the case of the left ventricle, to the pulmonary artery from the right.

Prior to birth there is an opening (*foramen ovale*) from the right into the left auricle through which the blood passes; but when the child first draws air into its lungs this opening closes and is represented in the adult only by a depression (*fossa ovalis*).

Valves.—As stated above there are four valves. The mitral valve consists of two irregular cusps, the tricuspid valve of three smaller cusps. The aortic and pulmonary valves each consist of three semilunar-shaped segments. The structure of a valve is a double layer of

the lining membrane of the heart (endocardium) strengthened by fibrous tissue between. Two of these are placed at the openings leading from auricle into ventricle, the 'tricuspid valve' on the right side, the 'mitral valve' on the left, so as completely to prevent blood from running back into the auricle when the ventricle contracts. Two more, the 'pulmonary valve' and the 'aortic valve', are placed at the entrance to these arteries, and prevent regurgitation into the ventricles of blood which has been driven from them into the arteries. The noises made by these valves in closing are known as the

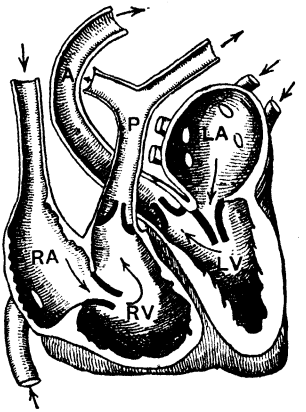


FIG. 258.—Diagram of heart with front surface removed to show valves. *RA*, Right auricle; *RV*, right ventricle; *P*, pulmonary artery; *LA*, left auricle; *LV*, left ventricle; *A*, aorta.

'heart sounds', and can be heard by any one who applies his ear to the front of a person's chest. 'Murmurs' heard accompanying these sounds indicate defects in the valves, and form one of the chief signs of heart disease.

Action.—At each heart-beat the two auricles contract and expel their contents into the ventricles, which at the same time they stimulate to contract together, so that the blood is driven into the arteries, to be returned again to the auricles after having completed a circuit in about fifteen seconds through the body or lungs as the case may be. The heart beats from sixty to ninety times a minute, the rate in any given healthy person being about four times that of the respirations. The heart is to some extent regulated by a nerve centre in the medulla, closely connected with those centres which govern the lungs and stomach, and nerve-fibres pass to it in the 'vagus' nerve. By some of these fibres its rate and force can be diminished, by others increased, according to the needs of the various organs of the body. If this nerve centre be injured or poisoned, for example by want of fresh air, etc., the heart stops beating in human beings, though in some of the lower animals—*e.g.* frogs, fishes, and reptiles—the heart may under favourable conditions go on beating for hours even after its entire removal from the body.

HEART-BURN means a burning sensation experienced in the region of the heart and up the back to the throat. It is caused by an excessive acidity of the gastric juice, and is relieved temporarily by taking alkaline substances, such as 20 grains of bicarbonate of soda or a similar amount of bismuth carbonate or carbonate of magnesia in water.

HEART DISEASES belong to that class of diseases which can be recognised only by the trained observer, though their presence may occasion severe symptoms and evident signs of general illness perceptible to every one. Their treatment, and a true appreciation of their slightness or gravity, belong still more to the department of the specialist.

Varieties.—Many general diseases affect the heart; but, considering the arduous work which this organ constantly performs (*see* EXERCISE), and the fact that it never rests completely from the time of its formation till death ensues, it is subject to wonderfully few disorders. Its diseases are classified according to the part of the heart affected, or the nature of the changes produced. *Inflammatory affections* are divided into pericarditis, myocarditis, and endocarditis, according as the pericardium or enveloping membrane, the myocardium or muscular substance, and the endocardium or lining membrane are affected. *Valvular diseases* form one of the most important groups; any of the four valves may be 'stenosed', *i.e.* the aperture between its flaps narrowed, or a valve may be 'incom-

petent', so that some blood leaks back through the opening in the wrong direction. *Hypertrophy*, in which the heart is enlarged and its wall thickened, and *dilatation*, in which one or more of the cavities is dilated, form another group often associated with the valvular diseases. *Degeneration* of the muscular tissue, producing enfeeblement of the heart's action, may take place, in the direction either of a 'fatty' or, less commonly, of a fibroid change. Finally, there is a class of *functional* disorders in which—with or without apparent diseased change in the structure of the heart—palpitation, irregularity, rapidity, slowness, or even severe attacks of pain appear.

Causes.—A great variety of factors enters into the production of heart disorders; but the number of cases in which the heart is seriously affected is small, considering the prime importance of the organ to life. The number of deaths from diseases of the heart in England and Wales during 1923 was 56,886, out of a total death-list of 444,785, that is to say, one death in every seven or eight is due to heart disease. The male sex, on account of the greater strain of daily life, is supposed to be much more subject to heart affections than the female sex. This, however, applies only to the active period of life, and from the age of 65 onwards women die from heart diseases in much greater numbers than men. An employment that necessitates constant and excessive physical strain, however, produces hypertrophy of the heart, which in later life tends to degeneration. Heredity plays an important, though vague and indirect part in the production of cardiac disorders, for, in persons suffering from heart disease, it is often found that a parent or other near relative has been similarly troubled. Diseases of other organs which impair the quality of the blood, or throw a constant mechanical strain upon the heart, lead finally to degeneration of the latter. Bright's disease, various lung diseases, and anæmia are specially potent in this direction. Over-indulgence in alcohol during the earlier part of life is apt, in more advanced years, to result in similar degeneration. All the acute, febrile diseases produce temporary weakness of the heart, and acute rheumatism and scarlatina are particularly liable to be followed by permanent changes in the valves. It is frequently found that a valve of the heart is affected after one of these diseases in childhood, but gives no trouble till middle life is reached, when the symptoms of valvular disease become manifest. Recurring attacks of acute tonsillitis and chorea sometimes affect the heart-valves in a similar manner. Syphilis also has a specially deleterious effect in later life both upon the muscle of the heart, upon its valves,

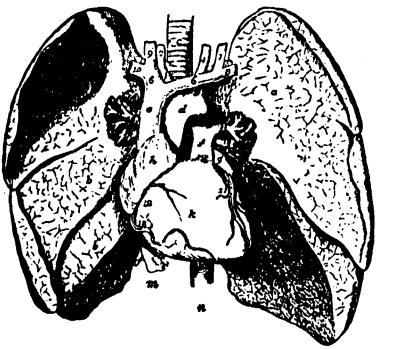


FIG. 259.—The organs of the chest. The lungs are turned outwards to show the heart and the intimate connections between heart and lungs. *a*, Upper, *a'*, lower lobe of left lung; *b*, upper, *b'*, middle, *b''*, lower lobe of right lung; *c*, trachea; *d*, arch of aorta; *e*, superior vena cava; *f*, pulmonary artery; *g*, left auricle; *h*, right auricle; *k*, right ventricle; *l*, left ventricle; *m*, inferior vena cava; *n*, aorta; 1, innominate artery; 2 and 4, carotid arteries; 3 and 5, subclavian arteries; 6, 6, innominate veins; 7 and 9, internal jugular veins; 8 and 10, subclavian veins; 11, 12, 13, left pulmonary artery, bronchus, and vein; 14, 15, 16, right bronchus, pulmonary artery, and vein; 17 and 18, coronary arteries. (Turner's *Anatomy*.)

particularly the aortic valve, and upon the arteries.

General symptoms.—The heart possesses a remarkable power, known as 'compensation', by which it adapts itself to new conditions. Thus if a person takes up some more arduous employment than usual the heart beats more powerfully and becomes larger, in order to overtake the extra strain; and, in a similar way, disease in one part of the organ, such as a valve, may be so compensated that not only do no symptoms arise, but the person may pass through a long life without suspecting the existence of any such defect. The establishment of this 'compensation'

is one of the chief objects of the gradual training which is necessary before undertaking any strenuous athletic exercise. It is a common mistake to suppose that disease of the heart ends always in sudden death, for only disease of the aortic valve and degeneration of the heart-muscle are associated with this accident, which even in these conditions is infrequent. If, however, the defect be so great that it cannot be remedied by 'compensation', or if general ill-health or the debility of age come on, the pumping power of the heart weakens and symptoms appear, some of which are referable to the organs in which the circulation is defective, others, like pain and palpitation, to the heart itself. For example, breathlessness and lividity are due to bad circulation in the lungs; faintness and giddiness to want of blood in the brain; dyspepsia, swelling of the abdomen, and dropsy of the feet, to impeded circulation in the veins of the lower part of the body.

Individual Diseases:

PERICARDITIS is an inflammation of the membrane covering the exterior of the heart. It may be 'dry', in which case the two opposing surfaces of the membrane are covered by a layer of fibrin worked up by the movements of the heart into ridges, very like those upon the surface of two slices of bread and butter forcibly separated from one another; or 'effusion' may accompany this condition, when the pericardial bag becomes much distended by fluid. The causes of the condition are much the same as those of the condition of endocarditis described below. In the majority of cases it arises in connection with an attack of rheumatic fever; and, so long as it remains of the dry type, it occasions only slight feverishness and pain felt over the heart. Poisoned wounds, consumption, scarlatina, diphtheria, pneumonia, and Bright's disease are also, though less frequently, causes. Pericarditis, 'with effusion', generally follows the 'dry' form, unless the latter be very slight in extent, and the amount of fluid effused round the heart may reach as much as two quarts. The fibrin upon the surface of the membrane increases with the amount of fluid, and may form a coating like thick leather round the heart, which very greatly embarrasses its action. Pain over the heart, high fever, rapid and feeble pulse, restlessness, difficulty in breathing, and even delirium, mark the presence of this serious condition. Recovery very often takes place, but the heart is apt to be left weak and dilated, in consequence of permanent roughening and adhesions between the two surfaces of the pericardium, and in long-standing cases this resistance to its action produces great increase in the size of the heart. This condition is known as adhesive pericarditis or adherent pericardium; it leads to great hypertrophy of the heart, and it is apt to be associated with recurring attacks of rapid cardiac action accompanied by breathlessness (paroxysmal tachycardia). Treatment during the acute stage is usually effected either by the application of an ice-bag, or of blisters to the front of the chest, while various stimulants are given to maintain the action of the heart. Occasionally it becomes necessary to tap the pericardial cavity and draw off some of the fluid which is embarrassing the heart's action.

ENDOCARDITIS is an inflammatory condition of the membrane lining the heart, and since the part most subjected to friction and strain is that covering the valves, so these valves are the most commonly affected parts, those on the left side of the heart being affected much more frequently than those on the right side. The inflammatory process consists in the appearance of small groups of nodules upon the valves. These unite to form wart-like growths, upon which fibrin is deposited from the blood to form pendants, often of some length. The condition just described is known as 'simple endocarditis', and occurs most commonly in connection with rheumatic fever and with chorea in childhood. Tonsillitis and scarlatina may also be complicated by simple endocarditis, and weakening diseases like phthisis, diabetes, Bright's disease, and gout may also produce it. Simple endocarditis arises especially in those cases of rheumatic fever which are not allowed to rest during the attack, and though the endocarditis may give no symptom of its presence, it may leave the heart with serious valvular disease. Palpitation and a slight increase of

temperature form often the only warning of the onset of endocarditis during an attack of rheumatic fever.

Another form of endocarditis is known as 'ulcerative' or 'malignant' or 'infective' endocarditis. In more than half of the cases there is a previous history of rheumatism or chorea. In some cases the 'malignant' infection is superimposed on a congenitally deformed valve. The essential feature is a progressive microbic infection of the heart valves or the endocardium of the heart wall. It is of much more serious import than the 'simple' type, since fragments of the ulcerating valves may be carried by the blood-stream all over the body, and set up abscesses in diverse organs, this form, indeed, resulting almost always in death. There is, however, no hard and fast dividing line between simple and ulcerative endocarditis, and various grades of intermediate severity in which life may be prolonged for many months are found. Little can be done for the condition beyond especial rest, quiet, and the application of an ice-bag over the region of the heart.

CHRONIC VALVULAR DISEASES form the most frequent and most important group of heart disorders. Although, in consequence of the power of 'compensation' already mentioned, the heart may become more powerful and so neutralise the ill effects of a narrowed or leaking valve, it is not possible to predict how far this change will be affected by ill-health or the strain of a laborious life, and consequently the detection of valvular disease unfits a person for entrance upon any public service, and renders him subject, if he becomes a candidate for life assurance, either to refusal or to a heavily increased premium. The commonest cause of valvular disease is rheumatic endocarditis, which, instead of passing off with the disease that produced it, has become chronic, leading ultimately either to thickening and contraction of the valves, so that they become unable to close their respective openings, or to adhesion of the segments of the valves to one another at their margins, so that the opening is very much narrowed. The former condition is known as 'incompetence', the latter as 'stenosis', and the two are found either separately, or together affecting the same valve. The valves on the left side of the heart are more frequently affected than those on the right side, in the proportion of about 18 to 1.

AORTIC DISEASE.—Of all the valvular defects, incompetence of the aortic valve is the most serious, and next to it in importance comes stenosis of the mitral opening. Aortic incompetence leads to great dilatation and hypertrophy of the heart, which in well-marked cases becomes so large as to receive the name of the 'cor bovinum' or 'ox-heart'. Although aortic disease in young persons follows upon endocarditis, and may produce a rapidly fatal issue, on the other hand it may give rise to few symptoms directly referable to the heart, though persons who grow up with the defect generally remain more or less stunted in body, and feeble or capricious in mind and temper. Stenosis at the aortic valve is much rarer than incompetence, but when present in childhood it leads even more markedly to feeble development of body and mind. In elderly men aortic incompetence may arise as the result of constant overstrain from an athletic or laborious life, combined with alcoholic indulgence. Syphilis is especially apt to lead to a degenerative and hardened condition of the aortic valve which renders it incompetent. Angina pectoris is not infrequently associated with this condition, in consequence of the spread of the degenerative process to the coronary arteries which supply the muscle of the heart itself with blood. (*See* ANGINA PECTORIS.) In either type, when compensation begins to fail, throbbing of the arteries becomes very noticeable, and headache, giddiness, faintness on rising quickly, and dull pain about the heart appear. Later, shortness of breath causing inability to lie down, and dropsy of the feet and legs appear. Sudden death may occur in a case of aortic incompetence, but death may also come on gradually, ushered in by increasing dropsy, great difficulty of breathing, and mental excitability.

MITRAL DISEASE is of two types. In one case the valve itself is at fault, owing almost always to endocarditis, which produces 'incompetence,' or 'stenosis,' or both. In the other, the left ventricle is dilated so that the two

segments of the valve are held apart by their attachments to its walls, and consequently a state of temporary, secondary, or relative incompetence is produced. It is of great importance to recognise this distinction, because, while the former is permanent and 'organic,' the latter, which is due to the weakness of acute fevers, the strain of a single violent effort, like a race, the debility of anæmia, etc., may end in complete recovery, and is therefore said to be merely 'functional'. Mitral incompetence unaccompanied by stenosis is of relatively little importance, and persons with this defect may lead a strenuous life to an advanced period of age. In defects of this valve, the symptoms relate chiefly to the lungs, breathlessness on exertion being one of the most common, and the lips and ears becoming of a bluish tint, in consequence of the slow passage of blood through the lungs. Bronchitis and spitting of blood are very common, particularly in cases where stenosis is present. When compensation is failing, these symptoms become more marked, the liver and stomach get congested, producing a jaundiced tint of the skin, together with dyspepsia, and congestion of the kidneys, shown by the presence of blood and albumen in the urine, may become dangerous to life. One of the most unpleasant symptoms is the 'sleep-start,' which catches the person as he is dropping off to sleep, making him start up gasping, and feeling as if his heart were stopping. All these symptoms pass off under treatment, to be renewed again and again at periods when the health is low. When the valve is stenosed, there is a tendency to the formation of small clots in the auricle; these may be carried away and lodged in various organs, *e.g.* in the brain, causing apoplexy. Sudden death in mitral disease is rare. Cases of mitral disease, and especially cases in which marked stenosis is present, are very frequently as time goes on associated with a state of dilatation of the auricles, and the condition of disordered action in these cavities is known as auricular fibrillation. This leads to great irregularity in the time and force of the heart-beats, with corresponding irregularity felt in the pulse. (*See below.*)

DISEASE OF THE VALVES ON THE RIGHT SIDE is rare. The tricuspid valve may be incompetent in consequence of far advanced mitral disease, which increases the difficulty of circulation through the lungs and so leads to dilatation of the right side of the heart. Stenosis of the pulmonary valve sometimes forms a congenital condition in children who do not often survive early life.

Treatment of valvular disease.—When a valve defect is accidentally discovered, even though it be perfectly compensated and give rise to no symptoms, it is well that the person should take certain precautions in his daily life, and he should therefore, unless of a peculiarly nervous and highly strung temperament, be informed by his medical adviser of the condition found in his heart. The subject of such disease must lead a quiet and well-regulated life, avoiding, as far as may be, excitement, worry, and sudden strains, though methodical attention to business, and even hard, steady work, are quite well borne. The question of marriage is an important one, and, speaking generally, it is unwise for the subjects of aortic disease to marry, for insurance companies decline the risk in this condition. In mitral disease marriage is not attended with the same risk, although in a woman the condition of a heart with defective mitral valve becomes progressively worse with each confinement. The excessive use of tobacco, prolonged hot baths, and excursions up mountains are, without question, bad for all cases of valvular disease. A simple, wholesome diet is necessary, and stimulants should not be taken so long as compensation remains good.

When compensation begins to fail—and frequently this does not take place till the approach of old age—the symptoms already mentioned appear, but, in early stages, rest may be the only remedy required. Various stimulants and tonics for the heart exist, of which the chief are digitalis, strophanthus, and strychnine. Many persons, by taking one of these drugs periodically and living a carefully regulated life, manage to keep in abeyance all the symptoms of a serious valve defect, and to live a busy, useful life. Congestion of the liver, lungs, and kidneys is treated by purgation, cupping, or even blood-letting,

according to circumstances. For dropsy in advanced cases tapping of the legs, abdomen, or chest has often to be practised. (*See* ASPIRATION.) For breathlessness, the patient must often remain in the sitting posture night and day, and it is very important that a comfortable bed-rest should be provided. Pain about the heart is not very common, but, when it occurs, is relieved by careful attention to the diet, so as to prevent dyspepsia, and by courses of iodide of potassium or nitro-glycerin. Spitting of blood, when it occurs, is not very copious, and is rather salutary than otherwise, so that it does not call for treatment. Sleeplessness is often a very distressing symptom of aortic disease, and is frequently relieved by a teaspoonful or more of compound spirits of ether or of paraldehyde.

ENLARGEMENT OF THE HEART is of two types, dilatation of the cavities with HYPERTROPHY of the walls, and DILATATION with thinning of the walls. The first takes place as the result of simple constant strain, as in professional runners and other athletes. It also arises in consequence of the increased difficulty in the circulation that results from a diseased valve, and it produces ' compensation ' of the valvular disease. It also arises in consequence of high blood-pressure produced by Bright's disease. To this extent, and while general health lasts, hypertrophy is an altogether good thing, the only sign of its presence being a large heart with an extra-powerful beat. But there is in the later years of life a special tendency for the muscle of these hypertrophied hearts to degenerate; and further, if the vessels throughout the body be weak, as in Bright's disease, the powerful beating of the heart may tear them, particularly in the brain, with apoplexy as a result. DILATATION of the heart, with thinning of its walls, is always a bad thing, leading to feeble action of the organ. It occurs also as the result of strain when the heart has not sufficient reserve force to hypertrophy, as often happens when persons not in ' training ' run a hard race. It takes place, too, in persons who are bloodless and subjected to overhard work, and it very often occurs to a slight extent after a severe fever. Sometimes it occurs suddenly, the heart becomes unable to contract upon the blood which accumulates in it, and death results in a few minutes or hours, in consequence of some extraordinary effort by a feeble person, or in consequence of injudicious exercise too soon during convalescence from a fever.

Treatment is much the same as for valvular heart disease where ' compensation ' is failing. For a dilated heart rest combined with regulated exercise is the special treatment. At certain spas and watering-places, these exercises have been brought to great *finesse*. At Nauheim, special gymnastic exercises to develop the heart are combined with carbonic acid baths, and by the Oertel treatment, patients are made to ascend a succession of increasing heights daily, and thus bring on more powerful contraction of the heart.

DEGENERATION OF THE HEART occurs principally in elderly people, the most common form being a change of the muscle fibres, in scattered patches, into fat. In another form of degeneration a deposition of fibrous tissue gradually takes place between the muscle fibres, which at the same time waste away. Less common forms of degeneration consist in a granular change in the fibres, producing great softening in the course of some fatal fevers; and a condition known as ' brown atrophy ', in which the heart-muscle wastes as old age advances, and becomes largely changed into brown pigment.

FATTY DEGENERATION. — In stout people a deposit of fat takes place upon the heart (fatty infiltration), interfering with its action and causing shortness of breath upon slight exertion, but this is not so serious as true degeneration, in which the change involves a gradual destruction of the actual muscle. Fatty degeneration arises as a senile change, most commonly in persons addicted to alcohol, in whom it may appear early in middle life; and also as a sequence to hypertrophy of the heart. In general devitalising diseases like pernicious anæmia, or when the coronary arteries, which supply the heart itself with blood, are narrowed by disease, fatty degeneration of the heart-muscle is common. It may come on acutely in infective diseases like pneumonia or influenza, and is one of the most frequent causes of death in these fevers. If it comes on

HEART DISEASES

gradually, it causes attacks of pain in the left side of the chest and left arm, with great irregularity and palpitation of the heart on exertion. Unusual torpor in the early part of the day following on very slight exertion is also a sign of its presence. Other symptoms are occasional fainting fits and great loss of mental activity, and there is a special danger of sudden death in persons affected by this degenerative process.

FIBROID DEGENERATION of the muscular wall of the heart is usually a result of gradual and very complete blocking in branches of the coronary arteries, due to patches of atheromatous thickening in their walls. The muscle fibres waste or die in patches as a result of defective nourishment, and are replaced by useless fibrous tissue. Dilatation of the cavities, clotting of the blood on the fibroid patches, followed, it may be, by angina pectoris and often by sudden death, take place. This condition of the heart is usually associated with advanced disease in the kidneys. The symptoms are much the same as those due to fatty degeneration. In the treatment, the same drugs are used as for valvular disease, though more sparingly. Careful regulation of daily life with simple diet is of great importance. The person should beware of any excessive mental or physical strain.

FUNCTIONAL AFFECTIONS.—Several varieties of abnormal action of the heart are recognised. Some of these are due to a definite organic disease of the heart, but in many there is no discoverable disease, and the abnormal action is then described as of 'functional' nature. Some of these conditions are due to disease affecting the mechanism in the heart which controls the regular sequence of contraction of the different cavities, but such disease is only recognisable during life by the abnormal action which it sets up.

Many troublesome irregularities of the heart are now known to be caused by defective action of the muscular connections. The site of these defects can be analysed by means of elaborate modern instruments. Of these the chief are the *polygraph*, an instrument by which tracings from the pulsations of the heart and various vessels can be recorded together on a moving strip of paper, and compared; and the *electrocardiograph*, which by means of a galvanometer registers photographically the electrical changes that take place in the body as the heart beats.

The heart-muscle has in itself, independently of nervous control, the power of contracting rhythmically when excited to do so, of conducting the impulse to contract from one part of the muscle to another, and of maintaining itself in a moderate state of tension or tone. When any of these properties is affected by disease some change in the force or rhythm of the heart-beat is apt to appear.

DISORDERED ACTION OF THE HEART is a condition which covers a number of varieties of irregular action, especially a form which occurs in young persons and is accompanied by shortness of breath, rapid and sometimes irregular action of the heart, and depression and irritability of temper. It is due generally to exercises or training, as, for example, in the case of young soldiers, beyond the physical capacity of the individual. It is often aggravated by smoking and by dyspepsia, and it may pass into a condition of neurasthenia. The most useful treatment for this condition is a temporary cessation of exercise, with rest, and bromide of sodium in 5-grain doses three times daily.

PALPITATION is a condition in which the heart beats fast and the person becomes conscious of its beating. (*See* PALPITATION.)

ANGINA PECTORIS is a serious condition in which extreme pain and a sense of impending death are due to spasm of the heart. (*See* ANGINA PECTORIS.)

SINUS ARRHYTHMIA is a condition of irregular action in which the heart delays now and then to start a normal beat. This is felt by the individual, and often causes anxiety. It forms the commonest cause of disordered action mentioned above, and it is not of serious importance, passing off completely under treatment.

AURICULAR FIBRILLATION is the commonest form of persistent irregularity of the heart's action, accounting for about one-half of all the cases of irregular pulse. It usually accompanies disease of the mitral valve, and is recognised by great irregularity in time and force of the pulse, visible pulsations in the veins of the neck, and various signs

which are made out by the use of the polygraph and by auscultation. In this type of irregularity the auricles do not empty themselves by the normal regular waves but contract partially in a rapid series of twitches, and in consequence the ventricles do not receive the normal rhythmic stimulus to contract, and they accordingly contract irregularly. This is a serious irregularity.

EXTRA-SYSTOLES form a common cause of irregular action in irritable states of the heart; the extra-systole is a premature beat followed by a pause of the heart for rest. This is not a serious form of disorder, and it may come and go for many years in certain individuals.

HEART-BLOCK is a serious condition in which the conducting mechanism between auricle and ventricle is impaired (incomplete heart-block) or destroyed (complete heart-block), so that the auricle and ventricle beat at different rates independently of one

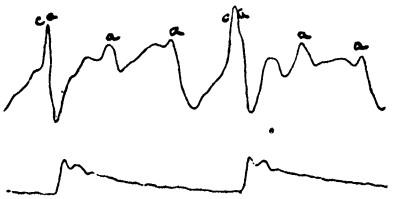


FIG. 260.—Double tracing made with the polygraph in a case of 'heart-block'. The upper tracing, from a vein in the neck, shows the rapid and regular contractions of the auricle; the lower tracing, from the pulse at the wrist, shows the slower beats of the ventricle.

another. During the incomplete stage the pulse is irregular, but when the heart-block becomes complete and the ventricles contract independently of the auricles, the pulse becomes regular and very slow, and the individual is liable to fainting or convulsive attacks (Stokes-Adams disease).

ALTERNATING PULSE is a condition in which there are regularly alternating strong and weak beats of the heart, forming a persistent type of irregularity, which is caused by degeneration of the heart-muscle. It is sometimes found in old age, and is of serious import.

RAPID HEART (*tachycardia*) with a pulse considerably above 100 per minute is often found as the result of enfeeblement of the heart-muscle following febrile conditions such as rheumatic fever. The rate of the heart also quickens when the temperature rises, and in all conditions in which the heart is defective in strength or dilated.

SLOW HEART (*bradycardia*) is a natural peculiarity with some persons, the heart beating only forty, fifty, or sixty times per minute instead of the normal seventy or eighty times. Such individuals are usually of a generally lethargic temperament. Slowness of the heart-beat is also a character of complete heart-block.

HEAT.—(*See* BURNS, HEAT-CRAMPS, HEAT-STROKE, and SUNSTROKE.) The curative uses of heat as applied by hot water and hot air are mentioned under BATHS. Hot-air applications are much used in the treatment of rheumatic conditions in the joints and muscles, and a more powerful application of heat for the same purpose is obtained by the use of high frequency electricity (*see* DIATHERMY). Excessive heat, in the form of the cautery, is also used in order to destroy diseased tissues (*see* CAUSTICS AND CAUTERIES).

HEAT-CRAMPS are painful cramps in the muscles occurring in workers, such as stokers, who labour in hot conditions. The cramps are the result of loss of salt in the sweat, and can be cured by giving salty water to drink.

HEAT SPOTS is a vague term applied to small inflamed and congested areas which appear especially upon the skin of the face, neck, and chest or other parts of the body in warm weather.

HEAT-STROKE, or HEAT HYPERPYREXIA, occurs after exposure to excessive heat, and is characterised by convulsions, unconsciousness, and a temperature above 105° F.

HEBEPHRENIA (ἥβη, puberty; φρήν, mind) is a form of mental disorder coming on in youth and marked by depression and gradual failure of mental faculties with egotistic and self-centred delusions. It is one of the forms of dementia precox.

HEBERDEN'S NODES are little hard knobs which appear at the sides of the last phalanges of the fingers in persons who are the subject of the disease known as rheumatoid arthritis.

HEBETUDE (*hebetudo*) is another term for mental dullness, especially the temporary dullness which arises in the course of weakening fevers like typhoid.

HECTIC (ἑκτικός, consumptive) is a type of fever which comes on late in the course of various tuberculous diseases, when the areas of disease have become infected with other bacteria in addition to the tubercle bacillus. For example, hectic appears when, in the course of consumption, cavities have formed in the lungs, or when in hip-joint disease an abscess has burst through the skin. The temperature rises during the day to 102° or 104° Fahr., and falls during the night almost to normal or even to below normal, 96° or 97° Fahr., with profuse sweating. (*See* CONSUMPTION.)

HEEL is the hinder part of the foot formed by the calcaneum and the specially thick skin covering it. It is not subject to many diseases. Severe pain in the heel is sometimes a sign of gout or rheumatism.

HEIGHT (*see* WEIGHT AND HEIGHT).

HELIOTHERAPY (ἥλιος, sun; θεραπεία, treatment) is a term applied to treatment of disease by exposing the body to the sun's rays. This form of treatment by sun bath has been greatly used in recent times for the cure of tuberculosis and wasting diseases in general. (*See* LIGHT TREATMENT.)

HELLEBORE (*see* VERATRUM).

HELMINTHS (ἕλμινς, a worm) is a name for worms. (*See* PARASITES.)

HEMERALOPIA is the term for describing the condition of day-blindness (*not* night-blindness), in which the patient can see better in a dull light than in bright daylight.

HEMIANÆSTHESIA (ἡμι, half; α, neg.; αἰσθάνομαι, I feel) means loss of touch sense down one side of the body.

HEMIANOPIA, HEMIANOPSIA, and HEMIOPIA (ἡμι, half; α, neg.; ὤψ, sight) are terms meaning loss of half the usual area of vision. The affected person may see everything clearly to the left or to the right, the field of vision stopping abruptly at the middle line, or he may see things only when straight in front of him, or thirdly, he may see objects far out on both sides, though there is a wide area straight in front for which he is quite blind. The position of the blind area is important in localising the position in the head of the disease responsible for the condition.

HEMIATROPHY is atrophy of one side of the body, or of part of the body on one side, for example, facial hemiatrophy, in which one-half of the face is smaller than the other either in the course of development or as a result of some nervous disorder.

HEMICRANIA (ἡμικρανία, pain in half the head) means a headache limited to one side of the head. (*See* HEADACHE.)

HEMIPLEGIA (ἡμιπληξία) means paralysis limited to one side of the body. (*See* PARALYSIS.)

HEMLOCK, or CONIUM, is used in the form both of the leaves and fruit of *Conium maculatum*. Its action depends upon the property which it possesses of paralysing the endings of the motor nerves. It therefore diminishes spasmodic conditions of all sorts, producing at the same time muscular weakness and confusion of vision. In large amount it causes complete paralysis and acts as a narcotic, and was the poison by which Socrates died. The action depends upon a liquid alkaloid, coniine.

Uses.—This drug is used to quiet spasmodic and convulsive conditions of various sorts, *e.g.* mania, chorea; the juice is used for inhalation in asthma.

HEMORRHAGE (*see* HÆMORRHAGE).

HENBANE (*see* HYOSCYAMUS).

HEPARIN is a substance, first obtained from the liver, which prevents coagulation of the blood. It is present chiefly in liver, muscle, and lung. It is thought to act by neutralising thrombin (*see* FIBRIN). Heparin has a complicated chemical structure and has been prepared in crystalline form. It is carbohydrate in nature, and contains amino and sulphuric acid groups. Its practical importance lies in the prevention of blood-clots forming after operation, and in the treatment of cases in which blood-clots have already formed.

HEPATISATION (ἧπαρ, the liver) means the solidified state of the lung which appears in pneumonia, giving it a consistence like that of the liver.

HEPATITIS (ἧπαρ, the liver) means inflammation of the liver. (*See* LIVER.)

HEPATITIS, EPIDEMIC INFECTIVE. Known also as COMMON INFECTIVE JAUNDICE, EPIDEMIC CATARRHAL JAUNDICE, EPIDEMIC JAUNDICE.—An acute infection of the liver probably caused by a filter-passing virus, occurring usually in epidemics, and in most cases manifesting itself chiefly by jaundice. The incubation period varies from 26 to 35 days; the disease may come on suddenly or gradually, sometimes resembling pneumonia or meningitis; jaundice appears about the 7th or 9th day, and may persist for 2 or 3 weeks. The patient may remain out of health for some weeks. The infective period is believed to be short, and isolation of the sick person for a fortnight is considered to be long enough. It is not known how the disease spreads, except that it is chiefly by contact and possibly as a droplet infection through the upper respiratory tract.

HEREDITY (*hereditas*, heirship) is a term indicating the principle on which various peculiarities of bodily form or structure, or of physical or mental activity are transmitted from parents to offspring, and so handed down through a family stock.

Every individual begins life as two cells, derived one from each parent. These germinal cells are in a sense half-cells, because in preparation for union the nucleus of each has extruded from the cell one-half of the rod-shaped bodies (chromosomes) by which the characters of the individual are supposed to be determined. Each germinal cell thus supplies 24 chromosomes, carrying certain characters from one of the parents, to form, with those of the other, the 48 chromosomes in the new cell from which all the other cells of the human body are derived by a process of growth and repeated division. (*See* FOETUS.) In the process of extrusion of chromosomes certain 'genes' or characters possessed by either parent may be lost to the offspring.

According to Weissmann's germ-plasm theory, a fragment of the new cell is at once set apart for the formation of the germ cells in the new individual and thus conformity of succeeding generations with their predecessors is secured. Galton stated a rule that the total heritage of an offspring is derived, on the average, one-half from the parents, one-quarter from the grandparents, one-eighth from the great-grandparents, and so on. This, while doubtless true in a general way, does not account for the evident differences among brothers and sisters. Mendel's theory to explain this supposes that simple or 'unit' characters, such as height or colour of hair, are 'segregated' or transmitted alternatively to the offspring (according to which chromosomes have been lost or retained) instead of being an average of these characters as shown in the two parents. Each unit character has a variation, which is in a sense its opposite, like tallness and shortness. The one of these which tends to give the appearance to the individual is called the 'dominant' character (in this example, tallness), the other variation is called 'recessive,' though both have an equal tendency to be transmitted.

For example, if two persons of a pure-tall stock are mated, their children will all be tall, while the children of a pure-short race union will all be short. If, however, a pure-tall stock person be mated with a pure-short stock person, all their children, though tending to be tall in appearance, may transmit either tallness or shortness to the next generation, and the final average result will be, out of every four children, one true tall who will transmit tallness, one true short who will transmit shortness, and two of tall appearance who will transmit with an equal chance tallness or shortness to their children. The last is the general formula on which in modern human communities hereditary characters are likely to be transmitted.

In plants or animals the breeding of single desirable unit characters like colour or length of limb or quality of hair is a comparatively simple affair of selection in mating. In human eugenics, however, desirable qualities are complicated matters of character

or intellect or general physique, which depend for their development as much upon environment and personal influence during childhood as upon heredity. It is noteworthy also that persons who appear unfit in one aspect are often well endowed in others.

The transmission of characters which predispose to certain diseases is a matter of some importance, although most serious defects tend to die out through difficulties to procreation set up by modern conditions of life. In regard to epilepsy, about one-third of all cases occur in families subject to this disorder, while out of 10 children of epileptics one is likely to develop epilepsy. Among mental disorders, manic-depressive insanity and schizophrenia show a tendency to appear in children of persons affected in these ways, and like the majority of mental conditions, these disorders are apt to be most pronounced in children of whom both parents have been similarly temperamental. Primary mental defect, on the other hand, is often wrongly supposed to be hereditary, for the great majority of mentally defective children are found in otherwise normal families; still, the mating of two feeble-minded persons is inadvisable.

The shape of the eye is largely a hereditary character so that short-sight, astigmatism, etc., tend to run in families; cataract is also largely familial; colour-blindness is handed down as a sex-linked character affecting males but transmitted by females who do not suffer from it; a rare form of blindness due to atrophy of the optic nerve is similarly transmitted. As to ear defects, the condition of otosclerosis, causing deafness late in life, runs in families, while among deaf-mutes one in four owes this condition to defects in the nervous system which may be transmitted.

A tendency to rheumatism, or to tuberculosis or to certain skin diseases is due to defective power to resist the effective causes of these diseases, which may be a hereditary defect. Similarly, faults in the structure of certain organs, which may be inherited peculiarities, produce a liability in some families or races to goitre, diabetes, gastric ulcer, asthma, etc.

HERMAPHRODITE (Ἑρμῆς, Mercury; Ἀφροδίτη, Venus) is the name applied to a person in whom the sexual organs are so defectively formed that it is difficult to decide the sex, or in whom there appear to be parts belonging to both sexes.

HERNIA (*hernia*) means the protrusion of any organ, or part of an organ, into or through the wall of the cavity which contains it. Thus 'hernia of the brain' may occur in consequence of a severe injury to the skull, 'hernia of the lung' in consequence of a wound of the chest wall, but these are uncommon, and, as a rule, the name is applied only to hernia of the bowel, the popular term for which is 'rupture.'

Varieties.—Though far the commonest organ found in a hernia is part of the bowel, yet any of the abdominal structures, such as stomach, kidney, ovary, womb, bladder, or omentum, may be found projecting through an opening in the wall of the abdomen and lying close beneath the skin. Probably the only two organs exempt are the liver and pancreas, by reason of their position and connections. The projecting organ carries in front of it, and is enveloped by, a 'sac' of peritoneum, the smooth membrane lining the interior of the abdomen. It is separated from the surface at least by this 'sac' and by the skin. A hernia is usually described according to the position at which it protrudes. There are certain natural openings in the region of the groin on either side; one known as the 'inguinal canal', through which the testicle descends in early life, and which the spermatic cord keeps always more or less open; the other, known as the 'crural canal', which lies to the inner side of the large femoral vessels that pass from the abdomen to the thigh. The inguinal canal ends just above the pubic bone, its exit, known as the external abdominal ring, being large enough to admit the tip of the finger. The crural canal is less in size and is separated from the former only by the inner end of Poupart's ligament, a strong band which lies beneath the oblique groove that can be seen on the surface to separate the abdomen from the thigh. A hernia emerging from the former is known as an *inguinal hernia*, and tends to descend along the

spermatic cord into the scrotum. A hernia emerging through the crural canal comes forwards on the front of the thigh, and is called a *femoral hernia*. A weak spot exists in the centre of the abdomen at the navel, and here, not infrequently in young children of poor development, a hernia may appear, which is then known as an *umbilical hernia*. A hernia which protrudes at some accidental opening on the abdomen, as, for example, through the scar of an operation wound, is known as a *ventral hernia*. A rare form of hernia is one which passes through the gap in front of the pelvis between the ischial and pubic bones; it is known as an *obturator hernia*. Finally, there are various forms of *internal hernia*, the protruded organ passing up into the chest, or into some other region where it does not show itself on the surface.

A hernia may also be considered as *congenital*, that is, existing at birth, or *acquired* later on in life. The only positions in which congenital hernia is found are in the umbilical and inguinal regions. In the latter case, the hernia descends along with the testicle toward the scrotum, the hernia being inside the tubular process of peritoneum (the lining membrane of the abdominal cavity), which descends with the testicle in order to provide it with a smooth tunic.

A very important classification of hernia is made according to the condition of the protruding organ. A *reducible hernia* is one which is so freely movable that it may be pressed back into the abdomen, though it comes down again by the same opening unless this be blocked up. An *irreducible hernia*, on the other hand, is one which cannot be returned, either because it has become adherent to its new surroundings, because it has enlarged after emerging, because much fat has been deposited inside the abdomen, or for some similar reason. An *obstructed hernia* is one in which, a part of the bowel being protruded, some of its contents become caught inside, and cannot for a time pass on, a state of costiveness arising in fact inside the hernia. A *strangulated hernia* is by far the most important variety, because of its immediate danger to life. In this form, the circulation of blood in the protruded bowel becomes cut off by the margin of the opening through which the loop of bowel has passed; and, if an operation be not immediately performed for its relief, the bowel will become gangrenous, and the patient will die within a few days. The great danger attending all forms of hernia is that they may at any time become 'strangulated'.

Causes.—Two factors come into play in causing hernia. Firstly, some defect or injury of the abdominal wall; and, secondly, some increase of pressure within the cavity. With regard to the hernia at the umbilicus of young children, there is usually some defect in the closure of the opening through which the navel-string passes before birth, and through this opening a loop of bowel is forced by excessive crying or the like. In inguinal hernia, which, it may be noted, is far commoner in men than in women, the defect consists in some failure of the inguinal canal, through which the testicle descends before birth, to close completely. There may, in congenital hernia, be a completely open passage leading out of the abdomen, or there may be simply a small pocket in the peritoneum which, by a sudden strain or by long-continued pressure, such as coughing, gets torn or stretched in front of a protruded organ. Femoral hernia is commoner in women than in men, probably on account of the peculiar shape and inclination of the pelvic bones, and arises in a manner similar to that just stated for inguinal hernia. Both in these and in ventral hernia, the occurrence of marked changes in size of the abdomen, such as great increase in stoutness, great loss of fat, and repeated child-bearing, have the effect of greatly weakening the abdominal wall and predisposing to the formation of hernia. All laborious occupations involving great efforts, and bodily conditions involving frequently repeated strains, such as chronic cough or constipation, conduce to hernia of all sorts. Accordingly hernia is much more common in the male sex, who lead a more laborious life, than among females.

Symptoms.—The symptoms vary much, depending upon the particular organ which is protruded, upon the size of the opening, which may or may not compress the hernia, and upon the condition of the latter. In the great

majority of cases, the hernia consists of one or more loops of the small intestine, and, if the hernia be of small size and readily reducible, the symptoms are somewhat as follows. If the hernia be produced quite suddenly, as during the lifting of a heavy weight, the person affected may hear or feel a distant crack, and be conscious that something has given way, but, as a rule, suffers no sharp pain. More usually the hernia develops gradually, and the symptoms have then no definite onset, but simply increase till they attract attention. An undefinable sense of weakness, and occasionally pain, are felt in the region of the hernia. When any great effort is made, such as coughing, or straining at stool, or lifting a weight, a swelling appears with a gurgling feeling at the seat of the hernia, though this can be made to disappear by pressure when the person lies down. Even if the hernia does not come far down, a distinct impulse on coughing is communicated to the hand laid upon the swelling, which is situated usually at the inner end of the groin. When the hernia has become irreducible, the swelling does not vary in size, but the impulse on coughing is still to be felt. The presence, even of a small hernia, generally occasions some interference with digestion, and constipation is a common accompaniment. A dragging sensation in the back is also another frequent symptom. When a hernia becomes ' strangulated ', as the result of stoppage of its circulation by the pressure of the margin of the ring through which it comes, a very marked set of symptoms ensues. The hernia first inflames, becoming acutely painful, and then in a few hours turns gangrenous, producing general peritonitis and death, if not relieved. At the same time, all passage of contents through the bowel is stopped, and, as a result, the bowels do not move, though some of their contents pass in the reverse direction, up to the stomach, whence they are vomited. Accordingly the onset of abdominal pain, accompanied by stoppage of the bowels and vomiting in a person possessed of a hernia, forms an ominous sign, and, even if no hernia be known to exist, the appearance of these three symptoms calls for immediate examination of the region of the groin by an expert medical practitioner.

Treatment. — When a hernia is present, it may be treated in a palliative manner, so as to relieve unpleasant symptoms and diminish the risk of strangulation, or an attempt may be made to cure it altogether.

PALLIATIVE TREATMENT. — If the hernia be reducible, it is pushed back through the opening into the abdomen by manipulation known as ' taxis ', and is then retained by an artificial support known as a ' truss '. The truss in its simplest form may consist merely of a pad of lint or folded handkerchief kept in position by a ' spica ' bandage. In infants, a very simple truss may be improvised from a skein of worsted, which is carried round the waist, one end passed through the other end over the site of the hernia, and the loose end carried down between the legs, and pinned to the circular part behind the back. For adults, the usual truss consists of a pad which fits over the opening, a spring to run round the pelvis and a strap to pass between the legs and prevent the truss from sliding upwards. The pad for an inguinal hernia is differently shaped from, and should be much larger than, that for femoral hernia. For bathing, a truss made of india-rubber and vulcanite may be obtained. In getting a truss the particulars required are: (*a*) the girth round the pelvis below the crests of the haunch-bones; (*b*) the variety of hernia; (*c*) the side on which it is situated; (*d*) the age and sex of the patient; (*e*) the strength desired in the spring. No pains should be spared to get a correctly fitting truss. In young persons, particularly those whose hernia is recently developed, a well-fitting and properly applied truss may be regarded not only as a palliative, but as an actually curative measure. For the latter purpose the hernia must, after being once pushed up, never again be allowed to appear, in order that the opening may gradually close. To this end, the truss must be worn night and day, a lighter and weaker truss being worn for comfort at night; and if this be rigorously carried out, a complete cure may result in a year or two. (*See* TRUSS.)

If the hernia be irreducible, a different type of truss, designed merely to protect the hernia, must be used.

CURATIVE TREATMENT.—The danger

of strangulation, involving an immediate operation with great risk to life, is present so long as a hernia exists, and, except in young people whose hernia is very small and who can attempt its cure by a truss, or in old people with a very wide opening, the chance of radical cure and removal of the danger, offered by an operation, deserve to be carefully considered. The operation, known as the 'radical cure', is not in itself a dangerous one, and the period of enforced idleness consequent on it amounts only to a few weeks.

Many operations are performed by different surgeons, but all consist briefly in this, that an opening is made over the hernia, and after the hernia has been returned into the abdomen, the sac is cut off, bunched up, turned aside, or otherwise disposed of, and the margins of the opening united by strong sutures. Almost all cases operated upon in this way result in complete cure.

When a hernia is irreducible, some special diet or other treatment is often required prior to the operation, in order to diminish the amount of fat in the abdomen, reduce the size of the hernia, etc.

When a hernia becomes strangulated, an operation becomes urgently necessary. The first object of this operation is to set free the hernia from the margin of the opening, tight band, or other cause that is impeding the circulation in it. This having been achieved, if the bowel is not too much damaged by the pressure it has received, it is returned to the abdomen, and the radical cure performed. Sometimes, however, the bowel has been so much damaged by several hours of pressure, that it would be too dangerous to replace it, and then, the compression having been relieved, either the damaged portion is completely cut out and the ends united by stitching, or the bowel is simply left in the wound for a few days, and the operation completed at a subsequent stage, if the bowel recovers its vitality. If the damaged loop of bowel does not recover, but sloughs away, then either the patient dies, or a fistula is left, from which the contents of the bowel escape to the exterior. This can, however, be closed by subsequent operation.

HEROIN, also known as DIAMORPHINE HYDROCHLORIDE and DIACETYLMORPHINE HYDROCHLORIDE, is a white crystalline powder of slightly bitter taste derived from morphine. It has a slighter soporific action than the latter and is not so liable to produce constipation. It has a special action in soothing the part of the nervous system connected with respiration, the beating of the heart, and other vital processes. It is much used as a mild soporific and for its special action in quieting excessive coughing in cases of chronic bronchitis and consumption. The dose is from $\frac{1}{12}$ to $\frac{1}{8}$ grain.

HERPES (ἕρπω, I creep) or SHINGLES is a skin eruption of acute nature, closely related to chicken-pox, consisting in the appearance of small yellow vesicles, which spread over an area, dry up, and heal by scabbing.

Varieties.—Herpes zoster or 'shingles' is the best-known form. It receives its name from the Greek word ζωστήρ, a 'circingle', or girdle, because it spreads in a zone-like manner round half the chest. Herpes of the face also occurs, particularly on the brow and round the eye. Herpes of the lip is a very trifling condition which arises during the course of pneumonia and other febrile conditions (herpes febrilis).

Causes.—The direct cause of the appearance of herpes is some affection of the nervous system. As a rule, an attack is due to inflammation limited to a single nerve in the wall of the chest, but more than one are sometimes affected. The inflammation may also be seated in the fifth cranial nerve, and manifest itself as herpes of the face.

Both sexes suffer from it equally, and young persons are much more frequently affected than old. Cold appears sometimes to be the cause, and herpes rarely shows itself in those who are thoroughly robust, but usually in persons recovering from some acute disease, suffering from some weakening condition like consumption, or some disorder of the nervous system, or in those who have passed recently through much worry and hard work. Sometimes, too, it is a sign of the presence of pleurisy which is not causing sufficient pain to attract attention. Herpes may also, though rarely, be a symptom of some grave disease in the spinal cord or spine.

In some cases herpes has been traced to infection from chicken-pox, and may be a variety of this disorder.

Symptoms.—The first symptoms of herpes are much like those of any feverish attack. The person feels unwell for some days, has a slight rise of temperature, and vague pain in the side or in various other parts. The pain finally settles at a point in the side, and, two or three days after the first symptoms, the rash appears. Minute yellow blebs are seen on the skin of the back, of the side, or of the front of the chest, or simultaneously on all three, the points corresponding to the space between one pair of ribs right round. These blebs increase in number for some days, and spread till there is often a complete half girdle round one side of the chest. The pain in this stage is severe, but it appears to vary a good deal with age, being slight in children and very severe in old people, in whom indeed herpes sometimes forms a serious malady. After one or two weeks, most of the vesicles have dried up and formed scabs, which finally drop off, leaving the skin just as it was before, or covered with small scars. Occasionally the little vesicles run together into large blebs, which leave ulcers difficult to heal, and followed by marked scars. The skin is generally healed completely in two or three weeks, but a peculiarity about the pain is that, in old people especially, it may not pass off when the eruption disappears, but may remain for weeks or even months.

Treatment.—If any cause for an attack of herpes be known, it should be removed. Thus, if the affected person be in poor health tonics are necessary; if he be of rheumatic constitution, salicylate of soda, and so on. In the very early stage, before the vesicles have formed, cocaine or atropine ointment rubbed into the side eases the pain and seems to prevent to some extent the outbreak of the eruption. Later, when the vesicles have formed and are discharging, a dusting-powder of starch, zinc oxide, and bismuth subnitrate gives much relief, or the side may be painted with glycerin jelly containing menthol or with a mixture of chloral, camphor, and menthol in equal parts. In any case the part should be kept warm by a dressing of cotton-wool.

HERXHEIMER REACTION is an inflammatory reaction produced in the tissues in cases of syphilis, especially in the nervous system following upon treatment with salvarsan or similar drug. It is due apparently to poisonous substances set free by the destruction of the organisms of this disease, and its possible occurrence forms a reason for great caution in treating syphilitic diseases of the nervous system by these remedies.

HESPERIDIN is one of two vegetable dyes in vitamin P, a crystalline substance obtained from lemon juice and Hungarian red peppers and believed to control the permeability of capillaries. Hesperidin has a vitamin-P-like action.

HEXAMINE, also known as HEXAMETHYLENAMIN and HEXAMETHYLENETETRAMIN, is another name for urotropin.

HEXOBARBITONE (*see* EVIPAN).

HEXŒSTROL is a synthetic œstrogen closely related to stilbœstrol (*q.v.*) and is similar to it in action. It has the great advantage over stilbœstrol in being less toxic and less apt to upset the gastro-intestinal tract. The chemical description of hexœstrol is 4 : 4′-dihydroxy-γ: δ-diphenyl-*n*-hexane.

HICCUP is a spasmodic indrawing of air to the lungs, ending with a click, due to sudden closure of the vocal cords. The cause is some irritation of the nerves which go to the diaphragm, producing sudden contractions of the latter. Most cases, especially those recurring habitually about the same hour of the day, are due to indigestion, and the symptom also occurs in some serious general diseases, like the uræmia of Bright's disease and typhoid fever, being in such cases a grave sign. Hiccup lasting over some days or weeks is in some cases a symptom of mild encephalitis lethargica.

Treatment.—If the condition be due to dyspepsia, it is often relieved by a copious draught of cold water or by some aromatic like a few drops of spirit of chloroform, a teaspoonful of Hoffmann's anodyne, or a tablespoonful of peppermint water or cinnamon water. When continuous and excessive it is usually controlled by bromides.

HIERA PICRA, popularly known as 'hickory pickory', is a powder composed of aloes and canella, used as an aperient and emmenagogue. Its dose is 3 to 10 grains.

HIGH FREQUENCY (*see* ELECTRICITY IN MEDICINE).

HILUM, or (incorrectly) HILUS, is a term applied to the depression on organs such as the lung, kidney, and spleen, at which the vessels and nerves enter it and round which the lymphatic glands cluster. The hilum of the lung is also known as its root.

HIP-JOINT is the joint formed by the head of the thigh-bone and the deep cup-shaped hollow on the side of the pelvis which receives it (acetabulum). The joint is of the ball-and-socket variety, is dislocated only by very great violence, and is correspondingly difficult to reduce to its natural state after dislocation. The joint is enclosed by a capsule of fibrous tissue, strengthened by several bands, of which the principal is the ilio-femoral or Y-shaped ligament placed in front of the joint. A round ligament also unites the head of the thigh-bone to the margin of the acetabulum.

For Hip-joint Disease *see under* JOINTS, DISEASES OF.

HIPPUS (ἵππος, horse) is the term applied to a tremor of the iris which produces alternating contraction and dilatation of the pupil. This is frequently a sign of hysteria.

HIRSCHSPRUNG'S DISEASE, or MEGACOLON, is the term given to a curious condition in childhood which is characterised by great hypertrophy and dilatation of the colon.

HISTAMINE is a substance which is normally present in the tissues of the body. It is a powerful stimulant of the secretion of gastric juice. On injection it causes a condition of shock, with dilatation of capillaries, and fall in blood-pressure. In anaphylactic shock it is liberated from the liver of the dog and the lung of the guinea-pig. Histamine is destroyed by an enzyme, histaminase, present especially in the kidney and the small intestine. Histamine can be obtained by the bacterial degradation of histidine, an amino-acid.

HISTIDINE is an amino-acid from which histamine is derived by decomposition. Histidine is believed to have a special healing action upon the gastric mucous membrane and has been used by intramuscular injection for the treatment of gastric and duodenal ulcer.

HIVES is a popular term applied to eruptions of the nature of nettle-rash.

HODGKIN'S DISEASE, or LYMPHADENOMA, is a condition in which the lymphatic glands all over the body undergo a gradually progressive enlargement. The cause is not known, though in some cases there seems to have been a local source of irritation in the neighbourhood of the glands first affected. The glands affected may reach a great size, and also glandular tissue forms in various organs all over the body. Along with these changes a considerable degree of anæmia arises, and the affected person becomes gradually weaker. The disease may extend over several years, but seems to be very little influenced by treatment. Arsenic appears to have more effect in retarding it than any other drug has. Surgical removal of affected glands is useless in checking the enlargement of others. The application of X-rays or radium to one of the masses of enlarged glands temporarily diminishes their size.

HOLOCAINE HYDROCHLORIDE, or PHENOCAIN, is a crystalline substance nearly allied to phenacetin, used as a local anæsthetic for application to the eye in 1 per cent solution, but not adapted for hypodermic use.

HOMATROPINE is an alkaloid derived from atropine and used to produce dilatation of the pupil and to paralyse accommodation temporarily for the purpose of examining the interior of the eye. It is used in 1 per cent solution, and its effects pass away in the course of a few hours.

HOMŒOPATHY (ὅμοιος, like; πάθος, disease) is a system of medicine founded by Hahnemann at the end of the eighteenth century. It is based upon the theory that diseases are curable by those drugs which produce effects on the body similar to symptoms caused by the disease (*similia similibus curantur*). In administering drugs, the theory is also held that their effect is increased by giving them in minute

doses obtained by diluting them to an extreme degree. This system has in recent years had few followers.

HOOKWORM is another name for the ankylostoma or uncinaria. (*See* PARASITES.)

HOPS are used in medicine as the powder got from the dried fruit of *Humulus lupulus*. The plant contains an alkaloid, lupuline, which is possessed of a weak sedative action; and various preparations of hops are used to control hysteria, nervousness, and insomnia. A poultice made from crushed hops is a household sedative in cases of localised pains, and hop pillows have been used for nervous insomnia, though probably the effect is largely imaginary.

HORDEOLUM (*hordeolum*, barley grain) is another name for stye.

HOREHOUND is the name for the dried leaves and tops of *Marrubium vulgare*, which is used for coughs, either mixed with sugar or as fluid extract in doses of 1 to 2 drams.

HORMONES (ὁρμάω, I stir up) are substances which on absorption into the blood influence the action of tissues and organs other than those in which they are produced. The internal secretions of the ovary, pancreas, thyroid, pituitary and suprarenal bodies afford examples of this action. (*See also* AUTOCOID.)

HORNER'S SYNDROME is the description given to a combination of bodily changes resulting from paralysis of the sympathetic nerve in the neck; they are: small pupil, sunken eye, and a drooping upper eyelid.

HORRIPILATION is another term for goose-flesh, due to contraction of the small muscles in the skin which make the hairs erect.

HOSPITAL (old French word) is a building intended for receiving sick or injured persons. In Great Britain hospitals are divided into four chief classes according to their manner of administration:

(1) VOLUNTARY HOSPITALS are supported by public subscription and administered by a board of managers chosen by the subscribers. The total number of voluntary hospitals in Great Britain is over 950, providing in all nearly 53,000 beds. The voluntary hospital was introduced into Europe from the East at the beginning of the thirteenth century, chiefly owing to the exertions and influence of Louis IX. of France and Pope Innocent III. Although originally supported as a charity by the wealthier members of the community for the benefit of the poor, the voluntary hospital now in most cases derives the greater part of its annual revenue from the subscriptions of those who have been or are likely to be treated in it. These subscriptions in many instances are collected by small weekly payments, for example, by deduction of a few pence from weekly wages. Hospital maintenance, therefore, has become a kind of informal insurance against serious illness or accident. At the present time, however, very few of the voluntary hospitals possess sufficient income to pay any salary to the medical men who carry out the treatment of the patients. In the other types of hospital, the medical staff receive salaries or, in the case of private hospitals, receive fees from the individual patients. The yearly cost of maintaining a bed in a voluntary hospital is about £100 to £150, or about £2 to £3 weekly for each patient; this sum makes allowance for nursing, food, lighting, heating, washing and renewal of linen and other stores, and use of special appliances, such as baths and X-ray apparatus, but does not provide for medical or surgical advice and treatment.

In America most of the large voluntary hospitals have private blocks or private wards attached, where patients pay the full cost of both maintenance and of medical or surgical treatment as required. These private sections, by sharing many of the unavoidable general charges, such as administration, prove a source of revenue to the large hospitals. For the same reason, the small private nursing homes, which form the main provision for private patients in Great Britain, and in which the general expenses are spread over a small number only of patients, are necessarily very expensive.

(2) COUNCIL HOSPITALS are supported by town and county councils, and administered by their local health authority, under the general supervision of the Ministry of Health

(England) and Department of Health (Scotland). Prior to the Local Government Acts (1929), most of these were devoted to treatment of infectious diseases, but municipal hospitals are now provided in many localities for treating general medical and surgical ailments. These are supported from local rates, and the Council may recover the cost of treatment from patients. These hospitals usually have whole-time resident medical officers, and salaried visiting consultants.

(3) STATE HOSPITALS are supported out of Parliamentary grants and administered by Military, Naval, Pension, or Prison authorities; these hospitals are relatively few in number. They have a medical staff composed of officers of the service to which they belong.

(4) PRIVATE HOSPITALS are owned and managed by private individuals or companies for profit; most of these are of small size, taking ten or twenty patients, and are then known as 'Nursing Homes'.

Hospitals are also classified according to the type of case with which they deal, as follows: (*a*) GENERAL HOSPITALS admit both cases of disease requiring treatment by diet, drugs, and other non-operative procedures (medical cases), and cases of disease and injury requiring operation or manipulation (surgical cases). Most of the larger general hospitals also possess special departments (for eye diseases, diseases of ear, nose, and throat, diseases peculiar to women, etc.). The general hospitals are classified into large hospitals with a number of beds between 100 and 1000; intermediate hospitals with 50 to 100 beds; and cottage hospitals with fewer than 50 beds. *Teaching Hospitals* form a special subdivision of the general hospitals, which are connected with a medical school, and are attended by medical students. These are among the largest and most efficient of the general hospitals. (*b*) SPECIAL HOSPITALS are reserved for one special kind of case. Of these, the best known types are *Children's Hospitals*, *Eye Hospitals*, *Maternity Hospitals*, *Mental Hospitals*, and *Cripple Hospitals*. (*c*) CONVALESCENT HOSPITALS are usually situated in a rural or seaside district where light and fresh air are abundant. They receive patients, usually from general or special hospitals, who require little in the shape of treatment, but whose bodily powers are still enfeebled after serious illness or operation. Since the main expenses incurred in these hospitals are for housing and feeding only, their cost is relatively much less than that of the general and special hospitals. The later stages of treatment are therefore carried out more effectively, more speedily, and more cheaply in such hospitals.

HOUR-GLASS STOMACH is the term given to the X-ray appearance of a stomach which is constricted in its middle part because of either spasm of the stomach muscle or contraction of scar tissue from a gastric ulcer.

HOUSEMAID'S KNEE (*see* BURSITIS) is an inflammation of the bursa in front of the knee-cap, often mistaken for some disease in the joint itself.

HOUSES and BUILDING SITES (*see* SANITATION).

HUMERUS is the bone of the upper arm. It has a rounded head, which helps to form the shoulder joint, and at its lower end presents a wide pulley-like surface for union with the radius and ulna. Its condyles form the prominences at the sides of the elbow.

HUMOUR (*humor*) is a term applied to any fluid or semifluid tissue of the body, *e.g.* the aqueous and vitreous humours in the eye. The term humour is also associated with a theory regarding the causation of disease, which originated with Pythagoras and lasted in a modified form until the early part of the nineteenth century. According to this theory diseases are due to an improper mixture in the body of blood, bile, phlegm, and black bile. There has been in recent years a certain amount of return to this theory because of increased knowledge of the influence of the endocrine glands in health and disease.

HUNGER is the term applied to a craving for food or other substance necessary to bodily activity. Hunger for food is supposed to be directly produced by the secretion of small quantities of acid gastric juice which irritate the stomach when it contains no food

to absorb the juice secreted. (*See also* THIRST.) AIR HUNGER is an instinctive craving for oxygen resulting in breathlessness, either when a person ascends to great heights where the pressure of air is low, or in some diseases such as pneumonia and diabetes.

HUNTINGTON'S CHOREA is a hereditary disease in which choreiform movements, ataxia, and paralysis develop at about the age of 40 and lead to progressive mental deterioration.

HUTCHISON'S TEETH.—This is the term applied to the narrowed and notched permanent incisor teeth which occur in congenital syphilis.

HYDATID (*ὑδατίς*) is a cyst produced by the growth of immature forms of a tapeworm. (*See* PARASITES.)

HYDNOCARPUS OIL is an oil pressed from the seeds of *Hydnocarpus wightiana*, used in the treatment of leprosy. (*See* CHAULMOOGRA OIL.)

HYDRÆMIA, or HYDREMIA (*ὕδωρ*, water; *αἷμα*, blood), is a condition in which the blood contains an excess of water. It is found in certain forms of Bright's disease leading to dropsy.

HYDRAGOGUES (*ὕδωρ*, water; *ἄγω*, I move). (*See* PURGATIVES.)

HYDRARGYRUM is another name for mercury.

HYDRASTIS, or GOLDEN SEAL, is the dried root of *Hydrastis canadensis*. Various preparations are used, both as a gastric stimulant in order to increase the appetite, and to check internal hæmorrhage, particularly that from the womb.

HYDROCELE (*ὑδροκήλη*) is a collection of fluid connected with the testicle or spermatic cord, due to some inflammation of the sac in which these structures are enclosed. It develops usually in middle life, though it may appear at any time, increases gradually in size, and is devoid of pain. The condition presents some resemblance to hernia, and there is occasionally some doubt in distinguishing between them, particularly when the hydrocele communicates with the abdominal cavity. In children, the application of counter-irritation to the skin covering the hydrocele is often enough to bring about the absorption of the fluid. In older people, some operative procedure is necessary; and either the hydrocele is punctured with a hollow needle, its fluid drawn off, and some strong irritant injected into the cavity, or, if the sac refills after this treatment, the wall of the sac is bodily removed under an anæsthetic.

HYDROCEPHALUS (*ὕδωρ*, water; *κεφαλή*, the head) is a term applied to two quite different forms of disease of the brain, both of which are attended with the effusion of fluid into its cavities. These are named *acute* and *chronic hydrocephalus*.

ACUTE HYDROCEPHALUS was the name formerly used to describe the disease now generally known as tuberculous meningitis. (*See* MENINGITIS.)

CHRONIC HYDROCEPHALUS is a different form of disease from that above mentioned, as regards both its pathology and its effects. It consists in an effusion of fluid into the serous cavities (arachnoid and ventricles) of the brain, not preceded by tuberculous deposit or acute inflammation, but apparently depending on chronic inflammatory changes affecting the membranes and causing retention of cerebro-spinal fluid secreted within the brain. The disease is frequently congenital, and its presence in the fœtus is apt to be a source of difficulty in parturition. It is, however, more commonly developed in the course of the first six months of life; but it occasionally arises in older children, or even in adults, as in the well-known instance of Dean Swift, who died from this disease.

Symptoms.—Chronic hydrocephalus affects mostly children who bear evidence of a scrofulous, rickety, or otherwise delicate constitution. The chief symptoms observed are the gradual increase in size of the upper part of the head, out of all proportion to the face or the rest of the body. Occurring at an age when as yet the separate bones constituting the skull have not become welded, this enlargement may go on to a very considerable extent in all directions, but chiefly in the transverse and antero-posterior diameters, the membranous spaces between the bones becoming more and more expanded, though ultimately, should the child survive, ossification takes place, and

the distended brain becomes encased in a thin skull.

As illustrating the extent to which this disease may proceed, it may be mentioned that the average circumference of the adult head is about 22 inches, while in the child it is of course considerably less. In chronic hydrocephalus, the head of an infant three months old has been known to measure 29 inches; and in the well-known case of the man Cardinal, who died in Guy's Hospital, the head measured 33 inches. In the museum of the faculty of medicine in Paris there is a hydrocephalic skull measuring 39 inches. The cerebral ventricles are widely distended, and the convolutions flattened, while occasionally the fluid escapes into the cavity of the cranium, which it fills, pressing down the brain to the base of the skull. As a consequence of such changes, the functions of the brain are interfered with, and in general the mental condition of the patient is impaired. The child is dull and listless, irritable, and sometimes imbecile. The special senses become affected as the disease advances, especially vision, and sight is often lost, as is also hearing. Towards the close, paralysis is apt to occur. Hydrocephalic children rarely live long, generally dying from the malady in a few years, or succumbing to some of the disorders of childhood, which they are little able to resist. Nevertheless, there have been many instances of persons with this disease reaching maturity, and even living to old age. It must also be borne in mind that there are grades of this affection, and that children may present many of the symptoms of it in a comparatively slight degree, and yet recover, the head ceasing to expand, and becoming firmly ossified.

Treatment.—Various methods of treatment have been employed in this disease, but the results are seldom satisfactory. Tapping the fluid from time to time through one of the spaces between the bones, drawing off a little, and thereafter employing gentle pressure, has been tried, but seldom with permanent benefit. The operation of tying both carotid arteries in the neck has been followed occasionally by promising results in hydrocephalic infants. Attempts have also been made by surgeons to establish a communication between the distended ventricles within the brain and the sub-arachnoid space surrounding it; but though great temporary benefit has occasionally been obtained by such an operation, it has not been found to produce a permanent result.

HYDROCHLORIC ACID is a gas which, dissolved in water, forms a clear, colourless fluid of sour taste and smell. It is present in the gastric juice to the extent of 2 parts in 1000. (*See* DIGESTION.) In large quantities it is a corrosive poison.

Uses.—Its chief use is in cases where the gastric juice is deficient, for example, in alcoholic catarrh of the stomach, in gastric cancer, and in some other forms of indigestion. Dilute hydrochloric acid is generally given along with a bitter infusion in doses of 5 to 60 drops.

HYDROCYANIC ACID (*see* PRUSSIC ACID).

HYDROGEN PEROXIDE (*see* PEROXIDE OF HYDROGEN).

HYDROMYELIA is the term applied to an abnormal expansion of the central canal of the spinal cord.

HYDRONEPHROSIS (*ὕδωρ*, water; *νεφρός*, the kidney) is a chronic disease in which the kidney becomes greatly distended with fluid. It is due to some blockage of the ureter connecting the kidney with the bladder. The two chief causes of this are the lodgment in the ureter of a stone formed in the kidney, and kinking of the ureter in consequence of a 'floating' condition of the kidney. The symptoms it occasions are those due to pressure on surrounding organs, along with the appearance of a rounded swelling high up on one or other side of the abdomen. This condition, like other disorders of the kidney, can often be definitely diagnosed by X-ray examination, after filling the ureters through the bladder with an opaque fluid. The treatment necessary is, generally, removal of the affected kidney, which, if the second kidney is sound, affords complete relief.

HYDROPATHY, or HYDROTHERAPEUTICS (*ὕδωρ*, water; *πάθη*, suffering: *ὕδωρ*, water; *θεραπεύω*, I heal), is the name for all those curative measures in which water is the agent employed.

(*See* BATHS, COLD, DOUCHES, FOMENTATIONS, WET PACK.)

HYDROPHOBIA (ὕδωρ, water; φόβος, fear) is an acute and very fatal disease which affects the lower animals, particularly carnivora, and may be communicated from them to man. In animals, it is known as 'Rabies'.

Cause.—The disease appears to be in existence constantly among dogs and wolves in some countries, and from these it spreads widely now and then in epidemics. Thanks to the Muzzling Order, it has been practically stamped out in Great Britain since 1897. It is highly infectious from the bite of an animal already affected, but the chance of infection from different animals varies. Thus only about one person in every four bitten by rabid dogs contracts hydrophobia, while the bites of rabid wolves and cats almost invariably produce the disease. Bites on exposed parts, like the face, are more dangerous than those got through the clothes. No bacterium has been found as the cause, and it appears likely that the organism is of an extremely minute ultramicroscopic nature. It seems to be developed particularly about the brain and spinal cord, and indeed the test as to whether a dog, which has died, suffered from rabies, is to inject a preparation made from part of its brain into another animal, and to watch the latter for signs of the disease. In the brain of an affected animal, certain microscopic appearances known as *Negri bodies* can usually be found. The saliva of infected animals is also highly poisonous.

Symptoms.—In animals there are two types of the disease, 'mad' rabies and 'dumb' rabies. In the former, the dogs run about, snapping at objects and other animals, unable to rest; in the latter, which is also the final stage of the 'mad' type, the limbs become paralysed, and the dog crawls about or lies still.

In man, the wound of the bite heals naturally, and then a period of three to six weeks passes before signs of the disease show themselves. It has been said that over a year may elapse before the disease develops, and certainly cases occur in which there is an interval of many months. The commencement of the disease is shown by mental symptoms, the person becoming irritable, restless, and melancholy. At the same time, feverishness and difficulty of swallowing gradually come on. After a couple of days or so, the irritability passes into a state of wildness or terror, there is great difficulty in swallowing either food or drink, and breathing becomes difficult. The flow of saliva is great, and therefore the patient is constantly spitting, and has a dry, short cough, which has given rise to the popular idea that he 'barks' like a dog. A loud noise, a bright light, and particularly any attempt to drink are sufficient to throw the person into a convulsion, and from this fact the disease receives its name. Convulsions and attacks of maniacal excitement become more frequent, and though between these the patient may be quite sensible and able to talk rationally, he becomes gradually weaker. Finally, about four days after the onset of the disease, the patient dies of exhaustion.

Treatment.—The best treatment is, of course, preventive, and this may be attained by strict muzzling regulations and the slaughter of all animals bitten by, or coming into contact with, rabid dogs. If a person has been bitten by a dog supposed to be rabid, the dog should not be killed at once, but should be carefully isolated for a week, by which time he may be pronounced healthy or rabid, and, in the latter case, means may be taken to treat the bitten person without further delay. When a person is bitten by a dog undoubtedly rabid, a ligature should at once be tied between the wound and the body, so as to check circulation, and the bite should be cauterised with nitric acid or cautery. In 1885 Pasteur introduced a method of treatment, which consists of injecting the bitten person with an emulsion made from the spinal cord of a rabbit killed by rabies. These injections, to be successful, should be begun within the first week after the bite, and they are repeated every day for about a fortnight, commencing with a spinal cord in which the poison has been rendered very weak by drying, and using each day a cord which has been less and less dried, till the person becomes immune to the full strength of the poison. Though this treatment

occasionally fails, it has been successful in thousands of cases.

When the bitten person develops the disease, all that can be done is to quiet the convulsions by bromides, chloroform, and similar drugs.

HYDROPS (ὕδρωψ) is another name for dropsy.

HYDROPS FŒTALIS (*see* ICTERUS GRAVIS NEONATORUM).

HYDROTHERAPY (*see* HYDROPATHY).

HYDROTHORAX (ὕδωρ, water; θώραξ, the chest) means a collection of dropsical fluid in the pleural cavities.

HYGIENE (ὑγίεια, health) means the science of preserving health. (*See* BATHS, CLOTHING, DIET, EXERCISE, HEALTH, SANITATION, VENTILATION, WATER SUPPLY, WATER-CLOSETS.)

HYOID is the name of a U-shaped bone at the root of the tongue. It can be felt from the front of the neck, lying about an inch above the prominence of the thyroid cartilage.

HYOSCYAMUS, or HENBANE, is a plant that grows commonly in the United States and in Europe. The preparations are made from the leaves, and have an effect in quieting pain and relieving spasm. In large quantities it is a narcotic poison.

Uses.—In all spasmodic and painful conditions, particularly in colic and in irritable states of the bladder, the tincture of hyoscyamus is used with good effect. Hyoscine, an alkaloid obtained from hyoscyamus, is much used in very small doses to quiet raving mania and in some nervous diseases, *e.g.* shaking palsy. It has also been used recently for the production of 'twilight sleep'.

HYPERACUSIS (ὑπέρ, over; ἀκουσις, hearing) means an abnormally acute sense of hearing.

HYPERÆMIA (ὑπέρ, over; αἷμα, blood) means congestion or presence of an excessive amount of blood in a part.

HYPERÆSTHESIA (ὑπέρ, over; αἰσθησις, sensation) means over-sensitiveness of a part, as found, for example, in certain nervous diseases.

HYPERCAPNIA means an abnormal increase in the amount of carbon dioxide in the blood or in the lungs.

HYPERCHLORHYDRIA is the term applied to a form of indigestion associated with excessive secretion of hydrochloric acid. The symptoms connected with it are particularly heartburn and a feeling of spasm in the stomach appearing two or three hours after meals. (*See* Dyspepsia *under* ACID DYSPEPSIA.)

HYPEREMESIS (ὑπέρ, over; ἔμεσις, vomiting) is a term applied to excessive vomiting, especially that which occurs in the later stages of pregnancy.

HYPERGLYCÆMIA (ὑπέρ, over; γλυκύς, sweet; αἷμα, blood) means excess of sugar in the blood, the condition preceding and accompanying diabetes mellitus. The amount of sugar normally present in the blood is about one part of sugar in 1000 of blood; in diabetes the sugar may rise to four or five times that amount.

HYPERHIDROSIS, or HYPERIDROSIS, means excessive sweating.

HYPERMETROPIA (ὑπέρ, over; μέτρον, measure; ὤψ, eye), or HYPEROPIA, is a term applied to long-sightedness, in which the eye is too flat from before back and rays of light are brought to a focus behind the retina. (*See* VISION *and* SPECTACLES.)

HYPERNEPHROMA (ὑπέρ, over; νεφρός, kidney) is a term applied to a tumor resembling the tissue of the suprarenal gland and occurring usually in the kidney.

HYPEROXÆMIA (ὑπέρ, over; ὀξύς, acid; αἷμα, blood) is the term applied to unusual acidity of the blood.

HYPERPIESIS (ὑπέρ, over; πίεσις, pressure) is a term applied to abnormally high pressure of the blood. The term HYPERPIESIA is often applied to the symptoms, such as headache, which result from this raised blood-pressure. (*See* BLOOD-PRESSURE.) When there is no hardening of the arteries, the increased pressure is often due to mental worry combined with lack of sufficient exercise.

HYPERPLASIA (ὑπέρ, over; πλάσις, formation) means an abnormal increase in the number of cells in a tissue.

HYPERPYREXIA (ὑπέρ, over; πυρέσσω, I am fevered) means an excessive degree of fever. (*See* FEVER, TEMPERATURE.)

HYPERTELORISM is a rare congenital deformity of the head and face,

The forehead is broad and low and the orbits are large and set widely apart. The divergence of the eyes is such that focusing on near objects is impossible. The abnormal shape of the skull is thought to be due primarily to a disproportion in the growth of the brain.

HYPERTHYROIDISM is a term applied to excessive activity of the thyroid gland, *e.g.* in exophthalmic goitre. The condition is found in a minor degree producing shakiness, nervousness, rapid pulse, and undue tendency to perspiration on slight exertion. (*See* GOITRE.)

HYPERTROPHY (ὑπέρ, over; τρέφω, I nourish) means the increase in size which takes place in an organ as the result of an increased amount of work demanded of it by the bodily economy. For example, when valvular disease of the heart is present and the heart is in process of dilating, 'compensation' occurs by an increase in thickness of the heart-muscle, and the organ, by beating more powerfully, is able to overtake the strain thrown upon it. Similarly, if one kidney be removed, the other hypertrophies or grows larger to overtake the double work.

HYPNOTICS (ὕπνος, sleep) are measures which produce sleep.

Varieties.—As certain conditions are necessary for the onset of sleep, even a slight departure from these may be sufficient to keep persons who are not in good health awake. Thus absolute quiet, darkness, a diminution of the circulation in the brain, and freedom from pain or irritation in any bodily organ are essential. Often some trivial alteration of the daily life or diet is enough to relieve habitual insomnia, in other cases the quieting of pain is alone necessary, in other cases drugs must be used which have a slight dulling effect upon the brain itself. For the relief of pain the drugs known as anodynes (*see* ANODYNES) are used. Of the pure hypnotics, which dull the brain without much other effect, the chief are chloral hydrate, chloralamide, bromides, sulphonal, trional, veronal, paraldehyde, hyoscine.

Uses.—Simple remedies should always receive a fair trial first of all. Thus a person may be kept awake by an overfilled state of the vessels of the brain, due to severe mental labour or worry just before retiring to rest. The activity of the brain continues and sleeplessness results. Some quiet employment for the latter part of the evening, or a light meal may relieve this. Sleeplessness is often due to difficulty of digestion through a meal having been taken shortly before retiring to rest, and this may be relieved by abstaining from the last meal at night. A condition of anæmia of the brain occurs in old men whose arteries are unhealthy, and this also debars sleep, unless the head be kept warm or a small quantity of alcohol be taken at bedtime. Occasionally sleep can be obtained by purely external applications. Massage of the head, the wet pack, and electrical (especially high frequency) applications are all used in different cases. A condition of anæmia and discomfort together, in heart cases, may ward off sleep, though the sick person be very tired, and in such a case the best hypnotic is perhaps paraldehyde. For delirium and the sleeplessness of fever, hyoscine, chloral hydrate, and chloralamide are generally employed, and for sleeplessness with no assignable cause, veronal, trional, or sulphonal is perhaps best, and is not attended by the risk of starting a habit which is hard to break.

HYPNOTISM (ὕπνος, sleep) is the modern name for the whole class of psychical phenomena, some of which were first produced by Athanasius Kircher in the seventeenth century and by Anton Mesmer about a century and a half ago through the process known as mesmerism.

Several distinguished scientists have attempted to turn this process to curative ends in nervous diseases, and though, in the hands of a few persons, valuable results have been attained, the method has never proved of much general use. Braid and Charcot particularly worked at the subject, and the name of Esdaile is known for the use to which he put hypnotism in producing insensibility to pain for surgical operations prior to the employment of chloroform.

The hypnotic state, according to Charcot, presents three types which can be produced at will by the operator. These are a state of catalepsy (*see* CATALEPSY), a state of lethargy, and a

state of artificial somnambulism. It resembles closely, therefore, some unusual types of ordinary sleep, and is due probably to an irregular stoppage of the action of different parts of the brain instead of a gradual resting from action of the greater part of the whole brain, as in natural sleep. (*See* SLEEP.)

Different people pass with varying degrees of ease into the hypnotic state. Many appear to be incapable of reaching the condition. Women are more readily hypnotised than men, and the acquiescence of the person in the attempt to hypnotise him, and a state of strained attention make the process easier, though they are not essential, since people may often be hypnotised though they do not understand what is being done. Generally speaking, persons are more and more easily hypnotised with each successive experimentation. The lower animals, particularly fowls, can be thrown very easily into a similar condition.

The condition is induced in a great variety of ways, but, usually, by making the patient stare at a bright object held a foot or so above the level of the eyes, so that a great strain is thrown upon the muscles of the eyes and lids, and by telling him at the same time to concentrate his mind upon it. The state may set in after so short a space as a few seconds. When the patient is in a semi-unconscious state, his attention is directed to the affected part of his body, and an attempt made to banish the pain by a process of suggestion.

Hypnotism is not without its dangers, and nowadays medical psychologists prefer to treat nervous patients by other methods. Hypnotism may, however, be occasionally useful as a 'short-cut' treatment for the removal of troublesome symptoms.

HYPOCALCÆMIA.—The condition of the blood in which its content of calcium is below normal. (Normally there are between 9 mg. and 11 mg. calcium in 100 c.c. of serum.)

HYPOCHLORHYDRIA means an insufficient secretion of hydrochloric acid from the digestive cells of the stomach lining.

HYPOCHLOROUS ACID is a powerful antiseptic which both kills organisms and neutralises the poisons they produce. It forms the active principle of the powder known as 'eupad' and of its solution 'eusol'. The powder is produced by mixing equal weights of boric acid and bleaching powder. The solution is prepared by adding 25 grams of this powder to 1 litre of water; and filtering. The clear solution so produced is 'eusol', and should contain ·5 per cent of hypochlorous acid. This solution will keep its strength for about three weeks in cold weather.

Uses.—The powder may be dusted upon dirty septic wounds and gives off hypochlorous acid slowly in contact with the discharges; or the solution may be used to wash these wounds, and lint and gauze dipped in it applied as dressings. The solution is so little harmful to the body tissues that in cases of general blood-poisoning it may be injected directly into the veins in doses of 100 c.c. or more, often with highly beneficial effect. In the Carrel-Dakin treatment of septic wounds a similar solution prepared from hypochlorite of soda is used for the free irrigation of the discharging cavities. The solution is either allowed to drip constantly into the wound from rubber tubes pierced by minute holes, or the wound is filled at frequent intervals with the fluid which is then allowed slowly to drain away.

HYPOCHONDRIASIS (ὑπό, under; χόνδρος, a cartilage) is a chronic mental condition in which the affected person's mind is constantly occupied with a delusion that he is seriously ill. As a rule, the ailments are referred to the stomach or the liver, and very often some trivial derangement of these exists to give colour to the person's views. Along with these complaints, there is a self-centred and gloomy turn of mind that prevents the patient from doing much of his proper work. Not uncommonly this mental trouble is hereditary, and passes gradually at a later stage into melancholia. The condition, apart from the affected person making a strong effort of will and taking up some active work which may distract his thoughts, is very difficult to treat.

HYPODERMIC (ὑπό, under; δέρμα, the skin).—(1) Of or pertaining to the

region immediately under the skin. (2) A hypodermic injection. (3) A hypodermic syringe (see illustration).

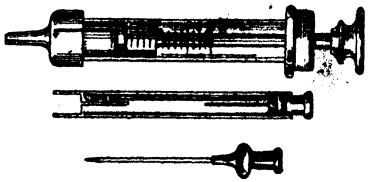


FIG. 261.—Hypodermic syringe, with needle-holder and needle.

HYPODERMOCLYSIS.—Injection of a fluid under the skin—for example, of a solution of glucose or of saline as a method of restoring fluids to the circulation of a person who is 'dehydrated'.

HYPOGASTRIC.—Indicating or pertaining to the lower middle part of the abdomen just above the pubis.

HYPOGLOSSAL NERVE (*ὑπό*, under; *γλῶσσα*, the tongue) is the twelfth cranial nerve, and supplies the muscles of the tongue, together with some others lying near it.

HYPOGLYCÆMIA (*ὑπό*, under; *γλυκύς*, sweet; *αἷμα*, blood) is the term applied to a deficiency of sugar in the blood. It may occur in states of starvation, or after the administration of insulin in too large doses, causing symptoms of weakness, tremors, nervousness, breathlessness, and excitement followed sometimes by unconsciousness. These symptoms are relieved by taking sugar or by an injection of adrenaline, which checks the action of insulin.

HYPOMANIA.—A slight degree of mania.

HYPOPHOSPHITES of lime, iron, etc., are often administered in combination as a tonic.

HYPOPHYSECTOMY.—Surgical excision of the pituitary gland. Hence HYPOPHYSECTOMISE.

HYPOPHYSIAL CACHEXIA, or SIMMONDS' DISEASE, is the term applied to the condition in which premature senility, loss of hair, and sexual and general weakness result from destruction by disease of the pituitary gland.

HYPOPHYSIS is another name for the pituitary gland.

HYPOPIESIS (*ὑπό*, under; *πίεσις*, pressure) means abnormally low blood-pressure, found, for example, in wasting diseases and in conditions which drain fluid from the body, such as severe diarrhœa.

HYPOPLASIA means excessive smallness of an organ or part, arising from imperfect development.

HYPOPYON is the term for describing an accumulation of pus between the iris and the cornea—*i.e.* in the anterior chamber of the eye.

HYPOSTASIS is the term applied to the condition in which blood accumulates in a dependent part as a result of a feeble circulation. Congestion of the base of the lungs in old people from this cause, and infection, is called hypostatic pneumonia.

HYPOTHALAMUS.—That part of the forebrain situated beneath the thalamus on each side and forming the floor of the third ventricle. The hypothalamus contains collections of nerve cells believed to form the controlling centres of (1) the sympathetic and (2) the parasympathetic nervous systems. The hypothalamus is the nervous centre for primitive physical and emotional behaviour. It contains nerve centres for the regulation of certain vital processes—of the metabolism of fat, carbohydrate, and water, and of sleep, body temperature, and genital functions.

HYPOTHERMIA (*see* CRYMOTHERAPY).

HYPOTHYROIDISM means the condition produced by defective action of the thyroid gland. (*See* MYXŒDEMA.)

HYSTERECTOMY (*ὑστέρα*, womb; *ἐκτομή*, cutting out) means the operation of removing the uterus. HYSTEROOOPHORECTOMY is the term applied to removal of the uterus and ovaries.

HYSTERIA (*ὑστέρα*, the womb) is a condition or set of conditions which it is difficult to define, because it is not known what changes in the nervous system lie at its root. The condition is also known as PITHIATISM (*πείθω*, I per-

suade), because many of its symptoms appear to be due to autosuggestion and are readily relieved by suggestion from another person. Hysteria manifests itself by over-action of some parts of the nervous system, or by failure of other parts to perform their necessary work. In consequence, there follow mental changes, convulsive seizures, spasms and contractions of limbs, paralyses, loss of sensation over areas of the body, affections of various internal organs, derangements of joints, and combinations of these which closely mimic various organic diseases. Hysterical manifestations are among the most difficult affections upon which the specialist in nervous disease is called to give his opinion. Although in many cases an element of conscious deception forms one of the mental peculiarities of the trouble, a patient should not rashly be held guilty of shamming illness, and the symptoms should in every case be treated as a real disease.

Causes.—The condition is far more common in women than in men, appearing generally about the age of fourteen, though it may begin earlier, and usually passing off when full development is reached, though it may persist through life to old age. It used to be supposed that the origin of the disease, as its name indicates, lay in troubles of the womb, but, though sexual irregularities often occur in the condition, they should more probably be classed as symptoms. Heredity is of importance, the disease being most common in the Latin races, and running to a great extent in families. Defective moral training and want of physical exercise in early youth predispose greatly to hysteria, which in young women of poor physique, unequally developed mind, and pampered habits, may be produced by sudden fright, family worry, grief, or a love affair.

Symptoms.—MENTAL CHANGES are almost always observable in hysterical cases, though the other symptoms in different cases may differ widely from one another. The affected person becomes whimsical, dominated by ideas, and unable for the same work and concentration as before. She becomes easily excitable, and is either morbidly sensitive, feeling keenly slight rebuffs, or unusually demonstrative, bursting into fits of laughter or paroxysms of weeping upon slight occasion. In marked cases, hysterical subjects become morally unhinged, deceiving every one around them, so that little credence can be given to their statements. In advanced cases, delirium and fever may appear and last for some time, or even insanity, especially of the nature of mild transitory mania, may ensue.

CONVULSIVE HYSTERIA is the most marked form. An attack may begin upon some excitement, with laughter or weeping, or may give no warning sign. The person falls in an unconscious or half-conscious condition, but whereas the fall in epilepsy is downright, the hysterical person subsides gently in general upon a couch or chair, and rarely or never so as to hurt herself. She may then lie still, or more generally moans or talks incoherently, rolls the head from side to side, and tosses the hands and feet about. In serious attacks, known as hystero-epilepsy, the onset resembles epilepsy and may be followed by curious posturing, the sufferer placing herself in attitudes which suggest powerful emotions of fear, ecstasy, or joy. In this state visions are seen, voices heard, and conversations held with imaginary persons. This forms one of the most perverted types of hysteria and one of the least hopeful as regards a cure.

LOSS OF SENSATION over some part of the body is one of the commonest symptoms. This loss may affect a limb, or may be irregularly distributed in patches, or may affect some special sense organ, causing failure of taste, blindness for all objects to one side of the field of vision, or for objects of some special type repugnant to the patient, deafness in one ear, etc. Sometimes there is complete loss of the sense of pain, so that pricks, pinches, and other painful stimuli are borne without wincing.

SPASMS AND CONTRACTIONS of muscles form also a very frequent manifestation of hysteria without any other sign save mental hebetude. If this contraction exist in the muscles of the body wall, it may, and frequently does, give rise to the idea that the person is the subject of a tumor. Such spasms may also lead to the drawing up of an arm or foot, so that the limb in time becomes

permanently deformed. Or when the mind becomes powerfully impressed by some person or idea, the spasm may pass off, and gradual or sudden recovery frequently takes place.

PARALYSIS is perhaps the most troublesome symptom of all to overcome. It may extend over one-half of the body, and is then very hard to tell from the effects of apoplexy. Most commonly the foot is affected and the person declares herself unable to walk. These cases sometimes last for years unimproved, and then the paralysis may suddenly vanish. They are, beyond every other case, suited for successful ministration by the faith-healer or by wonder-working shrines. Such persons, when the paralysis affects both legs, and is accompanied by pain in the back, have again and again been confined for years to bed or couch as cases of spinal disease, only to recover suddenly when some new interest has come into their lives, or force of circumstances has rendered an active life imperative. The muscles of the larynx are frequently affected, and the person may be deprived of speech for years, till some powerful influence forces her to exert her will and the organ of voice again comes into play.

CHANGES IN INTERNAL ORGANS take place in some cases and produce such signs as constant hiccup, barking noises, excessive vomiting, diarrhœa, absolute loss of appetite, and profound changes in the circulation. Among the features of the last named may be mentioned the appearance of swollen and congested areas in the skin, and, showing the power which the mind may exert over bodily functions, there is recorded the case of Louise Lateau, who, after meditating for many days upon the Crucifixion, developed on hands and feet 'stigmata' or bleedings beneath the skin.

JOINT AFFECTIONS are among the most remarkable physical changes. A joint, especially the hip or knee, becomes swollen, stiff, and painful, and may remain so for months. (*See* PAIN.)

Treatment.—Special care should be taken in the upbringing of children who come of hysterical family, and they should not, on the one hand, be allowed to work too hard at lessons to the neglect of healthy exercise, nor, on the other hand, should they be pampered and allowed to gratify every passing whim. No hysterical young woman should remain unoccupied, but should be provided with, and forced to do some congenial work. Needless to say, all the bodily functions should be maintained in the best possible order. In acute hysterical attacks rest and quiet are chiefly necessary. For the minor manifestations of hysteria, the drugs which do most good are valerian and asafœtida. Bromides, which are the remedy *par excellence* in epilepsy, appear of little or no use in hysteria. For symptoms such as vomiting, joint affections, loss of sensation, and spasms, removal from home and from the attentions of sympathetic friends to strict isolation, where the patient sees nobody but a nurse and eats only the simplest of food, is a good form of treatment. For the severest forms of hysteria, such as loss of appetite, serious paralysis, etc., the Weir Mitchell treatment has been most successful. (*See* NEURASTHENIA.) In this method also, isolation and absolute rest in bed are employed. Further, massage takes the place of exercise, and the patient is encouraged to eat large amounts of readily digestible food. Patients upon this system often fatten rapidly, and lose their nervous symptoms. In all cases of hysteria psychotherapy forms a very important element in treatment. This is carried out especially by suggestion, but in other cases it may take the form of persuasion, psycho-analysis, or education and employment.

HYSTERO-EPILEPSY is a term applied either to a severe type of hysteria with convulsions resembling those of epilepsy, or to a case of true epilepsy in which hysterical manifestations occur from time to time between the epileptic attacks.

I

IATRIC (*ἰατρός*, physician) is a term meaning anything pertaining to a physician.

ICE is used as a convenient form of applying cold both externally and internally. For external application the most convenient form of application is by placing chopped ice in an india-rubber bag, known as an ice-bag. The bag is closed by a screw cap and is laid upon the head, abdomen, or other part to which it is desired to make the cold application, a layer of flannel or a garment being placed between the bag and the skin to prevent a direct freezing action on the surface. When an ice-bag is not available, ice may similarly be applied to a small area by taking a

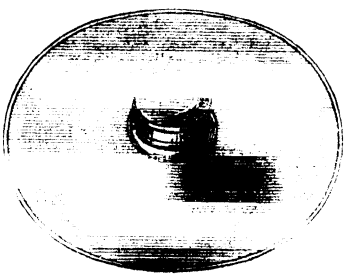


FIG. 262.—Rubber ice-bag.

large piece of gutta-percha tissue, laying the ice upon its centre, and bunching up the corners which are tied together with a string. Iced water is sometimes applied by means of a coiled tube, especially in cases of inflammation of the head. The iced water is allowed slowly to percolate from a jug placed a few feet above the bed through the coiled tube laid on the affected part.

For internal application ice is used in cases of bleeding or inflammation in the mouth, throat, stomach, etc. For this purpose a succession of small pieces of ice is held in the patient's mouth, a fresh piece being administered as each bit melts. (*See also* COLD, USES OF; and CRYMOTHERAPY.)

ICHOR is the term given to the thin fluid, yellowish or bloody, which issues from a sore or a wound.

ICHTHAMMOL is ammonium ichthosulphonate prepared from and of appearance and uses similar to ichthyol.

ICHTHYOL (*ἰχθύς*, a fish), a dark, brown, thick liquid of peculiar smell, is prepared by distillation from a deposit of fossil fish in the Tyrol. It is used in several chronic skin diseases, and also to diminish inflammatory conditions round the womb. In 20 per cent strength mixed in glycerin, it is used to smear over areas of skin which are the seat of erysipelas or other septic conditions.

ICHTHYOSIS (*ἰχθύα*, shark-skin) is a skin disease in which the surface is very rough and presents a dry, cracked appearance, very much resembling fish-scales. The peculiarity is generally hereditary, and persists through life, the skin being permanently hard, and deficient in oily material. The appearances differ considerably according to the part affected and the surrounding conditions. Thus the knees and elbows when affected become black from the collection of dirt in the deep crevices, and in winter the skin becomes specially hard and the condition still more marked.

Not much can be done for the condition beyond rubbing in ointments containing salicylic acid and other substances which soften the horny layer, washing with superfatted instead of ordinary soaps, and the internal and external administration of soft fats.

ICTERUS (*ἴκτις*, a weasel) is another name for jaundice. (*See* JAUNDICE.)

ICTERUS GRAVIS NEONATORUM (often known as ERYTHROBLASTOSIS FŒTALIS) is a severe disease of the newborn characterised by (1) deep jaundice; or (2) excess fluid in pericardial, pleural, and peritoneal sacs (HYDROPS FŒTALIS); or (3) severe hæmolytic anæmia (HÆMOLYTIC DISEASE OF THE NEWBORN). Underlying this hitherto mostly fatal disease, described under so many different terms, are a hæmolytic anæmia and the appearance in the blood of erythroblasts—red blood corpuscles—at an early stage of development. It now seems clear that the destruction of red corpuscles of the

newborn is due to the iso-immunisation of the Rh-negative mother by the Rh-positive fœtus. (*See* RH FACTOR). The mother thereupon produces anti-Rh agglutinins, which pass through the placenta and agglutinate the red corpuscles of the fœtus. Treatment is by transfusion with Group O Rh-negative blood, a method which has already saved a number of infant lives that would formerly (before 1942–1943) have been lost.

ICTUS is another term for a stroke.

IDIOCY, or IDIOTCY (*ἰδιώτης*, an unskilled person), is the term applied to a profound degree of mental defect in which the person is unable to guard himself against ordinary dangers and is of dirty habits. (*See* MENTAL DEFECTIVENESS.)

IDIOGLOSSIA means the continued utterance of meaningless sounds, the afflicted person 'speaking' a language intelligible to no one.

IDIOPATHIC (*ἴδιος*, peculiar; *πάθη*, suffering) is a term applied to diseases to indicate that their cause is unknown.

IDIOSYNCRASY (*ἴδιος*, peculiar; *σύγκρασις*, mixture) means an unusual effect produced by certain drugs or other agencies in certain persons. For example, some persons are poisoned by very small doses of opium or belladonna, while, on the other hand, some take huge doses of these or other drugs without any effect. The same applies to alcohol, arsenic, iodides, and many other drugs. Idiosyncrasies exist also for foods, some persons having an acute attack of dyspepsia, or even becoming dangerously ill when they take milk, or fish, or eggs, or oatmeal, as the case may be. Others may be powerfully affected by smells, such as that of roses, or of particular animals, as of mice or cats, but here one trenches on the borders of hysteria. This peculiarity as applied to special sensitiveness to protein substances, such as foods, the pollen of plants, etc., is known as allergy.

ILEITIS means inflammation of the ileum. A condition called REGIONAL ILEITIS attracted much attention between 1930 and 1940. As the term implies, there is an (apparent) inflammation of an area of the small intestine. This is accompanied by colicky abdominal pain, irregularity of the bowels, loss of weight, and slight fever. The abdomen is distended and the thickened intestine may be felt. The narrowed intestinal canal may become obstructed, necessitating immediate operation. According to G. Hadfield, the primary lesion is hyperplasia of the lymph tissue in the submucosa of the intestine, and in the lymph glands.

Resection of the abnormal gut does not prevent recurrence.

ILEOCÆCAL is the term applied to the region of junction between the small and large intestines in the right lower corner of the abdomen. The ileocæcal valve is a structure which allows the contents of the intestine to pass onwards from the small to the large intestine, but, in the great majority of cases, prevents their passage in the opposite direction.

ILEUM (*εἴλω*, I twist) is the lower part of the small intestine. (*See* INTESTINE.)

ILEUS (*εἴλω*, I twist) is another name for severe colic due to obstruction of the bowels. (*See* INTESTINE, DISEASES OF.)

ILIUM (*ilia*, the flank) is another name for the haunch-bone, the uppermost of the three bones forming each side of the pelvis. (*See* BONE, PELVIS.)

ILLUSION (*illudo*, I make game of). (*See* HALLUCINATION.)

IMBECILITY (*imbecillitas*, weakness) is a term applied to feeble-mindedness in which the mental powers are somewhat greater than those possessed by an idiot. (*See* MENTAL DEFECTIVENESS.)

IMMUNITY (*immunis*, exempt) is a principle by virtue of which the bodies of certain animals or human beings are protected from the invasion of certain diseases, or the action of certain poisons. It is a well-recognised fact that some persons expose themselves again and again to the risk of infection and are not affected, while others seem prone to contract any disease with which they are brought into contact. The immunity so enjoyed is of several types.

Natural immunity is one which is inborn; but immunity may also be acquired in the course of life, or it may be produced artificially by inoculation, injection of the blood serum of immune animals, etc.

Natural immunity.—Certain animals seem to be little affected by poisons which to others are very deadly. Thus the snake-killing mungoose of India is said to be highly immune to cobra poison. Pigeons are little affected by large doses of morphia; rabbits and other animals eat freely the leaves of the deadly nightshade plant. (*See* IDIOSYNCRASY.) The rat is little affected by tuberculosis, to which other creatures, including particularly man and the guinea-pig, are very susceptible. Man, on the other hand, is unaffected by swine fever, and some other diseases which are very infectious and fatal among the lower animals, while no animal, so far as known, contracts cholera, a disease which is so disastrous to man. Other examples are found in the fowl and the alligator, which are peculiar in being exempt from lockjaw, and white rats, which are not affected by anthrax. There is probably no such thing as absolute immunity, however, since animals are affected by any poison if their health be very low or if the amount of poison be very great.

One result of immunity is that the 'phagocytes', certain white corpuscles of the blood, have the power of destroying and consuming the bodies of bacteria in the blood or tissues. Formerly the whole action of immunity was attributed to this 'phagocytosis', although now the process is believed to be mainly a chemical one. (*See* SERUM THERAPY.)

Acquired immunity is that which is gained by passing through an attack of some disease. Protection is probably given by all infectious diseases for a longer or shorter period against a second attack of the same disease. In the case of some, such as smallpox, typhoid fever, scarlatina, the protection appears to last throughout life, or, at all events, for many years. Recovery from a disease is in fact a process of immunity, the poison of the disease being destroyed by antagonising substances produced in the tissues of the body, so that the disease comes to an end after a definite period.

Artificial immunity is of two kinds, known as active and passive immunity.

(*a*) ACTIVE IMMUNITY is produced by injecting beneath an animal's skin, or administering by the mouth in some cases, a small dose of some particular poison insufficient to produce death. This has the effect of stimulating the animal's powers of resistance, so that next time it can withstand a larger dose. The process is repeated over and over, the dose each time increasing, till finally the animal is unaffected by many times the dose which would have originally killed it. With regard to vegetable poisons see DRUG HABITS. This applies to snake poisons also, and the snake-charmers of India appear to render themselves indifferent to cobra-bites by a similar process. With regard to disease-producing bacteria and the toxins or poisons which they form, immunity is reached by injecting first of all small quantities of bacteria, or of their toxins, which have been weakened by mixing with antiseptics, by drying in air, by passing through the bodies of partially immune animals, or by other highly technical processes. Usually this process is a lengthy one; for example, to render horses highly immune against diphtheria occupies a space of several months, during which larger and larger doses of diphtheria toxin are given at intervals. It is evident, therefore, that, though this method offers protection against diseases, its slowness renders it useless for the cure of diseases which would run their whole course in a few days. The best-known practical example of this treatment is vaccination, in which 'cow-pox', a modified form of the disease, is produced in persons so as to render them immune to the far severer 'smallpox'. Another is Pasteur's preventive treatment for hydrophobia, in which, during the long incubation period before the disease has had time to appear, the person is treated by increasing doses of the poison taken from rabbits that have been killed by the disease. (*See* HYDROPHOBIA.) The principle of this method, then, consists in stimulating the power of the body to resist the action of poisons. Great success in preventing diphtheria has been achieved by injecting one to three doses of diphtheria toxoid (inactivated toxin). This is quite harmless, and

hundreds of thousands of children the world over have now been protected against this serious disease. Injections of tetanus toxoid were made on a wide scale in the armed forces in 1939, and injections of a vaccine of typhoid and paratyphoid organisms is still an important prophylactic measure in army hygiene.

(*b*) PASSIVE IMMUNITY is that form of artificial immunity obtained by injecting into the body of one animal or person whom it is desired to render immune blood serum drawn from an animal already rendered immune by the active method. The best-known example of this method is the treatment of diphtheria by anti-toxic serum. This serum is obtained from horses already protected from diphtheria, as explained above, by a course of several months' treatment. This serum temporarily protects a person against contracting diphtheria, and after the onset of the disease, it will, if injected, neutralise the poison and bring about a milder type of disease and speedier recovery. The theory of action is, that the antitoxic serum contains certain chemical substances (antitoxins) which have been produced by the cells of the horse's blood or other tissues, and which combine with the poisons (toxins) produced by the diphtheria bacilli so as to neutralise the latter. Antitetanic serum immediately given to soldiers wounded under such conditions as to render them liable to an attack of lockjaw will prevent the onset of tetanus; the introduction of tetanus toxoid as a preventive injection has considerably improved the prospects for those wounded on the battlefield. (*See* SERUM THERAPY.)

IMPACTION (*impactio*) is a term applied to a condition in which two things are firmly lodged together. For example, when after a fracture one piece of bone is driven within the other, this is known as an impacted fracture; when a tooth is firmly lodged in its socket so that its eruption is prevented, this is known as dental impaction.

IMPERIAL DRINK (for composition *see under* CREAM OF TARTAR).

IMPETIGO (*impetigo*, a ringworm; from *impeto*, I attack) is a skin disease of an infectious nature often found in schools, and apparently peculiarly liable to be communicated from one boy to another at football. It consists of vesicles which appear here and there, on the face particularly, and dry up, leaving yellowish-brown scabs from which the discharge is infectious. These scabs fall off, leaving no scars, but the disease spreads from place to place over the skin, and may last for months if untreated. The eruption quickly disappears, as a rule, when treated with dilute ointment of ammoniated mercury (white precipitate ointment) in the strength of 1 part of the ammoniated mercury ointment to 7 parts of vaseline. Sulphonamide ointments have proved to be most effective in treatment.

When nits are present on the hair, treatment is ineffective until these have been removed. (*See* PARASITES.)

INACTIVATION is a term applied to the destruction of the activity of a serum by heat or other means. Inactivation of serum complements means partial destruction of the serum produced by heating it to about 56° Centigrade for 15 or 30 minutes.

INCISION means a cut or wound and is a term specially applied to surgical openings.

INCISOR is the name applied to the four front teeth of each jaw (*see* TEETH).

INCOMPATIBILITY is a term applied to unsuitability in a prescription owing to the fact that its different contents either cannot be mixed, or that when mixed they undergo chemical changes, or that their actions are opposed to one another.

INCOMPETENCE (*in*, neg.; *competo*, I meet accurately) is a term applied to the valves of the heart when, as a result of disease in the valves or alterations in size of the chambers of the heart, the valves become unable to close the orifices which they should protect. (*See* HEART DISEASES.)

INCONTINENCE (*in*, neg.; *'continco*, I hold) is a term applied to the inability to retain the evacuations of the bowels and bladder. It occurs in diseases of these organs, injuries and diseases of the spinal cord, etc.

INCO-ORDINATION is a term applied to irregularity of movements produced either by loss of the sensations by

which they are governed or by defects in the muscles themselves or their nerves.

INCUBATION (*incubo*, I hatch) means the period elapsing between the time when a person becomes infected by some agent and the first appearance of the symptoms of the disease. Most acute infectious diseases have fairly definite periods of incubation, and it is of great importance that people who have run the risk of infection should know the length of time which must elapse before they can be sure whether they are to contract the disease in question or not. A person who has been exposed to infection is, during the incubation period, technically known as a 'contact'. By isolating and watching contact cases in a boarding-school, workhouse, barrack, or other public institution, medical officers can often very successfully check a threatened epidemic. It must be noted that diseases are not communicated to others by a person while passing through the stage of incubation. Some diseases, however, such as measles, become infectious as soon as the first symptoms set in after the incubation period is over; others, like scarlatina and smallpox, are not so infectious then as in their later stages. The incubation period for any given disease is remarkably constant, though in the case of a severe attack the incubation is usually slightly shortened, and if the oncoming attack be a mild one, the period may be lengthened. So far as schools are concerned, children who have been 'contacts' should not be allowed to return to school till several days beyond the maximum incubation period has elapsed since exposure to infection.

The usual incubation periods for some of the commoner infectious diseases are:

Scarlatina	2 days
Diphtheria	2 ,,
Smallpox	12 ,,
Measles	14 ,,
German measles	14 ,,
Chicken-pox	14 ,,
Typhoid fever	14 ,,
Mumps	21 ,,
Whooping-cough	8 ,,
Influenza	3 ,,
Cholera	5 ,,
Plague	5 ,,

All of these may, however, take a few days longer than the time stated to show themselves. (*See* INFECTION.) Several also, and especially whooping-cough, are very difficult to recognise in their early stages. For practical purposes, therefore, as regards the length of time that should be allowed to elapse after a child has been in contact with a case of infectious disease, and before he is permitted to return to school, the following table, taken from the 'Code of Rules for the Prevention of Infectious and Contagious Diseases in Schools,' issued by the Medical Officers of Schools Association in England, may well be followed:

	Isolation.
Chicken-pox	20 days
Diphtheria	12 ,,
German measles	20 ,,
Measles	16 ,,
Mumps	24 ,,
Scarlatina	10 ,,
Smallpox	16 ,,
Whooping-cough	21 ,,

INDIAN HEMP (*see* CANNABIS INDICA).

INDICATION (*indicatio*) is the term applied to any sign which points to the cause or particularly the treatment of a disease. The term 'contraindication' is applied to some circumstance which debars a particular line of treatment.

INDIGESTION (*see* DYSPEPSIA).

INFANT-FEEDING.—When a newborn child and its mother are healthy, the child should be entirely breast-fed for the first six or eight months of life. During the first three days the secretion of milk in the mother's breasts is not yet established, only a thin, clear fluid known as 'colostrum' being exuded, but the child should notwithstanding this be put to the breasts, both to stimulate the milk production, and because this fluid has an aperient action upon the child's bowels. No other food is necessary for the first three days. When the milk-flow is well established, the child should be fed at regular intervals of three or four hours, with a longer interval at night, for about ten minutes at a time, nor should crying on the part of the child cause any deviation from this rule. By this regularity, both the child's digestive organs and the mother's breasts are rested.

If for any reason the mother cannot nurse, recourse may be had either to a wet-nurse or to artificial feeding. If a wet-nurse be chosen she must be healthy, and her child should, if possible, be of about the same age as the foster-child.

In any case, milk in some shape should be the only food till the age of seven months. The simplest and perhaps the best substitute for mother's milk is cow's milk slightly modified. The following table shows the approximate composition of several milks in their natural state:

	Proteins.	Fat.	Sugar.	Salts.
	Per cent.	Per cent.	Per cent.	Per cent.
Human milk .	2	2·75	5	·2
Cow's ,, .	3·3	4	4·4	·6
Mare's ,, .	2·5	2	5	·5
Ass's ,, .	1·7	1·3	4·5	·5

It appears from these figures that mare's milk is very much the same in composition as human milk, and the same applies to ass's milk, which is a trifle more watery. Cow's milk not only contains much more protein than human milk,

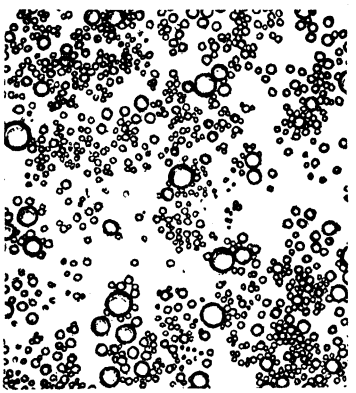


FIG. 263.—Microscopic appearance of milk, containing 3·6 per cent of fat. (Aikman's *Milk*, after Kirchner.)

but the protein is of a different character. In the cow's milk, most of the protein is found in the form of the cheese-producing caseinogen, while in human milk there is little of this and much albumin. Thus the cow's milk forms a hard curd in the stomach of the infant, that of human milk being, on the contrary, soft and quickly digested. Cow's milk is, therefore, apt in weakly children to remain undigested and to be passed in curdled lumps in the stools.

Humanised cow's milk may be prepared by diluting ordinary cow's milk with an equal amount of water and adding a small quantity of cream and of milk sugar. For infants brought up by hand, the cow's milk should be obtained quite fresh, and should be carefully diluted. This should be Pasteurised or sterilised by boiling. In most cases it is quite sufficient to dilute the milk with an equal quantity of water, or of barley-water; but if one wishes to be more exact one may add to every eight ounces of the mixture two ordinary teaspoonfuls of milk sugar, pressed level with the edge of the spoon, half an ounce (one tablespoonful) of cream and one tablespoonful of lime-water.

When the child is a month old, the amount of water added may be decreased gradually, till, by the age of six or seven months, the plain cow's milk is given and easily digested. After the age of seven months, the child's stomach will digest starchy food, and bread may be added to the milk or various soups and broths given. The child should be weaned about the end of the tenth month, and completely off the breast not later than the twelfth. The food during the second year of life, however, should still consist largely of milk, of which the child should consume over a pint daily. Some part of this will be used in the making up of milk puddings and starchy foods, and still more will be given along with these foods. Porridge, bread, eggs, and soups may also be given, but these must be considered merely as additional to the regular quantity of milk on which the main results of the feeding really depend. Solid animal food should be given only in small quantities until the second year has been completed.

The bottle in which milk is given is a matter requiring great attention. In the first place, it must always be kept clean, and should be sterilised daily by boiling water or steeped in boracic acid

lotion, two bottles being used and steeped upon alternate days. In the second place, there should be no tube attached to the bottle; a large india-rubber teat being fixed directly upon

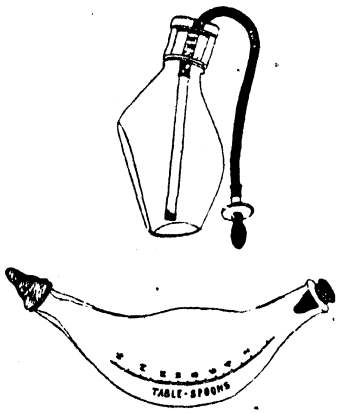


FIG. 264.—The upper figure shows the old and undesirable form of feeding-bottle; the lower figure shows a correct form.

the neck. The bottle may be of a simple, half-pint, narrow-necked form, or it may be flat and oval, tapering to a point at each end, on one of which is placed the teat while the other bears a valve for admission of air. Such bottles have the double advantage that they are simple and easily cleaned, and that the child cannot suck without the bottle being held to his lips, so that cleanliness and regular feeding are ensured.

The table below gives a general statement of the convenient amounts and intervals of feeding by diluted and sweetened cow's milk for various weights of the child up to about nine months of age. The quantity of sugar may sometimes be found too large. After six months (15 lb.) groats, soup, etc., are added, and less water is given with the milk. After nine months (18 lb.) more cereal food is given and the milk need not be diluted.

Sterilisation of the milk is important in the case of weakly children, and during the prevalence of summer diarrhœa and infectious diseases. In most cases simple boiling is sufficient, but the process is more thoroughly carried out in one of the many forms of steriliser in common use. (*See* STERILISATION.) When the higher grades of milk are obtainable for a child (Tuberculin Tested Milk or Pasteurised Milk), sterilisation may be dispensed with, and the risks of contracting tuberculosis or diarrhœa are avoided or greatly lessened. (*See* MILK.)

Causes of difficult digestion.—In the majority of cases such directions as those already given will be found sufficient for the rearing of the healthy infant. Cases arise, however, in which more elaborate methods are required in order to promote digestion, and, in some cases, actually to save life.

Difficulty may arise from several causes. (1) The child may be delicate from birth, as in the case of some prematurely born children, and may not be able to digest cow's milk as usually modified. (2) The child's vitality may be lowered by some acute illness and its powers of digestion thus interfered with. (3) The most ordinary cause, however,

METHOD OF FEEDING ON COW'S MILK BY DILUTION AND ADDITION OF SUGAR

Weight of Baby in Pounds.	Ounces of Cow's Milk Daily.	Ounces of Added Water Daily.	Level Teaspoonfuls of Sugar Daily.	Number of Feeds.	Bulk of each Feed in Ounces.[1]
5	7	6	5	6	2+
6	9	6	6	6	2½
7	11	7	7	6	3
8	12	8	8	6	3+
9	14	9	9	6	4−
10	16	9	10	5	5
11	17	11	11	5	5½+
12	19	11	12	5	6
13	20	13	13	5	6½+
14	22	13	14	5	7
15	25	10	5	5	7
18	24	..	..	3	8

[1] An ounce is approximately two small tablespoonfuls.

is previous improper feeding of the infant, and in every case of difficulty it is well to suspect such as a cause and to inquire carefully into the methods previously used.

Signs of difficult digestion.—The *weight* of the infant is the best means by which to judge of the success or otherwise of the method of feeding in use. If the child is not gaining weight but has no signs of indigestion, the food should be increased in amount. When the child, however, is not gaining or is actually losing weight, signs of difficult digestion can best be found by observing the behaviour of the stomach and bowels. (1) *Vomiting* is a fairly constant symptom of indigestion in children, the food being brought up soon after being swallowed, either in mouthfuls or in larger quantities. The milk in the vomit is often seen as large, hard masses of curd. (2) *Diarrhœa* is also a common sign of indigestion in children. The stools are usually frequent and offensive, and may be green in colour. They almost always contain little white masses of undigested curd and sometimes large quantities of mucus. (3) In some cases of indigestion, *constipation* is very marked, and, when movement occurs, hard brown masses with mucus and blood are passed. (4) *Pain* is usually present, causing fretfulness and loss of sleep, but it should be remembered that the act of vomiting is, in the infant, much easier than in the adult. Colic is also produced in some cases by the constipation.

Treatment of difficult digestion.—It is well, when these symptoms appear, to revise the method of feeding in use. Taste the food to ensure that it is sufficiently warm when given. See that the bottles are scrupulously clean, and their nipples fresh. The child should be prevented from taking the food too rapidly, the quantity given at each feed should be carefully regulated, and the hours for feeding strictly adhered to. Should the symptoms continue, it may then be well to reduce the amount of the feed, giving, for example, half the usual quantity every hour and a half instead of every two hours. Another method often adopted is to give the usual quantity but to lengthen the intervals between the feeds. Or by diluting one part of milk with two parts of water and omitting the cream from the food, one may sometimes be successful in allaying the symptoms. Lime-water, on account of its effect in softening the curd of cow's milk, is often preferred to plain water for diluting the food. It has, in addition, a beneficial action on the diarrhœa in these cases. It should be used in the proportions given above for ordinary water. Should these simpler measures fail, medical advice should be sought, because serious results may follow very quickly upon improper feeding of an infant.

When well-marked indigestion is present, means must be taken to subdue the irritation in the stomach and bowels, as well as to find a food suitable to the impaired powers of the stomach. In such cases, it is often well to begin treatment with a dose of some simple purgative, such as castor oil. This clears out any irritating contents from the bowel, and may be sufficient to check diarrhœa if present. In very severs cases, with the object of keeping the bowel clean and, at the same time, supplying needed fluid to the body, it is often requisite to wash out the bowel once or twice daily with warm saline fluid. In order to give a food which will leave no residue to irritate the bowels, raw meat juice in water or the whey of milk, instead of diluted milk, is often employed, in quantities suitable to the age of the child (see table above). As the stomach becomes less irritable, this may be partially, and ultimately entirely, replaced by some of the more easily digestible modifications of cow's milk. Thus condensed milk, the curd of which is softer than that of fresh cow's milk, is much used by some authorities. Others prefer to digest the food partially before giving it to the child, and this they do by means of peptogenic milk powder. (*See* PEPTONISED FOODS.) In severe cases of gastric dyspepsia much good is often derived from systematic washing out of the stomach, either with plain warm water, or with water to which bicarbonate of soda has been added in the proportion of one teaspoonful to the pint of water.

Medicinal remedies naturally play a very small part in such cases, but improvement frequently results, especially in those cases where the bowels show signs of much irritation, from the use

of small doses of grey powder (¼-½ grain) given with every second or third feed. Another powder much used by some authorities consists of grey powder and powdered rhubarb in doses of half a grain of each, along with two or three grains of bicarbonate of soda, administered three or four times in the day. Much harm, however, is often done in just this type of case by the use of so-called 'soothing' preparations, which may relieve pain for a time, but in reality aggravate the disorder from which the child is suffering.

The subject of infant-feeding has been given a much larger place in the public mind recently owing to the attention that has been called to the large infantile mortality, especially in the busier centres of population. In France, a movement was made some years ago which had for its aim encouragement of breast-feeding of infants. Accompanying this, however, there came the establishment of depôts for the supply of reliably prepared, modified cow's milk to infants who, for one reason or another had to be hand-fed. The movement thus begun has spread to other countries and, in most large towns, milk depôts have been established under the supervision of the Local Health Authority. The method employed in most of these establishments is briefly as follows. A reliable milk supply is obtained, and the milk, fresh and as free from bacteria as possible, is mixed with water, cream, and sugar, the proportions varying to suit the age of the users. Small bottles are filled, each with the proper quantity for one meal, and subjected to Pasteurisation. (*See* STERILISATION.) They are then carefully sealed and supplied to each user in sufficient number to provide for the entire feeding for one day. Where reliable statistics have been obtained, the results show a decided diminution in the death-rate of depôt-fed infants as compared with the general infantile mortality.

Expense is a drawback to the use of many of the prepared foods for children which are so largely advertised. In most of them, analysis has shown a deficiency of fat and a superabundance of sugar. Convenience and freedom from the presence of dangerous bacteria are the only claims that many of them can make, and, from the view-point of

nutritive value, none is superior to, while few equal, an intelligently pre-prepared modification of pure cow's milk. In cases of difficult digestion, however, one or other of the well-known foods is occasionally tolerated when difficulty is experienced with milk, and various proprietary foods may be cautiously tried till a suitable one is found in cases where milk is badly digested.

Food diseases.—Under this heading may be classed two diseases of infancy or early childhood, the causes of which depend to some extent on the nature of the previous feeding. The diseases are infantile scurvy and rickets. (*See* SCURVY *and* RICKETS.) Mention has already been made of the relation between improper feeding and serious diarrhœa. (*See* DIARRHŒA.) The possibility of conveyance of tuberculosis from diseased cows to children by the milk is discussed under CONSUMPTION and its prevention under MILK.

Infantile scurvy is due to deficiency in the diet of vitamin C, or ascorbic acid, as it is called. The remedy is to make good the deficiency by giving fruits rich in vitamin C, such as oranges, black-currants, etc. Vitamin C can also be given in tablet form. Once the scurvy is cured, care must be taken to see that an adequate diet is continued.

Rickets is another and later result of improper feeding, especially with some of the prepared foods and cheap condensed milks. Here, however, unhealthy surroundings also play an important part, and cleanliness, fresh air, and sunshine are urgently called for. In addition, the diet must be regulated. All proprietary, farinaceous, and highly sugary foods should be avoided. Rickets is the result of deficiency of vitamin D in the diet, and must be cured by giving oils rich in vitamin D, such as halibut-liver oil or cod-liver oil, and foods containing vitamin D, such as milk, cheese, butter, and eggs. At the same time foods containing calcium must be taken, which is also present in milk and cheese.

General rules for feeding young children.—The proper routine of feeding, sleeping, and exercise forms the beginning of a child's education, and the following general rules should be observed:

1. Give food at the regular hours only.

2. Take ample time; do not hurry the child in sucking or chewing.

3. If a child is disinclined to eat he should not be coaxed or forced to do so. Children are often overfed; if a child is losing weight he should be examined, beginning with the mouth, for signs of disease, otherwise the regulation of the amount of food should be left to his appetite.

4. Fancy dishes should not be given to tempt the appetite if simple food is refused; nor should food refused at meals be allowed at other times.

5. Although all food given to a child should be simple, it ought to be varied from day to day.

6. Highly seasoned food, much dressed food, and food with a large indigestible residue should not be given to children.

7. If a child habitually refuses some important article of diet, like milk, egg, or cereals, this should be given first and the more palatable food withheld till the simpler one is taken. The refusal of some special food tends readily to become a habit with some children.

8. If a child is feverish, food should be greatly reduced in strength and quantity. In very hot weather also, food should be much diminished and more water given.

9. The basis of a child's diet should be pasteurized milk (up to 2 pints a day); brown, wholemeal, or wheatmeal bread; butter or vitaminized margarine; eggs; cheese; fruit; salad vegetables; green leafy vegetables; potatoes and other root vegetables; meat; fish, especially fat fish such as herrings and pilchards; sugar (but not too much); and water to drink. In the winter months a child should take one to two teaspoonfuls of cod-liver oil, or drops of halibut-liver oil, daily.

INFANT MORTALITY means the number of deaths of infants under one year of age. The infant mortality rate in any given year is calculated as the number of deaths in the first year of life in proportion to every 1000 registered live births in that year. It is of great importance as an indicator of the social and health conditions of towns and other sections of the community. As a general rule it is lowest in agricultural districts, higher in thickly populated mining and manufacturing regions, and highest in large towns where textile industries are carried on and where female labour is largely employed.

INFANT MORTALITY

Towards the close of the eighteenth century about half the children born died as infants. Throughout the nineteenth century the infantile mortality rate was usually over 150 per 1000 births. This fell to 105 in 1910, to 80 in 1920, to 60 in 1930, to 59 in 1936, to 50 in 1939, 49 in 1942, and 46 in the second quarter of 1943.

The chief causes of infantile mortality are premature birth and various constitutional defects, inexperience and neglect on the part of mothers, adverse industrial conditions, and improper feeding of the infants. The diseases which especially operate to raise it are epidemics of measles and whooping-cough, respiratory troubles in the wet months of the year, and the prevalence of diarrhœa in hot summers.

Of recent years attempts have been made to combat this tendency to illness and death among infants. As a result, a remarkable decrease in infantile mortality has taken place in Great Britain since the beginning of the century. Much has been done by public health authorities of large towns, who have arranged for the sale of pure milk; and for the instruction and supervision of mothers and young children through responsible health visitors, and at antenatal and infant consultation clinics.

It may be mentioned that in New Zealand the infant mortality rate fell to 35 at one time, that before the war of 1939–194- it was 39 in Sweden and regularly below 40 in Holland. There would therefore seem to be plenty of room for improvement in England. It appears that the rate of improvement in infantile mortality has been much greater for Classes I and II than for Classes IV and V of the censuses of 1911, 1921, and 1931. Little change has occurred in the 'class rates' of neonatal mortality (*q.v.*), due chiefly to premature births, congenital malformations, birth injuries, convulsions, congenital debility. After the neonatal period, it is

argued, nurture plays a much greater part in determining fatal illnesses than Nature. If, therefore, there are differences of infantile mortality after the neonatal period among the five social classes, then inequality of nurture is to be blamed.

INFANTILE PARALYSIS.—Popular term for ACUTE ANTERIOR POLIOMYELITIS (*see* POLIOMYELITIS).

INFARCTION (*infarcio*, I cram in) means the changes which take place in an organ when an artery becomes suddenly plugged up, leading to the formation of a dense, wedge-shaped mass in the part of the organ supplied by the artery. It occurs as the result of embolism or of thrombosis. (*See* EMBOLISM.)

INFECTION (*inficio*, I taint) is the name given to the process by which a disease is communicated from one person to another. All diseases so communicable are called infectious. There is, in the case of all such diseases, some substance produced in the body of the diseased person which on being transmitted to a second person is capable of reproducing itself in larger quantity and causing a particular disease.

This substance may be a bacterium, a Rickettsia, a filter-passing virus, a protozoon, or a metazoon. Invasion of the body by a metazoon (*e.g.* by an intestinal worm) is more often known as an infestation.

The germs of disease may be grouped into those which will not flourish except about the temperature of the body, and those which are capable of maintaining their existence in decaying animal or vegetable matter, making only occasional migrations into the body and setting up disease. Speaking generally, bacteria of the first group are consistently much more deadly in their action, while those in the second group vary much in the severity of the disease they produce, causing a severer type if they have come direct from an infected person than if they have been germinating in drains, in the soil, or floating on dust particles in the air. This principle is of immense practical importance. In the course of a surgical operation many bacteria must fall from the air into the wound, but this does not appear to be any drawback, unless the bacteria be derived direct from suppurating wounds or like virulent source. Similarly diphtheria or pneumonia bacteria of a mild type may be found in the mouth of people who are, nevertheless, quite healthy, if certain conditions, necessary to render the bacterium virulent, be not present.

The same bacterium may produce very different types of disease, not only on account of its previous life-history, but even according to the channel by which it enters the body. For example, the tubercle bacillus produces the skin disease lupus, consumption of the lungs, chronic white swelling of joints, very chronic enlargement of glands in scrofula, and other diseases, these varying widely in their symptoms and their effects upon the general health. A certain amount of protection against the entrance of infective matter into the tissues of the body is afforded by the horny layer of the skin, by the acid of the gastric juice, and by the movements of the intestine, and a still greater measure of protection is afforded by the factors which ensure immunity against diseases. (*See* IMMUNITY *and* SERUM THERAPY.)

Modes of infection.—The infective material may be transmitted to the person by direct contact with a sick person, when the disease is said to be 'contagious', though such a distinction is purely artificial. Different diseases are specially infectious at different periods of their course; and the practical question of guarding against infection is rendered much more difficult by the fact that some diseases are infectious at a stage even before they are clearly recognisable. This applies particularly to the early stage of measles before the rash appears, when the infected child is showing symptoms merely resembling those of a catarrh or cold in the head.

Infection may be conveyed on dust driven by the wind, in drinking-water, food, particularly milk, evacuations with which the healthy person's hands have become contaminated, crusts and scabs from the infected person's body, or even clothes and linen which have been in contact with him.

In this connection what are termed

'carriers' are of great importance. Some persons who have suffered from a disease, or who have simply been in contact with an infectious case, harbour the germ of the disease. This is particularly the case in regard to typhoid fever, the bacillus continuing to develop in the gall-bladder of persons who have had the disease, it may be for years after the symptoms have passed away; it is believed that about 1 in every 10,000 of the population is thus a 'typhoid carrier', and where a cook or food purveyor is affected, he is apt to start an epidemic unless he exercises the most scrupulous cleanliness. In the case of cholera, which is endemic in some localities of the East, 80 per cent or more of the population may harbour the bacillus and spread infection when other circumstances favour this. Similarly in the case of dysentery, persons who have completely recovered may still be capable of infecting dust and drinking-water by their stools. Diphtheria is similarly liable to be carried by persons in whose throat the germ remains after recovery from the disease. Cerebro-spinal meningitis, which is particularly liable to infect children, appears to be transmitted through the germ being carried in the nose of persons who may not develop any symptoms.

Animals play an even more important part than human beings in spreading such diseases. Flies pass from garbage heaps to unprotected food, and are especially dangerous as regards the infection of butter with the bacilli of typhoid fever, and of milk and other food with the organisms causing summer diarrhœa. Mosquitoes convey from sick to healthy the germs of malaria and yellow fever, these undergoing part of their development in the body of the mosquito. Fleas convey the germ of plague from rat to man, lice are responsible for inoculating typhus fever by their bite, and the bed-bug is blamed for similar propagation of relapsing fever and kala-azar in the East.

Notifiable diseases.—Certain of the common and most serious infectious diseases were scheduled in the Infectious Diseases Act of 1889 as notifiable in Great Britain. That is to say that any medical practitioner, attending or called in to visit a person suffering from one of these, must immediately, on becoming aware that the patient is suffering from it, send a notice to the local medical officer of health. These diseases were: smallpox, cholera, diphtheria, membranous croup, erysipelas, scarlatina, and the fevers known as typhus, typhoid (enteric), relapsing, continued, and puerperal. Various other diseases have been included from time to time by other enactments or are included by local authorities in special localities. Such diseases are measles, whooping-cough, plague, cerebrospinal fever, chicken-pox, acute poliomyelitis, tuberculosis, ophthalmia in the new-born, malaria, dysentery, trench fever, acute pneumonia, and influenzal pneumonia. Anthrax and toxic jaundice are notifiable as industrial diseases. Similar regulations are found in the various States of America and in other countries.

Prevention of infection.—The various channels of infection are mentioned under the heading of the different infectious diseases, and also briefly under SANITATION. As children are much more liable to contract infectious diseases than grown-up people, attempts to prevent the spread of these diseases are specially directed towards separating affected persons from healthy children. The measures taken apply particularly to schools, which form the places of dissemination in a large proportion of cases, but the rules applicable to children may well be practised with regard to persons of any age and in respect of any public institution.

1. The following diseases may, for this purpose, be considered infectious: *chicken-pox, diphtheria, German measles* and *epidemic roseola, measles, mumps, ophthalmia, ringworm, scarlatina, smallpox, typhoid fever, typhus fever*, and *whooping-cough*.

2. Persons who have contracted any of these diseases should not again mix with the public till the following periods have elapsed. The periods are in the main taken from the 'Code of Rules for the Prevention of Infectious and Contagious Diseases in Schools', issued by the Medical Officer of Schools Association in England.

Chicken-pox, when all the scabs have fallen off, particular attention being paid to the scalp.

Diphtheria, four weeks from the be-

TABLE SHOWING DURATION OF INFECTIOUS DISEASES

	Incubation period after infection and before illness begins.	Day after illness begins on which the eruption		Length of time, after illness begins, at which infection ceases.	Isolation period required after the *latest* exposure to infection.
		appears.	fades.		
CHICKEN-POX	12 to 20 days	1st day and 3 following days.	About 4th	When every scab has fallen off.	20 days
CHOLERA	A few hours to 10 days, usually 3 to 6 days.	..	..	7 days from complete cessation of diarrhœa. Carriers occur.	8 days
CONSUMPTION	..	..	..	When the patient has ceased to spit.	..
DIPHTHERIA	2 to 10 days.	Membrane appears in throat on 1st or 2nd day.	..	In 4 weeks, if no discharges and no albumin in the urine, and if bacteriological examination of nose and throat be negative.	12 days, but depends on bacteriological tests
ERYSIPELAS	3 to 10 days	1st day	..	When rash has gone and desquamation ceased.	12 days
GERMAN MEASLES (Rötheln)	7 to 18 days or even longer	2nd to 4th	4th to 7th	In not less than 10 days from appearance of the rash.	21 days
INFLUENZA	1 to 4 days, usually 3 to 4 days	..	..	In 3 days after the temperature has become normal, and all catarrhal discharges have ceased.	5 days
MEASLES	10 to 14 days	4th day. The patient is highly infectious for 2 days before the rash appears.	5th to 7th	In not less than 2 weeks from appearance of the rash.	16 days, or medical inspection from 9th to 14th day
MUMPS	10 to 22 days	..	..	In not less than 3 weeks, and then only when 1 week has elapsed since subsidence of all swelling.	24 days
OPHTHALMIA	..	..	..	When all discharge and redness of the eyes have ceased.	..
PLAGUE	2 to 8 days, in rare cases up to 15 days	..	..	In 1 month.	10 days
PUERPERAL FEVER	3 to 10 days	..	..	When discharge stops.	..
RINGWORM	..	..	..	When examination reveals no broken-off hairs; and microscopic examination discovers no parasite in the hairs.	..
SCARLET FEVER	1 to 8 days, usually 2 to 3 days	2nd	5th	When desquamation and sore throat and albuminuria disappear, but never in less than 6 weeks.	10 days
SMALLPOX	12 to 14 days	3rd or 4th	9th or 10th	When every scab has disappeared.	16 days
TYPHOID (ENTERIC) FEVER	7 to 21 days, usually 10 to 14 days	8th or 9th	21st	Indefinite (typhoid carriers occur).	21 days
TYPHUS FEVER	5 to 14, very variable	5th	14th	After 4 weeks.	16 days
WHOOPING-COUGH	7 to 14 days	The characteristic whooping may not appear for 2-3 weeks, although the patient is infectious before then.	..	In 5 weeks from commencement, provided all characteristic spasmodic cough and whooping have ceased for at least 2 weeks.	21 days
YELLOW FEVER	3 to 8 days (in mosquito 12 days after biting patient)	..	..	3 days.	8 days

ginning, provided there is no sore throat, nor any discharge from throat, nose, eyes, or ears, and that the diphtheria bacillus cannot be found in the throat.

German measles and *epidemic roseola*, not less than ten days after the rash appeared.

Measles, not less than two weeks after the rash appeared, but then only if the cough has ceased.

Mumps, not less than three weeks after the beginning, and then only if all swelling has been gone for a week.

Ophthalmia, not until the redness of the eyes has disappeared, in one or two weeks, should the same washing utensils be used by the patient and by other people. In the case of trachoma, the child should be permanently removed from school.

Ringworm of the head, not until all bare patches and broken hairs showing the fungus have disappeared, as tested by careful examination. After ringworm of the body, infectiveness disappears when the skin has become smooth again.

Scarlatina, not less than six weeks after the rash appeared, and then only if desquamation and all discharges from nose, ears, or suppurating glands are stopped, and the surface of the body has been disinfected.

Smallpox, not until all the scabs have fallen off.

Typhoid fever, not less than six weeks from the beginning of the fever, and then only if there have been no relapses.

Typhus fever, not less than four weeks from the beginning.

Whooping-cough, not less than five weeks from the beginning of the whooping, and then only provided that the cough has ceased.

3. After persons have been 'in contact' with the following serious diseases, viz. *diphtheria, scarlatina, typhoid fever, typhus fever*, and *smallpox*, they should remain in quarantine for periods exceeding the longest possible incubation period, viz. diphtheria, twelve days; scarlatina, ten days; typhoid fever, twenty-three days; typhus fever, fourteen days; smallpox, sixteen days. It is essential, however, that the clothes of the suspected person should be disinfected at the *beginning* of the quarantine period.

After contact with the slighter diseases, viz. *measles, German measles, chicken-pox, whooping-cough* and *mumps*, children attending large schools where infection would spread easily should be isolated, after careful disinfection of their clothes, for the periods given under INCUBATION. But, in the case of adults and of children living at home, it suffices if they at once take up residence in an uninfected house, and, though mixing freely with other persons, report daily to a medical man for a few days before and after the end of the incubation period of the disease to which they have been exposed. In the case of measles, adults and children who have had measles previously should, after exposure to risk of infection, if they are mixing with the public, be carefully examined for signs of the disease for three days before and three days after the end of the usual incubation period. It is a good plan for children to stay away from school during these six days. (For the usual periods of incubation, see INCUBATION.) Instead of the 'contacts' changing their abode, the patient is usually removed, and the sickroom together with all clothing that has been in contact with him is disinfected. By these means, if 'contacts' become infected, the fact will be recognised within a day, and they can at once be isolated and treated.

4. Clothes, books, etc., which have been used by an infected person, must, when his illness is at an end, be destroyed or carefully disinfected before use by any one else. (*See* DISINFECTION.)

5. The methods applicable to certain diseases which are communicated in special ways, *e.g.* Consumption, Yellow Fever, are given under the heading of the disease in question. For the methods to be adopted against flies, lice, etc., see INSECTS IN RELATION TO DISEASE.

INFECTIOUS MONONUCLEOSIS (*see under* GLANDS, DISEASES OF).

INFESTATION is a term applied to the occurrence of animal parasites in the hair or clothing. (*See* INSECTS IN RELATION TO DISEASE.)

INFLAMMATION (*inflammo*, I set on fire) may be defined as the reaction of the tissues to any injury, short of one sufficiently severe to cause their immediate death. The term is limited sometimes to the changes which take place when bacteria enter the body, but

the changes in the latter case, though specially severe, are essentially the same as those produced by any other source of irritation. There are four cardinal symptoms of inflammation, viz. redness, heat, pain, and swelling, all of which, and particularly the last, are present in greater or less degree, so that these are also made a basis for defining the condition. The changes that take place have been studied by observing under the microscope the tongue, mesentery, or foot-web of frogs, newts, and similar animals in whom these structures are very thin and transparent. The changes which take place as the surface dries, or on the application of various irritant substances, are easily seen. These changes have been confirmed, so far as other tissues and other animals are concerned, by examination after death.

The first sign of inflammation consists in a dilatation of the arteries and veins of the affected part, so that the blood circulates in it more quickly and in larger quantity than before, thus causing heat and redness. Very soon, however, and apparently as the result of some change in the walls of the veins, the circulation becomes gradually slower, and the white corpuscles of the blood are seen to adhere to the inner surface of these vessels. Later, these corpuscles push their way in great numbers through the walls of the smaller veins and capillaries, migrating into the surrounding tissues along with large quantities of the fluid material of the blood and a few red corpuscles. Hence the swelling, which is the most characteristic sign of inflammation. These white corpuscles discharge many functions. In the first place, they have been seen, originally by Metchnikoff, and later by other observers, to attack the bacteria which have invaded the tissues, to develop them in their own substance, and, apparently by a process of digestion, to break them up. They also remove tissues which are dead or useless. Other corpuscles, at a later stage, when the source of irritation has been removed, play a part in producing the new tissues to repair the damage done, though the greater part of this repair is effected by cells from the surrounding tissues.

One of two results may follow inflammation. Either *resolution* may take place, when the white corpuscles, having played their part, find their way back into the circulation after the process of repair has been started at the site of injury, and the circulation proceeds as before, or *abscess-formation* results, the circulation comes to a complete standstill in the affected part, an excessive number of white corpuscles migrate from the vessels, an area of tissue becomes destroyed, and the process ends by a discharge of ' pus ' through the surface of the body, after which repair proceeds. (*See* ABSCESS, ACUTE.)

Symptoms.—As mentioned above, redness, heat, pain, and swelling are the classical symptoms of inflammation, and there are usually general symptoms of high temperature, feverishness, etc., varying with the severity of the inflammation. Various special symptoms are set up in special localities, for example, inflammation of the mucous membranes of the stomach and bowels leads to a copious excretion of mucus, and is known as ' catarrh ' ; inflammations of outlying parts, if they are very severe, may cause death of these parts, and are then called ' gangrenous ' inflammations ; intense inflammation limited to a surface may destroy patches of the surface and convert them into a leather-like membrane, such types being known as ' croupous ' inflammations, etc. Inflammation may become chronic, and in this case not only does the process described above proceed in a minor degree, but there is an exaggerated process of repair leading to the formation of much fibrous or scar tissue, which may come to replace almost entirely the organ in which the chronic inflammation is proceeding, thus rendering the organ small, hard, and irregular in outline.

Treatment.—In the earlier stages of an inflammation, cold, either in the form of ice or of evaporating lotions applied to the part, appears to be the remedy *par excellence*. Later on, cold has little effect, and moderate warmth with moisture, as gained by poultices or fomentations, has an emollient action, soothes pain, and, if an abscess be inevitable, allows this to form more quickly. Sedative substances, such as opium, are also employed to soothe pain. When the inflammation is a superficial one and direct applications are possible, various antiseptic washes, emollients,

and astringent powders are applied. Where the inflammation is deep-seated various means are taken to control excessive congestion in the blood-vessels of the affected organ, the chief being counter-irritation and blood-letting. (*See* BLOOD-LETTING.) Bier's method of treatment for inflammation aims at increasing the reaction of the tissues through producing in them a passive congestion by means of light constricting bands, suction cups, and other means. It is often very successful in cases where the reaction is slight. In chronic inflammations, counter-irritation to the skin surface is the most successful remedy. (*See* BLISTERS.)

For inflammation of special organs see APPENDICITIS, PNEUMONIA, PLEURISY, PERITONITIS, etc.

INFLUENZA (Italian word), also known as LA GRIPPE and EPIDEMIC CATARRH, is a term applied to an infectious febrile disorder of short duration, characterised specially by catarrh of the respiratory passages and alimentary canal, and occurring mostly as an epidemic.

Causes.—This disease is referred to in the works of the ancient physicians, but accurate descriptions of it have been given by numerous medical writers during the last three centuries, in connection with epidemics which have occurred from time to time. These various accounts agree substantially in their narration of the phenomena and course of the disease, and influenza has in all times been regarded as fulfilling all the conditions of an epidemic in its sudden invasion, rapid and extensive spread, and speedy and complete disappearance. Among the chief epidemics of influenza are those of 1557, 1762, 1782, 1787, 1803, 1833, 1837, 1847, 1889, and 1918. In several of these, the disease appeared to originate in some parts of Asia, and to travel westward through Europe and on to America, resembling in this respect certain cholera epidemics, although the two classes of disease have nothing in common. In some of the epidemics, influenza has spread through the whole of Europe in the course of six weeks. Wherever it appears, the whole community suffers to a greater or less extent, irrespective of age or condition of life. It has occasionally appeared in fleets at sea away from all communication with land, and to such an extent as to disable them temporarily for service. This happened in 1782 in the case of the squadron of Admiral Kempenfelt, which had to return to England from the coast of France in consequence of a severe epidemic of influenza attacking his crews, while at the same time the squadron of Lord Anson, off the coast of Holland, suffered extensively from a similar outbreak. Many instances of a like kind have been recorded.

Much speculation and some amount of scientific inquiry have been expended in endeavours to ascertain the cause of this remarkable ailment. The Italians in the seventeenth century ascribed it to the influence of the stars, and hence the name 'influenza', by which the disease has subsequently been known.

In 1892 Pfeiffer discovered a short, rod-shaped bacterium in the bronchial secretion, lungs, blood, and other tissues of those suffering from the disease, and this *Bacillus influenzæ*, which is very constantly found while the disease lasts, is undoubtedly an important infecting agent in what is known as influenza, even if it is secondary to a virus infection.

Andrewes and Laidlaw in England, and other workers in other countries, have repeatedly isolated a filter-passer or ultramicroscopic virus in influenzal epidemics, and there can be little doubt that such a virus is a cause of influenza. But in the epidemic in 1939-40 winter in England attempts to isolate a virus failed. There may be several distinct viruses, apart from that isolated by Andrewes, which can cause what is known as influenza. One such has already been isolated and is known as influenza virus B; Andrewes' virus is now known as influenza virus A. We might repeat a question asked in a well-known textbook of medicine, 'Are there influenzas rather than influenza?'

Symptoms.—The most common disturbances consist of a sudden febrile attack, accompanied by a chilly feeling, shivering, headache, and aching pains through the body, followed by the development of sore throat and cough. The onset is so sudden in many cases that the patient can describe what he was doing at the moment he was first

affected. Constipation, mental depression, and a feeling of great exhaustion commonly accompany the symptoms named, and last for 3 to 5 days, or the attack may be prolonged to several weeks. There is, however, after the feverishness and other symptoms have quite passed off, a very slow return to ordinary appetite and strength. A state of feebleness and easily induced fatigue, lasting for weeks or months after the attack has passed off, is also highly characteristic of influenza. Beyond these general symptoms there are three more or less distinct types of the malady, which shade off imperceptibly into one another, but of which one or other has been most pronounced in different epidemics. These are the types in which the respiratory, nervous, and digestive systems respectively are chiefly affected.

In the *respiratory form*, in addition to the symptoms mentioned above, the cough and bronchitis especially develop, and this type forms the most common of all. In many cases, particularly old people, just as they are apparently recovering from the influenza, pneumonia develops, and the illness takes a very serious turn. Pneumonia under these circumstances is far more likely to be fatal than an ordinary attack of pneumonia, and the chief mortality of influenza is due to this complication.

When the *nervous form* predominates, as in the epidemic of 1889, many varied symptoms referable to the nervous system appear. The headache and backache are often extreme. Sleeplessness, neuralgia, and irregularity or great slowness of the heart's action are common symptoms. Various mental disturbances, such as great depression, which may be prolonged into melancholy after the attack clears off; delirium, which sometimes passes into mania, or such enfeeblement of the powers of mind and body that a long-continued or even permanent state of weak-mindedness or of neurasthenia remains, are by no means infrequent results of influenza. A curious condition, in which the patient gradually becomes comatose and dies, or after remaining in this state for a day or two slowly recovers consciousness, also results now and then from the effects of the influenza poison on the brain. Paralysis of limbs or of single muscles, with gradual wasting of the affected part, is also an occasional symptom.

When the *digestive system* is chiefly affected, and this is perhaps the rarest form, in addition to the general symptoms of influenza, there ensue vomiting, colic, and diarrhœa, with the passage of a great deal of mucus, followed by a weakness of the digestive powers which may last for many months, and these symptoms are liable to be mistaken for those of appendicitis.

The mortality of influenza is not high, being not more than 2 per cent of all the cases affected. The death-rate is specially great among old people. As, however, a huge proportion of the populace is affected in epidemics, even this small death-rate doubles or trebles the ordinary mortality of large towns. It is said that, in the 1889 epidemic, two-thirds of the population of St. Petersburg were affected, one-third of that in Berlin, and at least one-seventh of all the people in London.

Treatment.—Often the enfeeblement and feverishness are so great that the person must perforce take to bed, but it is not at all uncommon for vigorous people to struggle on with their usual work. This is very unwise, because not only is the risk of pneumonia and other serious complications made much greater by this course, but the resulting enfeeblement is greater and lasts longer than if the patient had husbanded his strength. It is a good rule, therefore, to keep in bed as long as the temperature remains elevated, and, in the case of elderly people, for several days after it has become normal. At the beginning of the illness a rest in bed, combined with some of the measures mentioned under CHILLS AND COLDS, may be effectual in limiting the attack of influenza to mild illness. As to diet, the food should be of the lightest, particularly in the digestive type of the disease, being limited to milk, rice, or corn-flour, and thin broths. In severe or complicated cases, careful nursing, feeding, and stimulation of the heart's action are specially required. Salicylate of soda, with an equal amount of bicarbonate of soda, or phenacetin forms the favourite remedy for the pains and headache of slighter cases. Quinine is

also frequently used, especially in the form of ammoniated tincture of quinine, in doses of a teaspoonful. In cases where there is evidence that a considerable amount of bronchitis is present with threatening bronchial pneumonia, due probably to secondary infection with staphylococci or streptococci, one of the sulphonamide drugs or penicillin is indicated. When constipation is present it may be relieved by calomel or castor oil. In every case, after the attack has passed off, a course of tonic treatment is necessary for the speedy restoration of health and strength.

Persons who are liable to contract influenza or severe catarrhs, sometimes undergo protective inoculation with a vaccine in the autumn. In some cases this appears to confer a measure of protection for a few months, in most cases it is ineffective. (*See* VACCINE.)

INFUSIONS are preparations of vegetable drugs made by steeping them for some time in water and straining. In order that an infusion may keep well it is usually concentrated and mixed with spirit, being diluted just before it is dispensed. Among the better-known infusions are those of calumba, chiretta, cinchona, digitalis, gentian, orange, rhatany, quassia, roses, senega, and senna. The dose of most infusions is from one to several tablespoonfuls.

Infusion is also the term applied to the injection into blood-vessels or subcutaneous tissues of warm normal salt solution, glucose solution or gum acacia solution, in the case of persons who are in a feeble state from loss of blood, loss of fluid by diarrhœa, etc. The infusion is sometimes administered in an amount of about one pint at a time, or is frequently used by a drip method in which the warm fluid is suspended at a height and allowed to pass drop by drop for several hours into a vein.

INGLUVIN (*see* PEPSIN).

INGUINAL REGION (*see* ABDOMEN, REGIONS OF).

INHALATION (*inhalo*, I breathe in) means a method of applying drugs in a finely divided or gaseous state, so that, on being taken in on the breath, they may come in contact with the nose, throat, air passages, and lungs. There are five chief means by which drugs are mingled with the air and so taken in by breathing. These are as follows:

(*a*) Volatile drugs, which become gaseous at the ordinary temperature, are sprinkled on cloth, wool, or otherwise exposed to the air. Examples of these are chloroform, ether, nitrous oxide gas, nitrite of amyl. Most drugs so administered act as general anæsthetics.

(*b*) Respirators are worn in front of the mouth and nose when it is desired to admit small quantities of some slowly volatile drug constantly into the air passages. The simpler and lighter such respirators are, the better. Perhaps the best variety is one consisting of a thin piece of bent, perforated metal, padded round the edge, having a small piece of sponge in its interior upon which the drug may be dropped, and pieces of elastic at its sides to pass behind the ears and keep the respirator in position. Such a respirator may be worn by consumptives and others whose sputum is foul-smelling, and a few drops of eucalyptus, pine oil, or creosote upon this respirator help to purify the breath.

(*c*) Drugs which give off volatile substances on burning are mixed with some combustible substance, and the fumes they give off inhaled. Thus asthmatic persons obtain relief during an attack from the smoke given off by smouldering blotting-paper which has been previously soaked in a strong solution of nitre and dried. (*See* NITRE.) Similarly lobelia, stramonium, belladonna leaves, etc., are made into powders or rolled up in cigarettes, of which the fumes are inhaled.

(*d*) Steam inhalations are the most useful forms of all. Steam itself, or hot moist air, has a very soothing effect upon the mucous membrane of the air passages, and the steam may be impregnated with many moderately volatile drugs. This type of inhalation is used especially in bronchitis and inflammatory conditions of the throat and larynx. If it be desired to surround the patient constantly with a steamy atmosphere, the most convenient mode of doing so is by a kettle placed upon the fire or over a spirit lamp, from which a long white-iron funnel leads in beneath a tent formed by a blanket over the upper

half of the patient's bed. In cases of chronic bronchitis, one teaspoonful of the following mixture may be now and then added to the hot water: pine-wood oil 1 ounce, eucalyptus oil 1 ounce, creosote ½ ounce. Or in acute cases, where a soothing effect is specially necessary, a teaspoonful of the following: compound tincture of benzoin 1 ounce, menthol 10 grains, spirit of chloroform ½ ounce. Either of these formulæ may be used in the simple way of adding it to a jug half full of boiling water, over which the mouth is held, the head being enveloped in a towel that falls down round the sides of the jug. The same remedies may be added in similar quantity to an inhaler and the mouth directly applied to the tube leading from it.

(*e*) The most recent form of inhalation consists of a fine spray or cloud driven off from a fluid by a stream of compressed air. By this means, various medicaments can be made to reach the farthest recesses of the lungs. The smaller of these 'nebulisers' or 'atomisers' are worked by a hand-ball of india-rubber, which drives a strong stream of air across the mouth of another tube dipping into the liquid. In various spas, larger nebulisers worked by force pumps are employed to fill whole rooms with medicated vapour, which patients sit and inhale for hours.

INHIBITION (*inhibeo*, I restrain) means arrest or restraint of some process effected by nervous influence. The term is applied to the action of certain 'inhibitory' nerves, *e.g.* the vagus nerve which contains fibres that inhibit or control the action of the heart. It is also applied generally to the mental processes by which instinctive but undesirable actions are checked by a process of self-control.

INJECTIONS (*see* ENEMA *and* HYPODERMIC INJECTIONS).

INJURED, REMOVAL OF.—A knowledge of the manner in which injured persons may best be removed from the spot where they have sustained the injury is of great importance, because careless or unskilful handling or moving may produce much pain and in some cases is liable to aggravate the bodily damage already done.

Precautions before removal.—In the case of some injuries, such as that of the brain in apoplexy, or the perforation of the bowels caused by a bullet-wound of the abdomen, the less movement of the patient that takes place at first the better for his chances of recovery, and it is sometimes advisable that treatment should be carried out for some time near the spot where the injury has been sustained. When a bone has been broken it is essential that the fragments should be temporarily supported and made rigid by suitable devices before any attempt is made to change the patient's position. (*See* FRACTURES.) In other cases, as, for example, those of faintness, shock, immersion in water, etc., some other form of first-aid treatment or the administration of stimulants is urgently necessary prior to removal. (*See* FAINTING; COLLAPSE; DROWNING, RECOVERY FROM; HÆMORRHAGE, etc.) During removal an attendant must be constantly with the injured person, or at least the latter must be carried in such a way that one of the bearers constantly sees his face.

Position in removal.—The following hints are taken in part from Sir T. Longmore's *Treatise on Ambulances*. Severely injured persons, or those with any tendency to faintness, bleeding, shock, or other general symptoms, should be carried lying at full length with the head slightly supported on a low pillow; a similar position should be adopted in the case of persons who have sustained any injury to the bones or joints of the lower limb, or of the shoulder-joint, or severe wounds of the head, chest, or abdomen. On the other hand, injuries of the hand or forearm when properly supported, no matter how severe they may be, slight injuries of the foot, and uncomplicated wounds to the head, face, or upper part of the body, permit generally of the patient either walking or being removed in the sitting posture, as by one of the forms of hand seat.

In wounds of the head care should be taken that the injured part does not press upon the stretcher.

In severe injuries to the back the greatest care must be exercised in lifting the patient, and some rigid though well-covered form of stretcher is to be preferred, upon which the patient is placed face downwards.

In fractures of the leg or thigh the patient should lie upon his back inclined slightly towards the injured side and supported thus by a pillow, folded coat, etc.; in this position there is least jarring of the injured part.

In fractures of the upper limb, if the patient has to lie down, which is not usual, he should incline slightly towards the sound side, so that there is no risk of the body pressing the injured part.

In wounds or diseases of the chest there is often difficulty in breathing, which is relieved by propping the patient half up and turning him towards the affected side.

In painful conditions of the abdomen, or in the case of transverse or punctured wounds of this region, the patient should lie upon his back with the knees drawn well up and supported. In the case of a vertical wound of the abdomen the legs are kept straight.

The patient is usually carried feet first, but in going uphill or upstairs this position is reversed; in all cases, however, in which there is a fracture of the lower limb, the patient's head is kept lowest on a hill or stair so that the weight of the body may not press down upon the helpless and motionless part of the limb below the fracture. The taller bearer should be the further down on the hill or stair.

No attempt should be made by inexperienced bearers to carry a stretcher over a wall or ditch, and on no account should a stretcher be carried upon the bearers' shoulders, because a fall may do very serious injury to the patient.

The stretcher should be carried at the full length of the bearers' arms, as horizontal as possible, and the bearers, though walking at an equal rate, must be careful not to keep in step, which causes the stretcher to swing painfully.

Method of removal depends upon (1) how many persons are available as bearers, and (2) the degree of assistance required by the patient, as already stated.

I. BY ONE BEARER.—When an arm is injured the patient is usually quite able to walk, and, the arm being suitably supported, the bearer draws the patient's sound arm *over his shoulders* and places his own arm round the patient's waist.

If the bearer be strong and the patient seriously incapacitated, the latter may be carried *in the bearer's arms*, the right one passing beneath the patient's shoulder-blades, the left beneath the upper part of the thighs; in this case the patient should be carried high and supported as much upon the bearer's chest as by his arms. In other cases the patient may be carried *upon the bearer's back*, his arms round the bearer's neck and his legs under the bearer's arms.

In cases of complete unconsciousness, where the dead weight of the patient's body must be raised and borne by one bearer, the method known as the *Fireman's Lift* is applicable. The patient is turned on his face, arms by the sides;

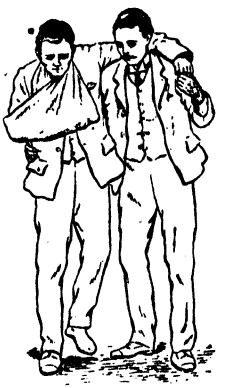


FIG. 265.—Removal of slightly injured person by one bearer.

the bearer stands at the patient's head, and, passing his hands beneath the latter's shoulders, raises him to a kneeling posture. The bearer next slides his hands under the patient's armpits and raises him still further; then stooping and pushing his head between the patient's right arm and his body, he allows the patient's body to fall over his right shoulder upon his back, while the patient's right arm comes round the bearer's neck and is steadied temporarily by his left hand. Finally, the bearer, passing his right arm round one or both thighs of the patient, grasps the patient's right wrist with his right hand, and bringing the weight of the body well on to the centre of his own back, rises to the erect position.

II. BY TWO BEARERS WITH HAND SEATS.—If the patient is suffering from such a condition as an injured foot and

is able to give some assistance, and if there are two bearers, the bearers divide his weight by means of one of the forms of hand seats, of which the two-handed seat is the most useful. If the patient be more seriously injured some form of stretcher must be obtained or improvised as described below.

For the *two-handed seat* the bearers face one another, the one on the right

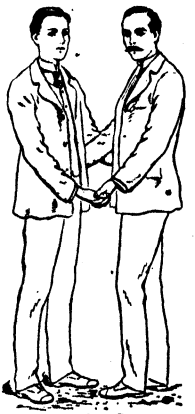


FIG. 266.—Two-handed seat.

interlocking the fingers of his right hand with those of the left hand of the other bearer; each places his disengaged hand

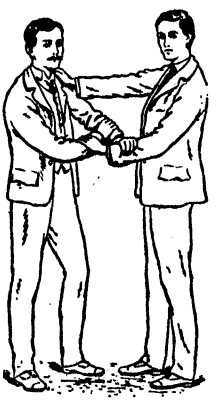


FIG. 267.—Three-handed seat.

behind the patient or on the other bearer's hip or shoulder. In lifting the patient, they kneel at his sides each upon the knee nearest to his feet, and, forming the seat beneath his thighs, they rise together supporting him, while he assists

if possible by putting his arms round their necks.

For the *three-handed seat*, the right-hand bearer grasps his own left forearm. The left-hand bearer places his right hand upon the shoulder of the other, and grasps the right forearm of the other with his left hand, his left forearm at the same time being grasped by the left hand of the other bearer.

For the *four-handed seat*, each bearer grasps his own left wrist with his right hand; each then clasps the disengaged

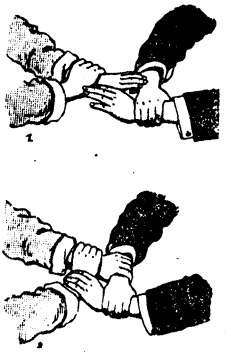


FIG. 268.—Four-handed seat. (1) Method of formation; (2) seat ready.

right wrist of the other with his left hand. To carry a patient by the three-handed or four-handed seat the patient must stand up, and the bearers, stooping, form the seat behind him.

If a patient be absolutely helpless and it is urgently necessary to carry him quickly for a short distance only, the *fore-and-aft carry* may be used. One bearer stands at the patient's head and passes his hands behind the shoulders into the armpits, while the other bearer stands between the patient's legs facing towards his feet and takes one leg under each arm.

III. BY HELP OF A STRETCHER.—If the patient be unable to walk or to sit upright in the conditions above described, a stretcher must be obtained. If no regular canvas stretcher be at hand, a satisfactory one may be improvised from a pair of poles 6 or 7 feet in length and a couple of coats with the sleeves turned outside in. The coats are buttoned over the sleeves, through which the poles are then passed. Or a blanket may be used, two poles, rifles,

or similar objects being laid upon it about 20 inches apart, and the ends and

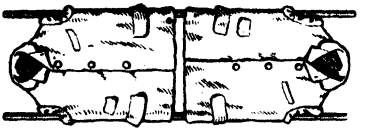
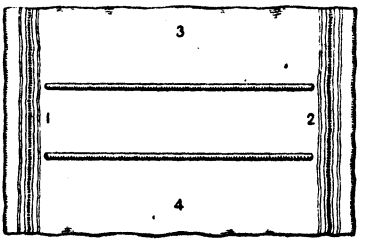


FIG. 269.—Stretcher improvised from poles and two coats.

sides of the blanket being then successively folded over them. Various other articles, such as a light sofa or a window-



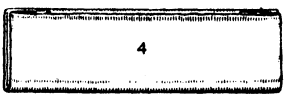


FIG. 270.—Stretcher improvised from poles and a blanket. The edges are turned over in the order marked.

shutter, or a blanket supported by four people, one at each corner, may also be used.

The patient having received suitable first-aid treatment is lifted on to the stretcher as follows:

(*a*) *When there are four bearers* (referred to as Nos. 1, 2, 3, and 4), the first three place themselves on the left side of the patient, and No. 4 on his right; No. 1 is opposite his knees, Nos. 2 and 4 are opposite his hips, and No. 3 is opposite his shoulders. All kneel on the left knee facing the patient and take hold of him as follows. No. 1 passes his hands and forearms beneath the patient's legs, the hands wide apart. Nos. 2 and 4 pass their hands and forearms beneath the patient's hips and loins. No. 3 passes his left hand across the patient and under his right shoulder, the right hand beneath the left shoulder of the patient. All then lift the patient off the ground and rest him upon the right knees of Nos. 1, 2, and 3. No. 4 disengages, gets the stretcher, places it directly beneath the patient, and again assists in supporting him as he is lowered gently on to the stretcher. The patient is lifted off the stretcher in precisely the same way.

(*b*) *When only three bearers are available*, the stretcher is first placed at the patient's head in line with his body. No. 1, kneeling on the injured side in line with the patient's knees, raises and supports the lower limbs by passing his hands and forearms beneath them; Nos. 2 and 3, kneeling upon opposite sides of the patient near his hips, pass one arm each under the back and one under the thighs, interlock fingers with one another, and so raise and support the patient. They then rise to their feet, carry him head first over the foot of the stretcher, and stooping, lay him gently upon it. In lifting him off they similarly raise him and carry him head first over the head of the stretcher.

(*c*) *When only two bearers are available*, the stretcher is first placed close to the patient's head and in line with his body. Both bearers then kneel on the injured side, and while No. 1 raises and supports the lower limbs by passing his hands and arms beneath them, No. 2 must place himself at the hips and raise the body, the patient assisting as much as possible by passing his arms round the neck of No. 2. The bearers then rise to their feet and carry the patient over the foot of the stretcher, on to which they gently lower him.

IV. REMOVAL BY CARTS.—If an ambulance waggon in which the patient lies upon the stretcher is not obtainable, a cart, well furnished with springs in order to diminish jolting, forms a good substitute. If the patient cannot sit, the floor of the cart should be deeply covered with straw or with a mattress. To place the stretcher in the cart, it should be raised by four bearers, one taking an end of each pole. The head end of the stretcher is then rested upon the floor of the cart, and two of the bearers get into the cart and assist the others in lifting the stretcher in. The patient may then either be lifted off on to the straw, etc., or may be left upon the stretcher.

INNOMINATE (*in*, neg.; *nomen*, a name) is a term applied to the large

flat bone which forms each side of the pelvis; also to the large artery from which the right carotid and right subclavian arteries spring; and also to the large vein formed on each side of the chest by the union of the internal jugular and subclavian veins.

INOCULATION (*in*, into; *oculus*, a bud) is the process by which infective material is brought into the system through a small wound in the skin or in a mucous membrane. Many infectious diseases and blood-poisoning are contracted by accidental inoculation of microbes. Inoculation may also be used as a preventive measure against disease; for example, prior to the introduction of vaccination persons were inoculated with an emulsion made from the crusts off smallpox patients, in order to produce a mild form of the disease, and thus gain protection against later severe attacks.

In recent years a similar procedure has been introduced with regard to other diseases, more particularly typhoid fever; an accurately measured dose of dead bacteria known as 'vaccine' being inoculated for the purpose of protection. For the results of this treatment see VACCINE.

INSANITY may be defined from a physical standpoint as a disease or disordered working of that part of the nervous system which determines mind and conduct. Not all persons, however, in whom these functions are unusual are commonly regarded as insane, and the general conception of insanity is a social-legal one. So long as individual peculiarities occasioned by mental disorder do not result in conduct or behaviour which is markedly opposed to prevailing social custom, society does not interfere with the person. Whether an individual is insane is determined by law, acting as the agent of society. When the person's conduct becomes so far divergent from social usages that he becomes legally certifiable, he can be sent compulsorily to an asylum. It must be remembered, however, that there are all grades of mental disorder from slight peculiarities or temporary delirium, upwards. A great number of persons who do not reach a sufficiently abnormal grade of conduct to be regarded as legally insane are regarded by society as eccentric or peculiar, and a large number whose conduct shows them to be maladapted for social life, as the result of inferiority of mind, are classed, owing to circumstances, among criminals, paupers, vagrants, inebriates, etc. Seeing that the term 'insanity' indicates largely a legal conception, it is better in a medical sense to speak of 'mental disease' or 'mental disorder'.

In primitive states of society mental disease is apt to pass unnoticed, and the more complex society becomes the more obvious is any maladaptation of an individual to his surroundings. By the old Greek physicians, in the time of Plato and Hippocrates, the brain was looked upon as the organ of intellect, sensation and the more purely animal functions being supposed to be situated in the thoracic region and in the lower part of the body respectively. Mental disease was treated in a rational manner just as other bodily disorders. From the decline of the Roman Empire through the Middle Ages, various manifestations of insanity were regarded largely in the light of crimes or misdemeanours, and were treated with great harshness. In the course of the eighteenth century, opinion in regard to the treatment of mental disorders began to change, and the modern attitude, which regards insanity as a disorder or disease to be treated on the same lines as other diseases, is generally regarded as having begun with the publication of Pinel's *Traité médico-philosophique sur l'aliénation mentale* in 1801. A great amount of attention was paid during the next fifty years to the study of mental diseases, and during this period a large number of asylums for the humane treatment of mentally disordered persons were founded.

The question of *responsibility in civil or criminal matters* is one of great importance in regard to mental disease. The question often arises in connection with the ability to make a valid will. There is no doubt that some persons regarded as insane can make a perfectly valid will, provided the delusions accompanying the insane state have not influenced the provisions of the will. Undoubtedly, however, the large majority of those definitely regarded as insane are incapable of making a valid

will. The occurrence of insanity does not excuse the patient from the fulfilment of a contract, provided he was not insane at the time when the contract was entered into. When a crime is committed, the question of responsibility is often very difficult to decide; the general principle accepted is that, if the accused person suffers from a delusion, but is not insane in other matters, he is held responsible for his offence, unless he has acted in such a way as would have been permissible if the facts about which his delusion exists had been true—in other words, in order to establish a defence on the ground of insanity it must be proved that 'at the time of committing the act the party accused was labouring under such a defect of reason, from disease of the mind, as not to know the nature and quality of the act he was doing or, if he did know it, that he did not know he was doing what was wrong'. The principle is also recognised that, if the mind is so diseased or so defective that there is complete absence of the power of self-control, so that the person acts under an ungovernable impulse, then he is not held responsible. This inability to exercise self-control does not, however, exonerate a person in whom the loss of self-control is due to his own default, as, for example, when he is intoxicated.

Causes.—The causes of mental disorder fall into two great groups. Certain persons go through life with a tendency to become disordered mentally when at any time certain causes arise, while other persons are subjected constantly to much greater strains of the same nature without developing any mental abnormality. It is necessary, therefore, to recognise (1) the nervous constitution or set of predisposing causes, and (2) the stresses which are particularly liable to unbalance the mind, or exciting causes.

(1) PREDISPOSING CAUSES.—A nervous constitution may be inherited or acquired, and is the primary or essential reason of a mental breakdown. There may be some congenital nervous, mental or moral defect which is peculiar to the family of the person affected. This tendency may be broadly described as *heredity*. It may show itself in other members of the same family by various nervous diseases allied to the insane state, such as epilepsy or hysteria. The tendency may also show itself by such inability to regulate conduct as drunken habits or various moral delinquencies which have got other members of the patient's family into trouble. *Intermarriage* of near relations in a family in which neurotic tendencies are manifested frequently results in offspring showing characteristics which are natural enough in the parents, but are apt to be exaggerated to an unnatural degree in the children, so that they reach the insane state. A similar evolution of traits of character may be seen in the children of marriages between individuals of similar nervous temperament, though these be not related to one another.

How far 'nature' is to be blamed for insanity and how far 'nurture' is uncertain. At one time the hereditary factor is over-stressed and at another the environmental factor. It is perhaps not far off the mark to state that in an unfavourable environment—using this word in a comprehensive sense to include the 'emotional' setting of family life as well as the physical environment—the person with an inherited unstable nervous system may break down with symptoms of insanity. Bizarre, abnormal, or vicious behaviour is likely to be not the cause of insanity but a manifestation of innate mental instability.

The most important of the predisposing causes is the presence of an *abnormal disposition or temperament*, either inherited or acquired in the course of years. This is the most frequent sign of a nervous constitution. It may be acquired in childhood from habitual contact with abnormal older persons. It may also arise from a prolonged struggle between conflicting instincts. The instincts concerned are usually the two primitive instincts of the 'herd' and 'self-preservation'. The person is constantly attempting to conform to the rules and usages of society and, at the same time, striving for objects which conduce to personal well-being and satisfaction, and is constantly finding the two aims incompatible. Into this group fall the cases of anxiety and mental unrest derived from what, according to the Freudian conception, is a repressed and sub-

conscious memory of sexual trauma. The resulting development of the abnormal temperament may show itself by some characteristic such as unusual irritability, jealousy, waywardness, unreasonableness, pessimism, etc. All of these render the person more liable to mental breakdown when a sufficient exciting cause supervenes.

(2) EXCITING CAUSES.—Among the most important of the stresses or exciting factors of mental disorder, in a person already predisposed, are other bodily diseases which produce defective nutrition, poisoning or exhaustion of the nervous system. These are sometimes grouped as toxic and exhausting causes.

Infectious diseases play an important part in this connection, especially when they are conjoined with some of the other stresses to be mentioned later. Puerperal sepsis occurring in connection with childbirth acts frequently in this manner. A similar effect may be produced in occasional cases by attacks of influenza, pneumonia, erysipelas, typhoid fever, and tuberculosis. *Disorders of the endocrine glands*, which secrete substances that enter the circulation and produce important effects upon the nutrition of the body, have also a powerful effect on mental processes. The diseases arising from these defects, which are often accompanied by mental disorder, are myxœdema, exophthalmic goitre, diabetes, etc. *Diseases of the blood and circulation* are very liable, when they have been present for a considerable time, to produce mental changes; such diseases are anæmia, arterio-sclerosis, and feebleness of the heart's action due to such conditions of this organ as fatty degeneration, disease of the aortic valve, etc. The kidneys are very liable in persons in whom they are diseased to fail in their action of secreting waste products from the body, and these, circulating in the blood, produce deterioration in the action of the nervous system. *Diseases of the reproductive organs*, such as atrophy of the testes or ovaries, inflammation of the uterus, etc., may similarly be causes. As other sources of *septic poisoning*, which often are in part responsible for mental disorder, may be mentioned septic teeth, intestinal disorder such as habitual constipation, skin diseases, and the absorption of poisonous material from internal tumors. External poisons may produce serious effects upon the nervous system as well as those developed within the body; such are especially the effects of *alcohol*, which is a very frequent cause and which produces many different results on different brains, with different types of mental disorder. Other poisons which may produce similar effects in occasional cases are opium, cocaine, lead, and sometimes tobacco. The recognition of these toxic causes is of the greatest importance, because this opens up a wide field for treatment of the mental disorder, which is likely to improve when its cause is duly recognised and removed.

The most important type of stress productive of mental disorder is what may be called 'biologic stresses', including all those changes which occur in the body during the reproductive *epochs and crises of life* in both sexes, when changes also take place in the mental outlook. The most important of these epochs are: (1) *adolescence*, the period when the body is attaining its maximum of activity and growth and when the function of reproduction is attaining full development. This adolescent change occurs in the female between the ages of fifteen and twenty-four, and in the male during a period about one or two years later. During this time hysterical outbursts and other manifestations pointing to an unstable nervous system are particularly apt to show themselves. (2) *Childbirth* is an important crisis in the life of a woman, which may occur up to the age of forty or fifty. This process is accompanied by considerable stress during pregnancy, the puerperal state, and lactation; and when to the biologic stress is added a septic or exhaustive process, as sometimes occurs in the puerperal state, mental disorder is very apt to occur. This type of mental disorder is, however, one of the most curable forms. (3) The *climacteric period* is the time about the age of fifty to sixty when there is a distinct waning of the reproductive powers which have been fully developed during adolescence; it is earlier in the female and associated with the cessation of menstruation; in the male it is more irregular and undefined. With its establishment the elasticity and enthusiasm of youth pass away; the strong passions

of earlier life become feebler, and there are often marked nutritional changes in the body such as increase of corpulence with marked diminution of activity. Mental peculiarities are very apt to set in at this time. (4) *Senility* may be regarded as commencing in healthy persons about the age of seventy; it comes on prematurely with special readiness in persons whose arteries are diseased. It has been said that a 'man is as old as his arteries'; and if the arteries of the brain remain healthy, the mental faculties may remain alert and the bodily functions active, long after the allotted span of threescore years and ten; if the arteries are diseased, the state of bodily and mental feebleness known as dementia is particularly apt to appear.

Hygienic stresses include privations or excesses in mode of life and exercise, productive of defective nutrition or exhaustion, thus leading to poisoning of the nervous system. These include want of food or of some essential element in the food such as vitamins; also excessive feeding and insufficient exercise, such as are apt to prevail in middle life. Physical or mental overwork with want of sleep, rest, or recreation, and sexual excesses have a similar effect.

Energic stresses consist of external changes which produce shock to the nervous system, such as head injuries, surgical operations, sunstroke, electric shock, etc., and are occasionally productive of sudden mental disorder.

Psychic stresses may also produce mental disorder of sudden or gradual onset. These include shocks or exhaustion of the nervous system caused by such influences as fright, anxiety, grief, prolonged worry, etc.

Organic disease of the nervous system, usually producing its effect by direct physical damage of the brain or by interference with its nutrition, forms another group of causes of mental disease which is then usually of a serious type as regards recovery. Such influences include general paralysis, apoplexy, tumors of the brain, meningitis, cerebro-spinal fever and encephalitis lethargica. Although the change that takes place in epilepsy is not definitely known, this disease as a cause of insanity naturally falls into this group.

Symptoms of mental disorder.—Before describing the chief varieties of insanity with the main characteristics of each, we must refer to certain early symptoms, and also to some general symptoms which commonly accompany the insane state.

(*a*) EARLY SYMPTOMS. — Insanity rarely develops quite suddenly, and indications of an approaching mental breakdown may be gathered from some early premonitory symptoms, although these may be of so light a character as to escape observation, or, if observed, to be considered as of no serious moment. Perhaps the most important is *alteration of disposition*, and this change may be either an exaggeration of the usual state of mind of the individual, or may be in a direction diametrically opposed to it. One man, for example, naturally of a suspicious nature, may begin to carry his suspicions so far as to imagine that people are talking evil about him, slandering him, and threatening him with violence; another, hitherto of a bright, cheerful disposition, becomes silent, moody, depressed, and self-depreciating to such an extent that he becomes quite unfitted for carrying on his ordinary work. In both these instances, such symptoms may be the forerunners of an attack of insanity, which may issue in homicide in the one case and suicide in the other. *Alterations of habit and conduct* also may be observed: a miser may become a spendthrift; a cool, calculating business man begins to indulge in foolish speculations; a hitherto temperate, upright man may give way to debauchery and depravity. In estimating these symptoms and attaching to them their proper significance, it is necessary always to bear in mind the social position and environment of the person, for it is obvious that a certain line of conduct would have a different meaning in an aristocrat from what it would have in a working man. These early alterations of habit and conduct are frequently associated also with various *physical symptoms*, such as pains in the head, sleeplessness, disorders of digestion and loss of weight, these all pointing to disturbed and perverted physical health.

(*b*) GENERAL SYMPTOMS of insanity fall under two divisions: (1) *Insane beliefs*; (2) *insane acts*.

(1) *Insane beliefs* may be either of the nature of delusions or of hallucinations.

A *delusion* may be defined as 'a belief in a fact which, to a sane person of similar education, age, and race, appears certainly false, and of the falsity of which the person labouring under the insane delusions cannot be persuaded either by his own senses or by the arguments of others'. The presence of delusions is a strong proof of insanity, and in the investigation of any mental state special care must always be taken to find out their existence—a task which is often very difficult, as they may be carefully and skilfully concealed. They may be classified as follows: *Delusions of grandeur* accompany states of mental exaltation. A poor man thinks he is possessed of millions of money; another is the King of England; yet another is the King of the Universe, and can summon and hold converse at any time with the prophets of both the Old and the New Testaments. *Delusions of unseen agency* lead their victims to imagine that they are electrified by batteries; disturbed at nights by persons who attempt to mutilate or ravish them; or that, inside their body, they have a person or animal, and that all the food they take goes to nourish the intruder. *Delusions of suspicion and persecution* cause the persecutions to be attributed to actual known persons; the annoyance is not caused by something intangible and unknown, but certain persons, who can be named by the insane person, are supposed to have poisoned his food, to call him bad names, or to follow him about and annoy him.

There are, in addition, numerous other delusions which cannot be classified under these heads, such as 'delusions of identity, the delusion of having no head, or no mouth, that speech is impossible, etc. There is, indeed, no end to their variety.

Hallucinations are false perceptions of the senses, those of hearing and sight being the most commonly affected. *Hallucinations of hearing* are often found in chronic cases of insanity, and when the illness is insidious, free from acute symptoms, and slowly progressive, they frequently constitute very early symptoms. Patients complain that they hear voices speaking to them. These voices may be well known to them or unknown, may be in the same room in some corner or cupboard, or outside in the open air; they may rule their lives, compel them to eat or abstain from food, urge them to destroy themselves or to commit murder. These patients, therefore, are looked upon as dangerous both to themselves and to others. *Hallucinations of sight* are common in acute excitement, and always accompany, for example, acute alcoholism; the things that are seen may be animals, such as bats, mice, rats, or dogs; or there may be bright flashes of light, during which imaginary people are seen. *Hallucinations of smell* are important, and often indicate serious mental disease.

(2) *Insane acts* include suicide, homicide, and various other hurtful or bizarre forms of conduct.

Suicide may be the result of profound mental depression, it may be prompted by delusions of persecution, or by hallucinations of hearing, the sound of voices, for example, urging to self-destruction. It may accompany an acute illness, or may be the one outstanding feature of the illness, a true suicidal impulse. The idea is sometimes quite a sudden one, an attempt at self-destruction being made, and the patient being afterwards totally unable to account for it, or, on the other hand, the wish may have long been harboured and the details of the attempted suicide carefully planned.

Homicide, again, like suicide, may be the outcome of delusions, specially those of persecution and suspicion; or the act may be committed while the patient is under the influence of hallucinations. A genuine homicidal act is frequently committed by patients suffering from both delusions and hallucinations. A man believes, for example, that he is being persistently slandered and persecuted; he hears voices urging him to murder his persecutors, and he murders them, either suddenly under the influence of a genuine homicidal impulse, or deliberately after having carefully laid his plans.

Other insane acts may be shortly mentioned, such as constant tearing of clothes, fantastic and extravagant dressing, or, on the other hand, disregard of personal appearance, refusal of food, kleptomania, dipsomania, in-

decent exposure of the person, and the commission of revolting, unnatural sexual offences.

Varieties of insanity.—NEUROSES and PSYCHO-NEUROSES form some of the milder types of mental disorder. The chief mental symptom in these is a general emotional tone of anxiety or apprehension; patients are afraid to open letters lest the contents convey bad news, and, for the same reason, they are terrified by telegrams; slight passing indispositions are feared to be symptomatic of some fatal disease; fleeting incidents are apt to be misinterpreted and worried over. Exophthalmic goitre, which is sometimes accompanied by mental symptoms, may in such cases be included in this group. Neurasthenia, hysteria, and various obsessions, including such symptoms as irrepressible thoughts, irrepressible fears, and irrepressible impulses, fall into the group of psycho-neuroses.

Psychoses include a group of the more serious and better-known types of mental disease, such as mania, melancholia, paranoia, dementia præcox, paraphrenia, and epileptic insanity.

MANIA.—The term 'mania', although applied commonly to various types of severe mental disorder, should, strictly, be reserved for a form of insanity characterised by mental exaltation. In *simple mania* the intellectual part of the cerebral function is in a state of over-activity, so that the patient is loquacious, garrulous, and often very clever in repartee; he flits, without apparent connection, from one subject to another; his mind never rests, and sleeplessness is a usual accompaniment. The insanity is not of a very profound degree, although the patient is a source of great annoyance to those about him. In the more pronounced form of *acute mania*, the motor functions of the brain are also affected; there is not only complete incoherence of speech, but there is intense restlessness and complete disappearance of will power; such a patient is popularly termed 'raving mad'. He seems to be insensible to fatigue, either of mind or body, and he gradually wears himself out; as a result, physical symptoms come on, especially loss of weight, and if the condition be not relieved, a fatal result may ensue from exhaustion. The majority of cases, however, recover, sometimes quite abruptly, more often gradually after relapses. Some cases pass into *chronic mania*, in which the symptoms continue, but in a quieter form, with a tendency to occasional acute attacks. A few cases pass into dementia, in which the mental powers become completely enfeebled, and the patient is quiet.

MELANCHOLIA is a disorder characterised by a feeling of misery in excess of that which is justified by circumstances, and also by physical weakness and loss of energy. In every person there is a tendency to fluctuate between times of mental elevation and times of mental lowness; an exaggeration and prolongation of this natural rhythm constitutes a mental disorder known as *manic-depressive insanity*, in which the patient varies between mania and melancholia, at intervals of days, weeks, or months. In *simple melancholia* the depression is not very great, and the patient may be able to pull himself together in the presence of strangers, or at other times when it is necessary to do so, only his intimates knowing of his disinclination to work, lassitude, desire to be alone, and painful introspection. The reasoning power is still present, though it is perverted in the way of magnifying slight failings of character into vices and taking an unreasonably gloomy view of the future. At times the mental depression becomes more intense, and the danger, in such patients, is that it may culminate in suicide. In *acute melancholia* the will-power disappears, the mental anguish is greater, and there is no control over action. Sometimes, especially after the melancholy state has lasted for some time, such patients are completely apathetic, sit staring straight in front of them, and are persuaded with difficulty to take food; other patients show restlessness and agitation, wringing their hands, swaying the body, weeping, or showing inability for even the slightest concentration upon any one subject. Delusions may be present, and patients think they have wronged themselves and their family, that they are responsible for the illness or misfortune of other people, that they are going to be burned, tortured, or otherwise maltreated, and in such people the impulse to suicide may

be very strong. Suicide more commonly takes place in people who say nothing about it than in those who threaten to take their own life. Along with the mental symptoms, physical signs are always present, including, especially, greatly disordered digestion with constipation and muscular weakness. Recovery is usual in melancholia, but a person of melancholic temperament is liable to subsequent attacks of the disorder, which often become more prolonged as life advances. Some cases end in *chronic melancholia* with permanently fixed delusions of an unhappy nature, and a few pass into dementia.

PARANOIA is a condition in which there are delusions forming a system which gradually develops, as a result of the disordered mind 'projecting' its own ideas into the supposed motives and conduct of other people. The patient takes a distorted view of his relationship to the world in which he lives. This form of insanity is the outcome of a particular temperament, usually develops slowly, and is only noticed in middle life, the patient very often having been previously regarded as merely eccentric or bad-tempered. It is more common in men than in women, and among single persons and those who lead a solitary life. To begin with, such persons are often full of wild altruistic impersonal theories to which they give outlet in books, or by addressing crowds in open spaces. Many of the persons regarded as political cranks, who preach anarchy, revolution, and various anti-social projects, are subjects of this mental disease and form 'borderland' cases of insanity. Other paranoiacs have delusions in which their own personality plays the most important rôle, and they usually believe themselves to be subjects of annoyance or persecution by other people. In this form of insanity the patient is often very dangerous, because of the schemes he makes to revenge himself on his supposed persecutors or opponents.

DEMENTIA PRÆCOX or SCHIZOPHRENIA is a mental disorder which appears in predisposed persons, most commonly during the twenties, and soon leads to a marked form of dementia. Such persons usually come of a family with a history of mental disorder. The main characteristic of this disease is disorder of thinking and behaviour, with a progressive withdrawal from the real world into the unreal world of infantile fantasy. The patient shows numerous peculiar mannerisms, such as stilted methods of talking, negativism, or a tendency to do precisely the opposite of what he is asked to do, an inclination to retain the limbs rigidly in any position in which they are placed, and to imitate any actions performed by other people in front of him. Meaningless repetition of actions, phrases, and words is also a characteristic. Some patients pass into a state of stupor (katatonia); others develop delusions, especially of persecution, or a double personality. The ultimate result of this disease is usually that the patient passes into a state of moderate dementia, in which the disorder becomes stationary, so that, although requiring supervision in some institution, he may live a long life and be capable of carrying out quite well some simple form of work or duty.

PARAPHRENIA is the name given to mental disease in which definite and often absurd delusions are present. Apart from the delusions and the alteration of conduct which they produce, the patient may show no other sign of mental disorder. The disease generally begins by misinterpretation of the actions of other people, the patient believing that he is being followed by the police, that the newspapers are making hidden references to his past life, etc.; later, hallucinations, especially of hearing, develop, and the patient may imagine he is being abused by the voices of unseen persons. Grandiose ideas are very apt to appear, so that the patient identifies himself with some well-known personality. This disease is usually progressive, and recovery is not likely to take place.

EPILEPTIC INSANITY. (*See* EPILEPSY.)

ALCOHOLISM AND DRUG HABITS are also of the nature of mental disorders, and alcohol in turn produces organic changes in the nervous system which lead to permanent mental disease. These are dealt with under ALCOHOLISM, CHRONIC, and DRUG HABITS.

CONFUSIONAL INSANITY.—This type of mental disorder usually follows exhaus-

tion due to over-exertion, or is due to poisoning, either by the toxins of fevers, or by poisons such as alcohol, chloral, morphine, etc., introduced from outside. Such patients are anæmic, with pale, greasy complexion; the appetite is poor; the circulation feeble, and occasionally there is considerable weakness. There is great enfeeblement of intellectual power, so that the patient has difficulty in understanding simple questions. Hallucinations are very common, and the patient may see faces in the air, insects crawling on the bedclothes, and mistake persons near him for old friends or enemies. It is very common, too, that the patient has no idea where he is. Memory is much disordered, and if the patient is going about, he is liable, in some cases, to lose his identity, fail to recognise where he is, and may wander long distances from home, even to distant cities, and be quite unable to say who he is, or from where he comes. Usually there is a certain amount of depression and restlessness. This is one of the most curable forms of mental disorder, and the majority of cases make a complete recovery in six to twelve months, or sooner.

STATES OF MENTAL ENFEEBLEMENT.—Amentia or mental deficiency, of which the severer grades are known as 'idiocy' and 'imbecility', is a primary mental defect or want of mind and not, strictly speaking, a mental disorder. It is considered under the heading MENTAL DEFECTIVENESS.

Dementia is a condition of great mental enfeeblement, usually the terminal stage of some more acute form of mental disorder. The patient in this condition shows great loss of perceptive and intellectual power as well as of bodily activity. It varies in degree, but when it is marked, the patient lives a vegetable existence, unable to converse or to work with any will-power, and he is usually of dirty habits. Recovery does not take place.

General paralysis, also known as 'paralytic dementia', is a mental and physical disease, due to syphilis of the nervous system. It is considered under the heading GENERAL PARALYSIS.

Treatment of insanity.—(*a*) PREVENTION.—The question of the prevention of insanity entails two considerations—first, the counteraction of the various evil influences which impair the mental health of the social body generally; and secondly, the recognition of certain broad lines of living which should be followed by any one who, on account of hereditary predisposition or abnormal temperament, is liable to become insane. In regard to persons predisposed to mental disorder, their adaptation to their surroundings is being increasingly effected by various agencies. These include the modern attempt to remove mentally defective persons into colonies for the feeble-minded; the treatment at public clinics of diseases which are apt to terminate in insanity; and the general amelioration of social conditions and of uncertainty as regards wage-earning and maintenance. The provision of social workers in connection with out-patient mental clinics at hospitals, to investigate the social conditions operating upon the production of 'borderland' cases of mental disorder, is also an important factor in preventing complete mental breakdown in many cases. Every effort should be made to encourage a healthy mode of living, to insist on the importance of good nourishing food, and to provide an education which shall be broad and liberal, and at the same time one that disciplines the mind in habits of self-control and self-denial. To those, however, in whom there is a strong hereditary tendency to insanity life frequently resolves itself into a 'continual struggle to oppose the bent of their being'. Has such a person any power over himself to prevent his becoming insane? That he is largely responsible for the preservation of his sanity there can be no doubt, and in connection with this the first truth for him to grasp is that his life must be lived under constant obedience to certain definite rules. Avoidance of psychic stresses, and especially those of an emotional character, is of particular importance.

(*b*) CURE.—Passing to the actual treatment of insanity, we recognise that, as the outcome of a more rational view of mental disease, the insane are now regarded and treated as sick persons. Greater care is taken at the present day than formerly in institutions for the insane, to treat physical diseases to which mentally disordered persons are

specially liable, and which are, indeed, often an important factor in the cause of the enfeeblement leading to the mental breakdown. The old methods of treatment by punishment, solitary confinement, manacles and strait-waistcoats, have now disappeared, except in occasional cases where physical restraint is a necessity. Many insane patients can be treated at home, looked after and nursed by their friends, who must be warned, however, that they are responsible for their safety. Recently also there have been instituted, for the treatment of early mental cases, wards attached to the large general hospitals, and thereby the stigma of certification as a lunatic is avoided. More especially is this method of value in those illnesses which are likely to prove of short duration or of a mild character, and which are accompanied by bodily disease.

Home treatment is often, however, impossible, more especially if it becomes clear that the illness is going to be a protracted or violent one, if it is aggravated by home associations and surroundings, or if it is characterised by suicidal or homicidal tendencies. In this case the patient must be duly certified and placed under asylum discipline and control. An increasing number of mentally affected persons avail themselves of the possibility of entering a mental hospital voluntarily while they are still capable of understanding the advisability of doing so. This has the great advantage that patients secure admission at an early stage of their disorder, before they are certifiable as insane, and the disease thus coming under treatment while it is still mild can be more easily and quickly cured.

The *asylums* and *mental hospitals* of the present day, especially those for the reception of the wealthier classes, are made to resemble as far as possible ordinary dwelling-houses: the grounds are large and beautifully laid out, and afford the means of abundant healthy physical exercise; the interiors are bright and cheerful, and everything is done to convey a pleasing impression and to take away any sensation of irritating discipline. The most recent mental hospitals are built on what is called the 'villa system', where, round a central administrative block, there are grouped small pavilions. This has the

advantage of allowing the patients to be carefully classified according to the form and stage of their illness — the convalescent in one building, the sick in hospital, the acute and noisy, and those with objectionable habits, removed from the quiet and timid. The asylum is controlled by a medical superintendent, and under him are assistant physicians, matrons, attendants, and nurses. Pauper patients are sent to the district or county asylums corresponding to the district or county to which they belong, or are chargeable to the rates of these, and application for admission must be made through the Inspector of Poor, who then becomes the person responsible for the payment of their board. Some of the pauper insane, if harmless, but in such a condition mentally that they cannot earn their livelihood, are 'boarded out' with trustworthy people in the country. They are then visited by the parochial doctor, by the Inspector of Poor, and occasionally by a Commissioner from the Board of Control. This method frequently relieves overcrowding in the asylum, and is, in addition, cheaper, though only applicable to selected cases.

The actual treatment of insane individuals may be divided into (*a*) Moral; (*b*) Medical.

(*a*) By *moral treatment* is meant that personal influence which the sane exercise over the insane. In exercising this influence there must be constant kindness and perfect firmness. For this purpose it has been found that female nurses with thorough training in a general hospital are most satisfactory. The patient, whenever suitable, is given some liberty, he is allowed out on 'parole', he can visit places of amusement, he is encouraged to take exercise and recreation, and, above all, he is encouraged to work. In this respect in pauper asylums, the inmates of which consist largely of those accustomed to manual labour, far more opportunities of bodily work are possible than in private. This *occupational therapy* is not only of benefit as exercise, but it provides the patient with an object upon which his miud can be concentrated, and so affords useful mental discipline. The work may include digging in the garden, and, in the case of a woman, employment in the kitchen or sewing in the

sewing-room. Useful work can often be produced by patients working at looms, making toys, baskets, and other simple articles. To enable this treatment to be properly carried out, the co-operation of good attendants and nurses is essential, and every effort is now made to have them in sufficient numbers and to encourage them in their work by good remuneration, lectures on the nursing and treatment of the insane sick, and the granting of certificates of proficiency after examination.

(*b*) *Medical treatment.*—The importance of absolute physical *rest* in the early and acute stages of the illness is becoming more and more recognised. At one time maniacal patients, for example, were encouraged to walk about until exhausted, to get rid of what was supposed to be superfluous nerve energy; this view has now been abandoned, and rest in bed is employed in order to conserve as much energy as possible The importance of *fresh air and sunlight* is now generally recognised. Good, plentiful food, of an easily assimilable kind, such as eggs and milk, is essential, and in those who refuse food, feeding through a tube passed through the nostril into the back of the throat is employed. The *control of excitement* and sleeplessness by various drugs, when simpler methods fail, is highly important. In patients who require soothing, especially in violent cases, it has been found that *prolonged baths*, at a temperature slightly below that of the body, have a highly beneficial effect. (*See* BATHS.)

Under such a regime there frequently come signs of improvement. Natural sleep gradually returns: the body weight increases; delusions become less prominent, are seldom spoken of, and finally disappear; a desire to get well returns; the manner becomes rational; conduct is no longer eccentric; the patient declares himself capable of earning his livelihood, and finally recovery becomes complete, and the patient is discharged.

One of the most remarkable forms of treatment, introduced during the late thirties of the twentieth century, is what is known as shock treatment. This has been used especially in cases of dementia præcox, and consists in making the patient go through a number of violent convulsions, so violent, indeed, as in some instances to break the back or the thigh bone. The convulsions are produced in various ways: by lowering the blood sugar by means of injections of insulin; by injections of convulsant drugs, such as metrazol and cardiazol; by passing electric current through the brain. Shock treatment is less useful in the treatment of dementia præcox or schizophrenia than it was at first hoped to be. But it has proved valuable in the treatment of depressed or melancholic cases. A drastic treatment recently introduced is known as 'leucotomy' or 'prefrontal lobotomy'. This is an operation in which the white nerve fibres in the frontal lobes of the brain are cut, the connections between these lobes and the thalamus and the hypothalamus being thus severed. Leucotomy (*q.v.*) has been found to relieve the symptoms of severely depressed or melancholic patients who did not respond to other treatment.

Law of lunacy.—A person certified as insane is not recognised as a free agent, and by his illness he is incapacitated both legally and socially. His care, safety, treatment, and the disposal of his property are provided for, generally by his nearest relative, in accordance with the statutes laid down by law.

MODE OF ENTRANCE INTO AN ASYLUM.—When it becomes necessary to place a patient under asylum control, the *statutory certificates* must be properly filled up. The forms in England, Scotland, and Ireland are almost identical, though the mode of procedure is somewhat different in the three countries. In Scotland, a petition is presented to the Sheriff, along with two medical certificates, and a statement, drawn up by the petitioner, who is usually a near relative, or in the case of a pauper patient, is the Inspector of Poor. It is the duty of the Sheriff to see that the medical certificates are in order, and that the medical men signing them are duly registered; he then signs the warrant, and on this being presented to the asylum superintendent, the patient is admitted. Each medical certificate must be clearly expressed, and the medical man must carefully state the 'facts indicating insanity observed by himself'. The statutory form also

requires him to state that he has visited and examined the patient separately from any other practitioner.

In the case of a private patient the superintendent of the asylum in which the patient is to be detained may not sign either of the certificates.

In England a private patient is placed in an asylum on the order of a magistrate, after the medical certificates and a petition from a relative have been obtained.

The second method of placing a patient under control is by the *emergency certificate*. This method of certification is a temporary one, and is used when it is necessary that a patient should be put under control at once. On the expiry of three days from the dating of this certificate, the usual Sheriff's warrant must be signed, and without it no person can be detained any longer in an asylum. The certificate of emergency must, like the ordinary petition, be signed by a relative, etc., and it must also be accompanied by one medical certificate, which is in the same form as that accompanying an ordinary petition, with the important addition that the case is one 'of emergency'. In England and Ireland this is paralleled by an *urgency order*, which, however, remains in force for seven days.

PRIVATE ASYLUMS OR LICENSED HOUSES are the property of one or more private individuals who obtain for their house a licence, which must be renewed from year to year. These houses are visited regularly by Commissioners and, in the Provinces, by Justices of the Peace. The same rules, with regard to admission of patients, hold good in regard to them as in regard to public asylums.

VOLUNTARY ADMISSION to an asylum is a method followed with increasing frequency at the present day. If a patient wishes to place himself voluntarily under control, he signs two identical applications to be received into the institution which he wishes to enter; one of these goes to the superintendent of the institution, the other goes to the Board of Control. The patient may at any time leave the asylum on giving three days' notice of his intention to the superintendent.

NURSING HOMES, in Scotland, may take patients for the purpose of observation and treatment over a period up to six months, without other formality than a certificate that the patient is an inmate of the home in question. The certificate should state that the patient is suffering from some specified form of mental disorder, that the malady is not confirmed, and that treatment in the particular home, for not more than six months, with a view to recovery, is expedient. The certificate is retained by the proprietor of the nursing home.

THE LEGAL GUARDIAN of a patient in an asylum is the Board of Control. This Board is a legal Court of Appeal, and all letters to it from patients must be immediately forwarded, unopened. In it is vested the superintendence of all matters relating to lunatics, public, private, and district asylums, and houses licensed for the reception of the insane.

It is the duty of the PAID COMMISSIONERS to visit all the asylums at least twice a year, when they see every patient personally and grant any one of them who desires it a private interview, and in the case of any patient complaining by letter of wrongful detention, they institute a strict inquiry, exact a full report of his mental condition from the superintendent, and if necessary visit him in person.

As to the PROPERTY of an insane person, in Scotland a 'Curator Bonis' is appointed, who manages the property and reports to the Court of Session annually. In England and Ireland affidavits are given, stating the facts indicating insanity and proving incapacity to manage property. An Inquisition is held, and two persons are appointed, one to control the person, another to control the estate.

Thus the safeguards preventing sane people being wrongfully detained and their property misappropriated are very strict, and considerate sympathy, humane treatment, careful nursing accompanied by strict supervision, have gradually taken the place of the mere physical restraint, accompanied sometimes by cruelty and harshness, which marked the conduct of asylums early in the last century.

INSECTS IN RELATION TO DISEASE.—Many insects play an important part in the transmission of infectious diseases. Thus flies by their feet and their feeding habits carry the organ-

isms which cause typhoid fever, summer diarrhœa, and other diseases, the tsetse fly spreads sleeping sickness, mosquitoes transmit the germs of malaria and yellow fever, fleas convey plague germs, lice are held responsible for typhus fever and for the mild pyrexia known as 'trench fever', while the bed-bug is blamed for transmission of several Eastern diseases. In addition, these creatures are nuisances as well as dangers.

HOUSE-FLY (*Musca domestica*). This fly lays its eggs in manure, or in moist fermenting vegetable matter. The maggot is hatched within a day, feeds on the manure, etc., passes through the pupa stage in little more than a week, and becoming a fly is capable of egg-laying about fourteen to twenty days from its own appearance as an egg. As 120 to 150 eggs are laid by each female fly, this fly is capable, under the most favourable conditions, of producing between twenty-five and fifty million progeny within two months. The fly gorges on fluid food which it sucks up by means of its proboscis, and it has the habit of repeatedly vomiting and re-swallowing the contents of its crop as it feeds. It walks in filth habitually, and being provided with hairy legs and body it is apt to carry off portions of this, in which are entangled numbers of bacteria. The fly has been well described as a 'winged sponge', and its immense power to distribute disease germs over the surface of uncovered food is evident.

BLOW-FLY or BLUE-BOTTLE (*Calliphora erythrocephala*) lays its eggs (450 to 600 in number) on meat, fish, or decaying animal matter. The maggot hatches out within a day, passes through the pupa stage and becomes a full-grown fly in about three weeks. Its habits are similar to those of the house-fly, though in numbers it is much less plentiful.

Treatment of flies.—The most important measure is to destroy their breeding grounds near human dwellings. All kitchen refuse must be burned, and none should be left exposed so that flies may deposit their eggs in it. Stable litter and manure must be disposed of, or kept covered and shut up in outhouses, not allowed to accumulate in the open air and sunshine near houses. Adult flies may be destroyed to a great extent by covering all food in summer with muslin or wire gauze, and by exposing sticky fly-papers or fly-traps in kitchens or other places where flies are numerous. A good plan is to set out over night in a wide dish a 3 per cent solution of formalin to which a little sugar and milk have been added.

LICE.—The presence of the head-louse (*Pediculus capitis*) and of the crab-louse (*Pediculus pubis*) is comparatively easily prevented by the methods described under PARASITES. The body-louse (*Pediculus vestimentorum*) is much more difficult to banish. The lice suck blood from their 'host' once or twice daily; and, if they do not get food, they die in three to five days. The female produces five eggs daily for about twenty-five days, laying them in folds and seams of the clothing next the skin. The young lice are hatched in one to five weeks and mature so rapidly that the time for a new generation from egg to egg is about twenty-four days.

Treatment of lice.—Wearing a small bag of camphor or of sulphur next the skin has a certain amount of effect in repelling lice. For the head- and crab-louse crude paraffin oil is an effective remedy. For the body-louse merely laying aside the clothes for a week kills all the adults but not the eggs; baking of the clothes in a disinfector or laying them aside for two months destroys life in the latter also, but this is not always easy to carry out. Many remedies have been used in the treatment of louse infestation of the head—paraffin, cresol solution, sassafras, alcohol. But they are volatile and do not kill the nits. Attempts have been made to find a substance which will not only kill the lice but will also remain in the hair long enough to kill any lice that will hatch out of the nits later. Three have been found to meet the requirement—namely, (1) 25 per cent technical lauryl thiocyanate in a white oil; (2) 50 per cent lethane 384 special in a white oil; and (3) derris cream. For removing nits a special steel nit comb—'Sacker's' or 'Binns'—is used.

FLEAS (*Pulex irritans*) and BED-BUGS (*Cimex lectularius*) are responsible for conveying some diseases. They are kept off by dusting the clothes with the N.C.I. powder consisting of naphthalene 96 parts, creosote 2 parts, iodoform 2 parts, or with fresh pyrethrum

powder, and they are killed by fumigation of clothes and rooms with sulphur. For the quantity required and method of use see under DISINFECTION. Bedsteads, floors, etc., in the crevices of which these creatures are concealed, may also be treated by scrubbing with 5 per cent cresol solution in water or with 1 per 1000 corrosive sublimate solution.

MOSQUITOES. — One of these (*Anopheles maculipennis*) is responsible for conveying the parasite of malaria, another (*Stegomyia calopus*) for distributing the infection of yellow fever.

Treatment.—*See under* MALARIA *and* YELLOW FEVER.

INSOLATION (*insolo*, I expose to the sun) is a term applied both to treatment by exposure to the sun's rays (*see* LIGHT TREATMENT) and to fever caused by excessive heat (*see* SUNSTROKE).

INSOMNIA (*see* SLEEP, HYPNOTICS).

INSPISSATION (*inspissatio*) is a term applied to the process of drying or thickening fluids or excretions by evaporation.

INSUFFICIENCY (*see* INCOMPETENCE).—The term insufficiency is applied to incompetence of the heart-valves, and also more widely to the action of organs which are not carrying out their proper functions to a sufficient extent; for example, renal insufficiency is a condition in which the kidneys do not excrete the normal amount of urea and other substances of which they should free the body.

INSUFFLATION (*insufflatio*, a blowing in) means the blowing of powder or vapour into a cavity, especially through the air passages, for the treatment of disease.

INSULIN (*insula*, an island) is the name applied to the internal secretion of the pancreas formed by groups of cells called the 'islands of Langerhans' in this organ. Its existence was indicated by Schäfer in 1909, and it was successfully isolated in a pure form by McLeod, Banting, and Best in 1921. It acts by enabling the muscles and other tissues which require sugar for their activity to take up this substance from the blood. When it is deficient, the sugar derived from the food accumulates in the blood and is wastefully excreted in the urine. Insulin prepared from the pancreas of sheep and oxen is administered by hypodermic injection in cases of diabetes, and thus enables the sugar in the circulation to be utilised so that its excretion in the urine ceases. Each unit of insulin administered to a diabetic patient enables him to utilise somewhere between one and two grams of additional carbohydrate material. The appropriate dose of insulin in any given case depends upon its severity. Some persons react to insulin with great rapidity, and for these a slowly absorbed form of the remedy (protamine insulin and zinc protamine insulin) is often desirable.

INTERCOSTAL (*inter*, between: *costa*, a rib) is the term applied to the nerves, vessels, and muscles that lie between the ribs, as well as to diseases affecting these structures.

INTERCURRENT (*intercurrens*, running between) is a term applied to one disease which occurs during the course of another disease already present, and modifies its course or increases its severity.

INTERMITTENT (*intermitto*, I leave off) is a term applied generally to fevers of malarial nature, which continue for a time, subside completely, and then again return. The name is also used in connection with a pulse in which occasional heart-beats are not felt, in consequence of irregular action of the heart.

INTERSTITIAL (*interstitialis*) is a term applied to indifferent tissue set amongst the proper active tissue of an organ. It is generally of a supporting character and formed of fibrous tissue. The term is also applied to diseases which specially affect this tissue, as interstitial nephritis.

INTERTRIGO (*inter*, between; *tero*, I rub) is a term applied to a chafed or abraded condition between two surfaces of skin that rub together, *e.g.* under the breast or in the armpit. (*See* CHAFING OF THE SKIN.

INTESTINAL STASIS (*see* STASIS *and* CONSTIPATION).

INTESTINE (*intestinus*, that which is within) is the whole of the alimentary canal situated below the stomach. In it the chief part of digestion is carried on, and through its walls all the food material is absorbed into the blood and lymph streams. (*See* DIGESTION.) The length of the intestine in man is about 28 to 30 feet, and it takes the form of one continuous tube suspended in loops in the abdominal cavity.

Divisions.—The intestine is divided into 'small intestine' and 'large intestine'. The former comprises that part of the tube which extends from the stomach onwards for 22 feet or thereabout, and is at its broadest point about 1½ inches in width. The large intestine is the second part of the tube, and though shorter (about 6 feet in length) is much wider than the small intestine, reaching in places a size of 2½ inches. The *small intestine* is divided rather arbitrarily into three parts,—the *duodenum*, consisting of the first 10 or 12 inches into which the ducts of the liver and pancreas open; the *jejunum*, which is generally found empty after death, and comprises the next 8 or 9 feet; and finally the *ileum*, which at its lower end opens into the large intestine.

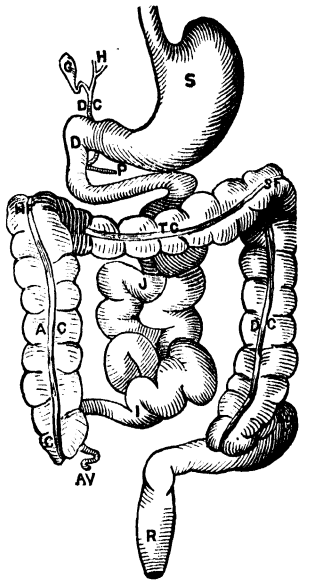


FIG. 271.—Diagram of the stomach and intestines. *S*, Stomach; *D*, duodenum, *J*, jejunum, and *I*, ileum, together forming the small intestine; *AV*, appendix, *C*, cæcum, *AC*, ascending colon, *HF*, hepatic flexure, *TC*, transverse colon, *SF*, splenic flexure, *DC*, descending colon, *Sg*, sigmoid flexure, *R*, rectum, together forming the large intestine; *G*, gall-bladder; *H*, hepatic ducts; *DC*, common bile-duct; *P*, pancreatic duct. (*Ency. Brit.*)

The *large intestine* begins in the lower part of the abdomen on the right side. As the small intestine opens into its side a few inches from the end, a blind cul-de-sac, known as the *cæcum*, lies here, into which the *appendix vermiformis* opens. The appendix is a small tube, about the thickness of a quill, from 2 to 6 inches in length, which has much the same structure as the rest of the intestine. At one end it is closed, at the other it opens into the cæcum, and though it appears to play little or no part in digestion, it is of great importance because of the frequency with which serious inflammation takes place in it. (*See* APPENDICITIS.) The cæcum is continued into the 'colon', which

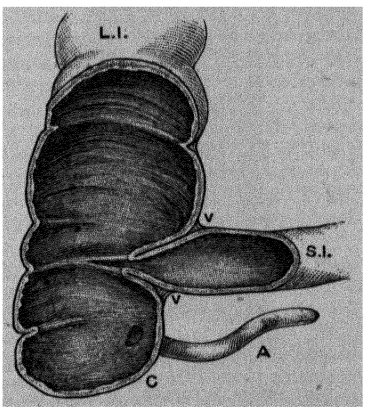


FIG. 272.—Part of the intestine situated in the right iliac region. The front of the bowel has been removed to show the interior. *A*, Appendix; *C*, cæcum; *LI*, continuation of large intestine; *SI*, small intestine; *VV*, the two flaps of the ileo-cæcal valve which prevent the return of digested material from the large into the small intestine. (After Gegenbaur.)

first ascends through the right flank to beneath the liver, where it bends and crosses the upper part of the abdomen transversely to the left side; here, coming in contact with the spleen, it again bends downwards and descends through the left flank into the pelvis. The last part of the large intestine is known as the *rectum*, which passes straight down

through the back part of the pelvis, to open to the exterior through the *anus*.

Structure.—The intestine, both small and large, consists of four coats, which vary slightly in structure and arrangement at different points, but are of the same general nature throughout the entire length of the bowel. There is on the inner surface a mucous membrane; outside this is a loose submucous coat, in which blood-vessels run; next comes a muscular coat in two layers; and finally a tough, thin peritoneal membrane. The total thickness of all four coats amounts to about one-eighth of an inch.

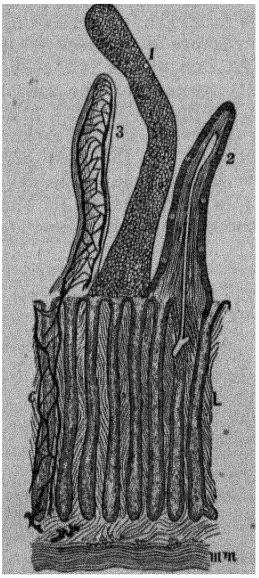


FIG. 273.—**Diagram of a section** through the mucous membrane of the small intestine, showing three of the 'villi' with which the inner surface is covered. 1 shows the cells covering the villus; 2 is a section showing the lymphatic-vessel in its centre; 3 shows the network of blood-capillaries continuous with those in the deeper part of the mucous membrane *c*; *L* is opposite the tube-shaped glands that secrete the intestinal juice; *mm*, muscle of mucous coat. (Turner's *Anatomy*.)

MUCOUS COAT.—The interior of the bowel is completely lined by a single layer of pillar-like cells placed side by side. These rest upon a smooth, fine membrane, beneath which is a loose network of connective tissue and muscular fibres, richly supplied with blood-vessels and lymphatic-vessels. There are two

arrangements by which the surface in the small intestine is much increased for the ends of digestion and absorption. Countless ridges with deep furrows between them run across the upper part, and the whole surface is thickly studded with short hair-like processes called 'villi'. As blood- and lymph-vessels run up to the end of these villi, the digested food passing slowly down the intestine is brought into very close relation with the circulation. Between the bases of the villi are set little openings, each of which leads into a simple, tubular gland lined by cells, which are similar to those covering the surface, and which produce a fluid with digestive powers. In the small intestine, cells here and there produce mucus, and, in the large intestine, a great number of cells are devoted to the production of this substance for lubricating the passage of the food through the bowel. A large number of minute masses, called 'lymph follicles', similar in structure to the tonsils and lymphatic glands, are scattered over the inner surface of the intestine. In the lower part of the small intestine these are grouped into patches of a square inch or thereabout in size, known as Peyer's patches, which are of special interest, because the inflammation and ulceration of the bowels that occurs in typhoid fever is limited to them and to the scattered follicles. The large intestine is bare both of ridges and of villi, and, as already stated, its mucous membrane produces mucus in large amount.

SUBMUCOUS COAT.—This consists of a loose connective tissue which allows the mucous membrane to play freely over the muscular coat. The blood-vessels and lymphatic-vessels which absorb the food in the villi pour their contents into a network of large vessels lying in this coat.

MUSCULAR COAT.—The muscle in the small intestine is arranged in two definite layers, in the outer of which all the fibres run lengthwise with the bowel, while in the inner they pass circularly round it. The muscular coat is of immense importance, because by its contraction and relaxation, somewhat after the mode of progression of a worm, the food is slowly squeezed down the bowel, the process being known as 'peristalsis'. In the large intestine the only departure from the above arrangement is that

the fibres which are placed lengthwise are collected into three thick bands upon the outward surface of the bowel, and these bands, being slightly shorter than the other coats of the bowel, cause it to present a puckered appearance.

PERITONEAL COAT forms the outer covering for almost the whole intestine except parts of the duodenum and of the large intestine. It is a tough fibrous membrane, covered upon its outer surface with a smooth layer of cells, which in the movements of the bowel rub against a similar surface upon the peritoneum lining the general cavity of the abdomen, and so cause a minimum of friction. From the peritoneal coat of the intestine of animals catgut is prepared.

Support.—The duodenum and greater part of the large intestine are covered only in front by the peritoneum which lines the abdominal cavity, and this tough membrane serves to bind these parts of the intestine firmly against the back wall of the abdomen. The jejunum and ileum, the transverse part of the colon, and the first part of the rectum are not only completely surrounded by peritoneum, but a double layer of this membrane suspends these parts of the bowel at a distance of several inches from the lines on the back of the abdomen, where the two layers become continuous with the rest of the peritoneum. In this way freedom is given to the movements of these parts of the bowels. These suspending structures are known as 'mesenteries'. That of the small intestine is the largest, being shaped like a fan, 6 inches long at its attached margin, and spreading out to 22 feet at its frilled border, where it meets the intestine. The vessels and nerves which supply the intestine run between the two layers of the mesentery.

INTESTINE, DISEASES OF.—The signs of trouble which has its origin in the intestines are sufficiently vague, amounting generally to pain somewhere about the abdomen, sometimes vomiting, and irregularity in movement of the bowels in the direction either of stoppage or of excessive action. The conditions arising in the bowels are therefore specially difficult to recognise exactly.

Several diseases are treated under separate headings. *See* APPENDICITIS, CHOLERA, CONCRETIONS, CONSTIPATION, DIARRHŒA, DYSENTERY, ENTERIC FEVER, HERNIA, ILEITIS, PARASITES, PERITONITIS, PILES, RECTUM, DISEASES OF.

INTESTINE, DISEASES OF

INFLAMMATION of the bowel may affect either its outer or its inner surface. The outer surface is covered by peritoneum, and peritonitis is a serious disease with very special symptoms. (*See* PERITONITIS.) Inflammation of the inner surface is known generally as 'enteritis', inflammations of special parts receiving the names of 'colitis', 'appendicitis', etc. Enteritis may form the chief symptom of certain infective diseases due to special organisms, for example in typhoid fever, cholera, dysentery. Again, it may be acute, though not connected with any definite organism, when, if severe, it is a very serious condition, particularly in young children, to whom the enteritis producing summer diarrhœa is a very fatal malady. Or it may be chronic, especially as the result of dysentery, and produces then a less serious though very troublesome complaint. Indiscretions in diet, such as the eating of unripe fruit, form the general cause, and a very serious type results from the action of irritant poisons. In some persons inflammation of the stomach and bowels is liable to result from exposure to cold and damp.

Symptoms.—Diarrhœa is the most common and most marked symptom, and in chronic cases usually the only symptom, though, when the small intestine alone is affected, constipation is a more usual result than diarrhœa. Pain, particularly of a griping nature, which comes and goes, is also common. The temperature in acute cases is raised, and there is restlessness, even delirium. If the diarrhœa is very profuse, collapse speedily comes on.

Treatment. — Each case requires special handling, according to the cause and the severity. Where diarrhœa is very severe this requires special treatment. (*See* DIARRHŒA.) There are a few general principles which are applicable to all cases. The food should be lessened and as concentrated as possible, or even withheld completely for a day, so that the inflamed surface may not be irritated by the passage over it of half-

digested food. Rest in bed is essential. Considerable quantities of warm water, containing bicarbonate of soda, have a beneficial action by flushing out the bowel and removing irritating substances. In general, water is given by the mouth, and in some cases it is introduced by an enema to irrigate the lower bowel. Various drugs which have a mildly astringent and soothing action, of which the chief is carbonate of bismuth, are given by the mouth. When the 'inflammation' is not the result of a chemical or physical irritant, but the result of an infection, as in dysentery, treatment with a sulphonamide drug absorbed only slowly from the intestine is indicated. At present sulphaguanidine and succinyl sulphathiazole have been given with good results in the treatment of dysentery. In acute cases of inflammation various applications are made to the surface of the abdomen in order to exert a soothing effect. The most common are hot fomentations, to which laudanum, turpentine, or other substances have been added.

ULCERATION of the bowels arises in a manner similar to the production of ulcers on the skin surface, though probably these internal ulcers heal much more rapidly than others. They may be due to scratches produced by sharp hard bodies which have been swallowed, or to other injuries which damage the surface and lead to its destruction by the digestive juices. Such ulcers are found not infrequently in the duodenum just outside the stomach, and give rise to symptoms much resembling those of gastric ulcer. Typhoid fever regularly produces ulcers in the lower part of the small intestine, this variety arising in the patches of lymphatic tissue found in this region. Tuberculous ulcers arise late in the course of consumption, and produce a diarrhœa which not uncommonly terminates this malady in death.

Symptoms of ulceration are much the same as those of enteritis, and the formation of ulcers is simply an advanced stage of this condition. In addition, the ulcerated surface is apt to bleed, and, if the ulcer be situated high up in the bowel, this blood is voided as black or brown material; if it comes from near the lower end of the bowel the blood is red and unchanged. The healing of these ulcers leads, in the case of all save those of typhoid fever, to the formation of scars, and, as these scars contract, there is a tendency to narrowing of the bowel and obstruction. This is particularly apt to follow tuberculous ulcers, if these should heal, because they often run circularly round the inside of the bowel.

Treatment in cases of ulceration is similar to that for inflammation.

PERFORATION of the bowel may take place as the result either of injury or of disease. Stabs and other wounds which penetrate the abdomen may damage the bowel, and severe blows or crushes may tear it without any external wound. Ulceration, as in enteric fever, or, more rarely, in consumption, may cause an opening in the bowel-wall also. Again, when the bowel is greatly distended above an obstruction, fæcal material may accumulate and produce ulcers, which rupture with the ordinary movements of the bowels. Whatever be the cause, the symptoms are much the same.

Symptoms.—The contents of the bowel pass out through the perforation into the peritoneal cavity, and, making their way between the coils of intestine, set up a general peritonitis. In consequence, the abdomen is painful, and after a few hours becomes extremely tender to the touch, as a result of the peritonitis. The abdomen swells, particularly in its upper part, owing to gas having passed also into the cavity. Vomiting is a symptom, and the person passes into a state of collapse. Such a condition is almost invariably fatal in two, or at most three, days, if not promptly treated. Occasionally, however, the perforation is preceded by a certain amount of peritonitis, which forms adhesions in the neighbourhood of the ulcerated part, so that when perforation finally takes place a localised abscess, instead of general peritonitis, may result, and the person may recover.

Treatment.—All food should be withheld, because whatever is taken into the stomach is either vomited or is liable to pass out of the perforation into the peritoneal cavity. Ice may, however, be given to suck in order to allay thirst and vomiting. An operation is urgently necessary, the abdomen being

opened in the middle line, the perforated portion of bowel found, and the perforation stitched up. If the bowel be damaged badly, a part is often cut out and the divided ends joined together. Finally, the peritoneal cavity is thoroughly washed out, and a drainage tube left for some days in the abdominal wound.

OBSTRUCTION of the bowels means a stoppage to the passage down the intestine of the partially digested food. Obstruction may be due either to some cause within the abdomen or to the thrusting of a loop of bowel through an opening in the wall of this cavity. The latter class of cases has been referred to under HERNIA. Obstruction may be acute when it comes on suddenly with intense symptoms, or it may be chronic, when the obstructing cause gradually increases and the bowel becomes slowly more narrow till it closes altogether, or when slight obstruction comes and goes till it ends in an acute attack. In chronic cases the symptoms are much the same as those of the acute variety, though they are milder in degree and more prolonged.

Causes.—Obstruction may be due to causes outside the bowel altogether, for example, the pressure of tumors in neighbouring organs, the twisting round the bowel of bands produced by former peritonitis, or even the twisting of a coil of intestine round itself so as to cause a kink in its wall. Chronic and partial forms of obstruction are sometimes due to such kinks near the end of the small intestine, sometimes to the pressure of the mesentery on the upper end of the small intestine. Chronic causes of the obstruction may exist in the wall of the bowel itself, for example, a tumor, or the contracting scar of an old ulcer. The condition of 'intussusception', where part of the bowel passes inside of the part beneath it, in the same way as one turns the finger of a glove outside in, causes obstruction and other symptoms. Finally some body, such as a concretion, or the stone of some large fruit, or even a mass of hardened fæces, may become jammed within the bowel and stop up its passage.

Symptoms.—There are four chief symptoms of this condition, and any case where these are combined demands immediate treatment. These are pain, vomiting, constipation, and swelling of the abdomen. The *pain* is of a griping character, and may be very severe though it comes and goes, getting now stronger and again for a time less marked. When the small intestine is the seat of obstruction the pain is almost always referred to the region round the navel; when the large intestine is affected the pain may be more accurately referred to the part from which it arises. In addition to this, acute cases are marked by great tenderness of the abdomen to touch. The *vomiting* is peculiar in character. It begins with the first onset of pain, and consists of the contents of the stomach. Later it is yellow or green, bitter, and contains much bile, while, after several hours have elapsed, it becomes brown and ill-smelling, and is then known as 'fæcal vomiting'. The *constipation* in acute cases comes on suddenly, while in chronic cases it may be preceded by a state in which constipation and diarrhœa alternate, or by one in which the stools gradually get smaller and smaller in size, possibly over a period lasting for several months. In chronic cases of obstruction to the large intestine, it is not uncommon for the sufferer to possess a constant desire to go to stool with straining pain, though he can pass nothing (tenesmus). In some conditions, particularly that due to intussusception, though there is constipation in the ordinary sense, the excessive straining produces a copious discharge of blood-stained mucus. The *swelling of the abdomen* varies in different cases. In acute cases the whole belly is blown up with gas, much increasing the pain of the condition. The constipation is so complete as to prevent even flatus from being passed—a very important sign of its gravity. In chronic cases, where the wall of the intestine is thickened, individual loops stand out now and then and become visible on the surface in their attempts to force their contents past the obstruction. When the small intestine is affected its loops stand out one over the other, resembling the rungs of a ladder; while obstruction low down in the large intestine causes a bulging in the flanks and across the upper part of the abdomen.

In addition to these abdominal symptoms there is generally, in the later

stages, collapse, though consciousness is retained till the end. If the condition be not relieved by operation, death almost always results, in acute cases, in the course of three to six days.

Treatment.—In a few cases, as, for example, in hernia and in intussusception, relief may be obtained by manipulation. But this is dangerous, as it merely relieves the condition temporarily without preventing its recurrence; and it is more satisfactory to perform an operation for radical cure at once. As a rule the surgeon opens the abdomen, finds the obstruction and relieves it or if possible removes it altogether. The task of the surgeon is rendered specially hard by the difficulty of determining, before he opens the abdomen, where the obstruction is, by the fact that the intestine is inflamed, and by its distension with gas and fæces. He has generally to open the abdomen in the middle line, examine the usual sites of obstruction, and, failing to find any cause at these points, to pass the whole length of intestine carefully through his hands till he finds the obstruction. Even after this is found, if it be of the nature of a tumor, it may be impossible of removal. If the obstruction be successfully removed, something must next be done, by puncturing the bowel or other means, to relieve the collection of gas and fæces, and this adds to the operation the great risk of sepsis. In all these manipulations care must be taken, by warm towels and the like, to prevent unnecessary exposure and chilling of the bowel.

INTIMA is the innermost coat lining the arteries and the veins.

INTOXICATION is a term applied to states of poisoning. The poison may be some chemical substance introduced from outside, *e.g.* alcohol (*see* ALCOHOLISM), or it may be due to the products of bacterial action, the bacteria either being introduced from outside or developing within the body. The term 'auto-intoxication' is applied in the latter case.

INTRACRANIAL (*intra*, within; *cranium*, the skull) is the term applied to structures, diseases, etc., contained in or rising within the head.

INTRATHECAL means within the membranes or meninges which envelop the spinal cord. The intrathecal space, between the arachnoid and the pia mater, contains the cerebrospinal fluid.

INTROSPECTION (*intro*, within; *spicio*, I look) is a term applied to observation of one's own thoughts or feelings. It is generally applied to this process when it occurs to an abnormal extent in association with melancholia.

INTUBATION is a simple operation, consisting in the introduction, through the mouth into the larynx, of a tube designed to keep the air passage open at this point. The procedure is employed chiefly in cases of diphtheria. (*See* DIPHTHERIA.)

INTUSSUSCEPTION (*intus*, within; *suscipio*, I receive) is a form of obstruction of the bowels in which part of the intestine enters within that part immediately beneath it. This can best be understood by observing what takes place in the fingers of a tightly fitting glove as they turn outside in when the glove is pulled off the hand. The persons affected are almost always young children, and the condition follows severe purging, injury of the abdomen, or the eating of indigestible substances. The point at which it most frequently occurs is the junction between the small and the large intestines, the former passing within the latter. The symptoms are those of intestinal obstruction in general, and in addition there is often a discharge of blood-stained mucus from the bowel. The treatment consists—unless the symptoms rapidly subside, when it may be assumed that the bowel has righted itself—of an operation in which the surgeon opens the abdomen and removes the inner piece of intestine from that into which it has passed. The condition is an extremely grave one.

INUNCTION (*in*, into; *unguo*, I anoint) is a method of administering drugs by rubbing them into the skin mixed with oil or fat. The method is not often used, mercury being the chief drug given by this means. Mercury ointment is rubbed into the armpits and groins night and morning, or into the abdomen, and a flannel shirt or binder is worn next the skin. Weakly children,

who cannot digest fat readily, have cod-liver oil or olive oil administered to them sometimes by rubbing into the abdomen.

IN VITRO is a term commonly used in medical research and experimental biology. Literally 'in a glass', it refers to observations made outside the body —*e.g.* on the action of drugs on bacteria. The opposite term is IN VIVO, which refers to observations of processes in the body.

INVOLUCRUM is the term applied to the sheath of new bone which is formed round a piece of dead bone in, for example, osteomyelitis.

INVOLUTION is the term which describes the process of change whereby the uterus returns to its resting size after parturition. The term is also applied to any retrograde biological change, as in senility.

IODIDES are salts of iodine; those which are especially used in medicine being the iodide of potassium and iodide of sodium.

Action.—The action of these two is much the same. Whether they act by virtue of iodine given off in the tissues, or whether they combine with the latter, displacing the chlorides, is a matter of dispute. What is quite certain is that they are rapidly excreted from the body and in the process stimulate the kidneys, skin, mucous membranes of the air passages, and glands generally to increased activity. The great rapidity of the excretion of iodides is shown by the fact that if a few grains be administered in cachet, the saliva and urine will, after ten or twenty minutes, show traces of its presence, if chemically tested. Further, iodides increase the processes of repair and so aid in the absorption of diseased and damaged tissues, and they increase the tendency of the blood to clot. When iodides are taken in over-large doses, a kind of poisoning, known as 'iodism', results. The symptoms of this are running at the nose and eyes, headache, skin eruptions, loss of appetite, and gradual wasting of the muscles and of the breasts and other glands. These symptoms pass off when the drug is discontinued.

Uses.—The chief use of the drug is to cause absorption of the unhealthy tissues in syphilis, upon which it acts with great rapidity when taken into the system. It is used for a similar reason in chronic forms of rheumatism, and in cases of aneurysm. Iodides are given in chronic lead-poisoning, because they dissolve the lead deposited in the tissues and so permit of its excretion from the body. Iodide is administered over long periods in small doses to children living in districts where goitre is common, with the object of preventing the onset of this disease.

IODINE is a non-metallic element which is found largely in seaweed. It is prepared in the form of dark violet-brown scales, which are very soluble in alcohol or ether. It has a pleasantly pungent smell and a burning taste. It has a highly irritating action, and, when applied to the skin, stains the latter dark brown and causes it to peel off in flakes, while internally it is a violent irritant poison in large doses. It is, like chlorine, a powerful antiseptic and disinfectant, though it is too expensive to use in large quantities for this purpose.

Uses.—Externally iodine is much used as a counter-irritant. (*See* BLISTERS AND COUNTER-IRRITANTS.) For this purpose the strong liquor of iodine (10 per cent) is commonly used if a few applications are to be made; or, if repeated applications are to be made for some time, the weak liquor of iodine (2½ per cent strength) is employed. Iodine ointment is also much used for rubbing into the skin. One or other of these preparations is very frequently used to paint over glands enlarged by various causes, in order to bring about their decrease in size. Liquor of iodine is painted over the chest in cases of pleurisy to aid absorption of the pleuritic effusion, and, when pain due to this cause is experienced in the chest in the course of chronic consumption, iodine is one of the best remedies. The disadvantage of iodine is that it is 'fixed' by protein and so is rendered less effective as an antiseptic for open wounds. For its antiseptic properties it is used to sterilise the skin by painting over the surface before surgical operations. Either the strong or the weak liquor is much used to paint over the surface in cases of chronic inflammation of bones, joints, and bursæ,

and the weak liquor is a useful preventive of chilblains, applied while the hands are still red before the skin has begun to crack.

Internally iodine dissolved in glycerin is much used as an astringent application in chronic inflammatory conditions of the throat and tonsils. Small doses of the weak liquor (2 to 5 drops) are administered to relieve vomiting in cases of sea-sickness. Iodine—often as Lugol's iodine (5 per cent iodine and 10 per cent potassium iodide in water)—is given internally in the treatment of goitre, especially before the operation of thyroidectomy for Graves's disease.

The weak liquor of iodine was formerly called weak tincture of iodine. Both this and the strong liquor of iodine contain potassium iodide. There is also a simple liquor of iodine of 10 per cent strength, also known as French tincture of iodine, containing iodine dissolved in strong alcohol only; it is given in doses of 3 to 15 drops, usually in milk.

IODOFORM is a saffron-coloured crystalline substance made by the action of iodine upon a mixture of alcohol and potash. It has a most penetrating, rather pleasant odour and strong taste. It is insoluble in water, but dissolves in alcohol, ether, and oils. It relieves pain when applied to a raw or mucous surface, and has the property of preventing putrefaction when brought in contact with discharges. When applied in large quantities to a raw surface it is apt to be absorbed and to cause symptoms of poisoning, consisting of a red rash over the body, fever, loss of appetite, and, it may be, delirium.

Uses.—Iodoform is mainly used in surgery to apply to ulcers and discharging wounds, particularly those of either a tuberculous or venereal nature. Dissolved in oil or glycerin, it is much used to inject into tuberculous abscesses and joints, producing often a cure of the disease without recourse to a serious operation.

IODOLYSIN is the name of a compound of thiosinamin and iodine used by hypodermic injection in the treatment of rheumatism, rheumatoid arthritis, and other joint conditions.

IODOPHTHALEIN is the sodium salt of tetra-iodophenolphthalein, a bluish-violet crystalline powder. As it is excreted quickly by the liver, collects in the gall-bladder and casts a shadow with X-rays, it is administered by the mouth or by intravenous injection for the diagnosis of disease of the gall-bladder by means of X-ray photography.

IODOXYL (*see* UROSELECTAN).

IONISATION (*ἰών*, going) means the breaking up of a substance in solution into its constituent ions. The term is used in medicine to designate a process by which various substances are made to pass through the skin into the underlying tissues by means of the electric current. This is also called iontophoresis, iontherapy, galvano-ionisation, and medical ionisation. Only those drugs can be used for ionisation which are soluble in water and can be dissociated when dissolved. These are known as electrolytes, and include inorganic salts and similar organic compounds such as salts of the alkaloids and salts of organic acids like salicylate of soda. The form of electricity used for ionisation is the continuous current, and high currents of 50, 60, or more milliamperes are employed, large electrodes being used so as to distribute the electricity over a wide area. Applications last from fifteen minutes to half an hour, and great care must be taken to avoid irregularities or interruptions of the current during the applications. In order to avoid burning or blistering the skin, as well as to maintain a supply of the solution which it is desired to introduce, the electrodes consist of large brass, aluminium, or silver plates covered with thick layers of lint, cotton, or felt. Any tender areas in the skin are protected from the electrode by small pieces of rubber plaster, and care must be taken to turn off the current gradually. The drugs mostly in use for introduction are chlorides of sodium, ammonium, and lithium, salicylate of soda, sulphate of zinc, iodides of potassium and lithium, sulphate of quinine, and hydrochloride of cocaine. Of these, the most frequently used drug is salicylate of soda for its action in the treatment of neuritis, rheumatic affections, lumbago, and certain skin diseases. Sulphate of zinc is also used for the treatment of

ulcers, infected wounds, and similar conditions where an antiseptic and astringent action is desired.

IPECACUANHA, IPECAC, or HIPPO, is the root of *Cephaëlis Ipecacuanha*, a Brazilian shrub. It contains an alkaloid 'emetine' which acts as an irritant when brought in contact with the interior of the stomach, producing vomiting. This effect is also brought about after its absorption into the blood by its action on the vomiting centre in the brain. In small doses it acts, not as an irritant, but as a gentle stimulant to the mucous membrane of stomach, bowels, and respiratory passages.

Uses.—In bronchitis and croup, particularly among children, who swallow whatever they cough up, great relief is often obtained after an attack of vomiting has been produced by ipecacuanha wine, in doses of a teaspoonful for a child of one year, or more for an older child. On account of its stimulating properties small doses are given to produce the very opposite action in the vomiting associated with sick-headache, or to cure acid dyspepsia or diarrhœa. For the latter purpose the powder of ipecacuanha and opium, or Dover's powder, in doses of 5 to 10 grains, acts very well. In winter-cough among old people, ipecacuanha wine forms a favourite ingredient of cough mixtures, on account of its stimulating effect upon the mucous membrane and nervous centres. It is given, especially in the bronchitis of very young children, in 5-drop doses. The wine is now replaced by tincture of ipecacuanha.

For acute amœbic dysentery, powdered ipecacuanha and emetine have become the chief remedies. The powder is given in a dose of 30 grains or more, sometimes combined with opium to check the vomiting. If vomited up, the dose is at once repeated. Emetine is given by hypodermic injection in dose of ½ or 1 grain. It is essential that the patient should rest quietly and be kept warm in bed till the ipecacuanha has produced a copious evacuation of the bowels, after which the diarrhœa often stops and recovery from the dysentery takes place.

IRIDECTOMY (ἶρις, a halo; ἐκ, out; τέμνω, I cut) means an operation by which a piece is removed from the iris, and the pupil of the eye thereby increased in size.

IRIDENCLEISIS is the term for describing the condition in which the iris is caught in a small gaping wound of the cornea.

IRIDIN is a powdered extract obtained from the root of the blue flag, *Iris versicolor*. It has a bitter taste and purgative properties. It is generally taken in the form of two or three grains in a pill.

IRIS (ἶρις, a halo) is the muscular and fibrous curtain which hangs behind the cornea and serves, by alteration of the size of the 'pupil' or round hole in its centre, to regulate the amount of light entering into the eye. (*See* EYE.)

IRISH MOSS (*see* CARAGHEEN).

IRITIS means inflammation of the iris. Inflammation of the iris is very closely associated both in cause and in symptoms with inflammation in the ciliary body and choroid membrane, which together with the iris make up the middle coat of the eyeball.

Varieties and causes.—Attacks of iritis differ mostly in severity or in the absence of one or more of the usual symptoms, for, whatever be the cause, the resulting disease has much the same appearance. It is not a common condition in young children, and, when it occurs in them, is associated generally with ulcers of the cornea. Most of the cases are found in young adults, and about half of all such cases are due to syphilis. Indeed iritis, accompanied by inflammation of the cornea or of the choroid coat, is the usual cause of the serious impairment in vision which is apt to ensue from this disease. Chronic rheumatism and the presence of local inflammatory troubles, such as dental abscesses and suppurative conditions of the nose, form the cause in the majority of the remaining cases, though the disease, in occasional instances, appears during the course of fevers and in persons suffering from diabetes.

An important form of inflammation of the eye commencing in the iris and ciliary body of one eye, as the result of a wound received by the other eye, is

known as 'sympathetic iritis'. This form of inflammation seldom starts, save as the result of an open wound in the ciliary region, or of one caused by a foreign body which enters and remains in the eye. Formerly it was supposed that the damaged eye exerted upon the other one an irritating influence through their nervous connections; now it is generally held that the inflammation is due to organisms which enter by the wound, cause inflammation of the damaged eye, and then infect the other eye either by the lymph spaces which

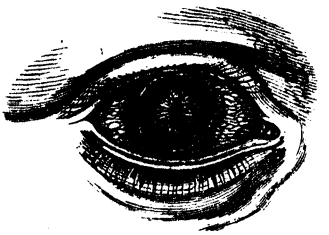


FIG. 274.—Eye showing the appearance of iritis. (Miller's *Surgery*.)

connect the two, or indirectly through the blood. For this reason when an eye has received a severe penetrating wound, and when it is sightless, inflamed, and painful, it should be removed to avoid the risk of sympathetic trouble in the sound eye.

Symptoms.—The most marked symptom is pain situated either in the eye itself or more commonly in the forehead above it. There may be much watering of the eye, and bright light always occasions more or less distress. The eye is red around the margin of the iris, and for this reason the condition is often mistaken for inflammation of the conjunctiva covering the eye—a much less serious condition. (*See* EYE, DISEASES OF.) Dimness of vision is present, and, particularly in chronic cases, may for long be the only sign. When one looks at the eye closely, one notices that the iris has lost its lustre, and the pupil is generally narrow. If the affected person have suffered previously from iritis, the iris may be adherent behind to the lens of the eye, so that the pupil loses its usual circular outline, and ceases to vary in size in different lights. An acute attack of iritis generally lasts some weeks even when treated, and, if the condition be not carefully treated, the sight may be much impaired or lost as the result of opacities in the lens or cornea, deposit of inflammatory matter in the pupil, and the like.

Treatment.—Rest of the eye is of the highest importance. To effect this, all reading and other near work, even with the unaffected eye, must be given up. To prevent the eye from being used, atropine, which paralyses the muscles of accommodation, is dropped into the eye, usually in a solution which contains 2 or 4 grains to each ounce of water. As a still further protection, dark glasses are worn. Sometimes a blister is applied to the temple to afford relief from the pain. The application of warmth to the eye, the administration of aspirin, and confinement to bed are also helpful. The disease which is responsible for the iritis is at the same time treated by suitable remedies.

IRON is a metal, and is not only necessary in small amount in the food, but is used both in the form of a finely reduced powder and of various of its salts, as a drug. Both the muscles and the red blood corpuscles, and in a less degree various other tissues, require a constant supply of iron from the food in order to maintain their activity. This form of iron, whether derived from vegetables or from meat, is in organic combination, but, in certain disordered states of the alimentary canal or of other parts of the body, this combination becomes decomposed in the intestine. It is probable that the inorganic form produced by the decomposition is not so readily absorbed, and that thus the iron is to a great extent lost to the system and voided in the stools. When large quantities of inorganic iron salts are given with the food, these appear to protect the organic compounds, and therefore iron is administered in all forms of bloodlessness. All forms of iron salts have an astringent action, and several act so powerfully in this way, for example the sulphate and chloride, that their solutions are used as styptics to check bleeding.

Uses.—Iron is used as a tonic in all cases where there appears to be a deficiency of hæmoglobin, and there are many different preparations of the substance which are used in varying cir-

cumstances. For young women with anæmia, Blaud's pill, containing carbonate of iron, and iron in colloidal form (iron jelloids) are favourite forms, and very large doses are taken. (*See* ANÆMIA.) For persons recovering from fevers and other weakening diseases, the citrate of quinine and iron is often used. The perchloride of iron, which has a very astringent action, is employed frequently to check diarrhœa, and the iodide is a form frequently administered to scrofulous children.

Persons requiring treatment by iron frequently obtain great benefit by the use of iron-containing waters. Springs which contain a notable amount of iron are known as 'chalybeate' springs, and as examples may be mentioned Tunbridge Wells and some of the springs at Harrogate in England, Schwalbach in Germany, and Bailey springs and Stafford springs in the United States.

Sometimes persons are found in whom even small doses of iron disorder the stomach greatly and produce headache. All forms of iron are liable to constipate, and therefore require to be combined with some aperient food or medicine.

IRRADIATION is the term applied to treatment by various forms of light and radiant activity.

IRRIGATION is the name given to the method of washing out wounds, or cavities of the body, like the bladder and bowels, by means of a copious supply of water. (*See* DOUCHES, ENEMA.)

IRRITATION is a word sometimes used in a popular sense to denote mild degrees of inflammation. (*See* CHAFING, INFLAMMATION.)

ISCHÆMIA means bloodlessness of a part of the body, due to contraction or spasm or constriction or blocking by embolus or by thrombus of the arteries —for example, of the heart.

ISCHIORECTAL ABSCESS is the name of an abscess arising in the space between the rectum and ischial bone and frequently resulting in fistula.

ISCHIUM (*ἰσχίον*, the hip-joint) is the bone which forms the lower and hinder part of the pelvis. It bears the weight of the body in sitting.

ISCHURIA (*ἴσχω*, I check; *οὖρον*, urine) means insufficiency in the amount of urine passed, due either to suppression of the excretion or retention in the bladder.

ISO-IMMUNISATION is the immunisation of one member of a species by an antigen lacking in himself but present naturally in other members of the species, as, for example, the immunisation of an Rh-negative mother by an Rh-positive fœtus, the mother as a result producing anti-Rh agglutinins which injure the fœtus. (*See also* ICTERUS GRAVIS NEONATORUM and RH FACTOR.)

ISOLATION in infectious diseases is an important procedure, applied both to persons who are themselves sick and to persons who have come in contact with them, technically known as 'contacts' or 'suspects', and who may later develop the disease. (*See* INCUBATION, INFECTION, QUARANTINE.)

ISOTONIC is a term applied to solutions which have the same power of diffusion as one another. An isotonic solution used in medicine is one which can be mixed with body fluids without causing any disturbance. An isotonic solution of *boric acid* lotion for application to the eyes, bladder, etc., is one of 2 per cent strength. An isotonic *saline solution* for injection into the blood, so that it may possess the same osmotic pressure as the blood serum, is one of 0·9 per cent strength or containing 80 grains of chloride of sodium to the pint of water. This is also known as *normal* or *physiological salt solution*. An isotonic solution of *bicarbonate of soda* for injection into the blood is one of 1·35 per cent strength in water. An isotonic solution of *glucose* for injection into the blood is one of 5 per cent strength in water. Solutions which are weaker than or stronger than the fluids of the body with which they are intended to be mixed are known as hypotonic and hypertonic respectively.

ISSUE is an old term for a suppurating sore. The formation of an issue formed an old type of treatment, in which a severe form of counter-irritation was produced by the introduction of a seton or some irritating substance to produce suppuration.

ITCH is a popular name for SCABIES, a skin disease caused by a minute parasite, the *Acarus scabiei*, which resembles

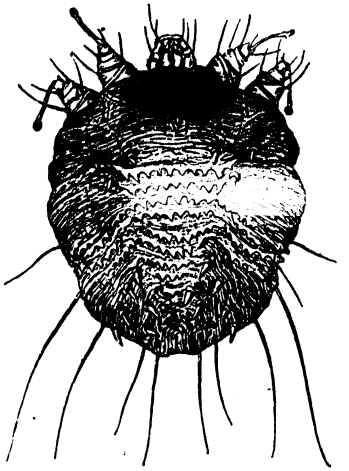


FIG. 275.—The female acarus, magnified about 80 times. (Thoma's *Pathology*.)

the cheese-mite in appearance. The female acarus burrows in the skin, particularly that on the back of the hand, forming small tunnels in which she lays her eggs, while the male wanders on the surface. The sides and legs may also be affected in the same way, though rarely the upper parts of the body. Scabies is (1939–1943) rife among the population of Great Britain. It is believed that personal contact, especially in bed, is the most important factor in keeping this infestation going; less stress is now laid on dissemination of the mite by infested clothes and blankets.

Symptoms.—The person complains of great itchiness and heat, felt particularly soon after he goes to bed, and preventing sleep in the early part of the night. The spaces between the fingers, the backs of the hands, and the front of the wrists are red and scabbed as the result of scratching, or the surface in these localities may even be much inflamed.

Treatment.—Sulphur is still probably the most popular remedy, in the form either of sulphur ointment or of a preparation which liberates sulphuretted hydrogen when applied to the skin (the Danish method). Benzyl benzoate made up with methylated spirit and soft soap is widely recommended. Derris root, or rotenone derived from it, is also considered a good remedy. Whatever remedy be employed, the gloves, underclothes, bedding, etc., must be baked or fumigated, although less stress is laid on this than formerly.

ITCHING is an unpleasant condition of the skin-surface which in some cases is so constant as to become unbearable.

Causes.—It is due to many different conditions, some of which are local and can be easily removed. Some are general, while occasionally the condition becomes so chronic and the skin so changed by scratching, etc., that it is incurable. Itching is produced by slight mechanical irritation, such as contact with rough woollen underclothing, also by parasites such as lice, scabies (in the disease specially known as 'the itch'), and these mechanical causes being removed the itching speedily vanishes. Various skin diseases, of which eczema is the chief, have itchiness as one of their main symptoms. In old age, when the skin is becoming thin and inelastic, itching sometimes becomes a troublesome complaint. In these and other conditions, a habit of scratching, which in course of time renders the skin rough and thickened, is apt to be contracted, and this of itself aggravates and keeps up the itchiness. Among the general diseases which set up itchiness, the chief is diabetes. In fact, any one who is much troubled by itchiness, especially if this be situated about the genital organs, should have his urine examined for the presence of sugar. Jaundice caused by various liver derangements, and Bright's disease, are often accompanied by itchiness in a milder degree. Dyspepsia is not uncommonly the cause of nettle-rash, which may be of an itching type and appear soon after indigestible food has been taken. Some persons are much troubled by itching of the body when changes in size of the blood-vessels in the skin take place, as occur upon getting warm in bed or upon the advent of spring and autumn. A similar condition, which affects persons on going to the tropics, is known as 'prickly heat'. (*See* PRICKLY HEAT.) A peculiar and often very aggravated form of itching

occurs sometimes at the anus, known as pruritus ani. (*See* RECTUM, DISEASES OF.)

Treatment.—Warm baths, alkaline, or containing bran, are among the most soothing applications for general itching. (*See* BATHS.) It is essential that a proper examination should be made as to the functions of the internal organs in cases where itching is a chronic complaint. In diabetic cases the surest remedy to prevent the itching is to treat the diabetes. A variety of treatments have been recommended for pruritus ani, in the causation of which the psychological element is sometimes overlooked.

-ITIS is a suffix added to the name of an organ to signify any diseased condition of that organ.

IVORY, or DENTINE, is the hard material which forms the chief bulk of the teeth. (*See* TEETH.)

JABORANDI, or PILOCARPUS, is the leaf of a South American plant, *Pilocarpus pennatifolius*. It contains an alkaloid, pilocarpine, upon which its action depends. When taken internally, pilocarpine causes a flushing of the skin, followed by profuse perspiration, commencing upon the face and neck and later spreading over the whole body. It also causes a great flow of saliva. In larger doses it slows the pulse and weakens the heart's action.

Uses.—It is mainly administered to people who are the subject of acute Bright's disease, in order to increase the action of the skin and so reduce dropsy and prevent poisoning by the products which the kidneys are failing to excrete. Pilocarpine is also used in several skin diseases; and, as a remedy for baldness, infusion of jaborandi forms the chief constituent of many vaunted hair-washes.

JACKSONIAN EPILEPSY (*see* EPILEPSY).

JAIL FEVER is another term for typhus fever.

JALAP is the tuber of *Ipomœa Jalapa*, a Mexican plant, which contains two resins of irritating properties.

Uses.—Jalap is used as a purgative, generally in cases where dropsy is present, in order to relieve this. It is included in various pills, but the commonest form of administration is by compound jalap powder, of which a dose of about 40 grains is given to produce a marked effect.

JASMINE (*see* GELSEMIUM).

JANICEPS is a fœtal monstrosity characterised by one combined head and two faces.

JAUNDICE (Fr. *jaunisse*) is a yellow discoloration of the skin due to the deposition of bile pigment in its deeper layers. The condition is really a symptom only of some obstruction to the normal excretion of bile from the liver; but, both owing to the fact that the appearance presented by a jaundiced person is so striking, and because this symptom occurs more or less constantly along with a group of others, jaundice is usually considered as a disease by itself.

Causes.—Jaundice is divided into two classes: *hepatogenous jaundice*, arising from the absorption of bile formed by the liver, and *hæmatogenous jaundice*, arising from the formation of a yellow pigment in the blood, derived especially from the breaking down of red blood corpuscles. The former is the usual type, and is described below; the latter is found in such conditions as pernicious anæmia and snake poisoning. When the bile cannot escape into the intestine in the usual way, it is absorbed by the blood- and lymph-vessels, and some of its constituents are deposited in the various tissues throughout the body. Some obstruction to the outflow of bile is, therefore, a necessary condition, and this obstruction may either exist in the bile-ducts, which convey the bile from liver to intestine, or it may be caused by some disorganisation in the liver which prevents the bile, formed by the liver-cells, from finding its way to the bile-ducts at all. The tint of the jaundice has no relation to the severity of the cause. Among those cases of jaundice due to obstruction of the larger bile-ducts, some are due to swelling of the mucous membrane lining the bile-duct or of that lining the small intestine at the point where the bile-duct enters it (catarrhal jaundice). This may arise as the result of a chill or of eating some irritating and indigestible food, and, though the resulting jaundice may last for several weeks, it forms a trifling malady. Obstruction may be due to gall-stones, and the resulting jaundice is then a symptom of this condition. (*See* GALL-STONES.) Obstruction may be due to some cause quite outside the liver and bile-ducts, for example, the pregnant uterus, or enlarged glands lying near the liver, or cancer of the pancreas, the seriousness of the jaundice depending then upon the seriousness of the disease responsible for the pressure. In elderly persons, who are likely to be the subject of cancer, long-continued jaundice is for this reason a serious symptom. Cirrhosis of the liver, in which the small branches of the bile-duct become compressed by the formation of fibrous tissue, may also be a cause of chronic jaundice. (*See* CIRRHOSIS.)

Among the causes which disorganise

the liver, one finds many poisons which are carried to it in the blood, for example phosphorus, mercury, chloroform, and snake poison. Certain infective diseases are also prone to produce this effect, of which may be mentioned yellow fever, malaria, typhoid fever, and pyæmia. A serious but uncommon condition, accompanied by rapid and often fatal jaundice, is that known as acute yellow atrophy of the liver. Another form of jaundice is known as spirochetal jaundice or *spirochætosis icterohæmorrhagica* (*q.v.*). These conditions cause such changes in the liver that the bile is unable to escape save by re-absorption into the blood.

Symptoms.—Yellowness, appearing first in the whites of the eyes and later over the whole skin, is the symptom that attracts notice. This tint varies from a pale sulphur-yellow through all gradations to a deep olive or bronze colour, according to the completeness of the obstruction and the length of time the jaundice has lasted. The urine passed during the time the jaundice lasts is of a dark greenish-brown colour, owing to the excretion of bile by the kidneys. Various digestive disturbances are present, the tongue is furred, the appetite poor, and a feeling of sickness is often felt, and is aggravated by eating fats. The stools are of a grey or white colour, owing to the want of bile in the intestine, and for the same reason constipation, relieved occasionally by diarrhœa, is present, and the stools have an excessively offensive smell. A bitter taste in the mouth is generally felt by the jaundiced person, due, as it is supposed, to the presence in the saliva of salts of the bile-acids, and the same or other substances in the sweat lead to occasional itching of the skin. It is commonly supposed that the fact that 'all seems yellow to the jaundiced eye' is a constant symptom of jaundice, but yellow vision is really the exception rather than the rule. Slowness of the pulse, and, in long-continued cases, mental confusion and dullness, are other less evident accompaniments of jaundice.

Treatment.—The physician attempts, in the first place, to find out the cause of the obstruction to the outflow of bile. In old persons particularly this is occasionally a difficult matter, requiring long-continued observation of the patient. The activity of the liver must be checked as far as possible, and to this end rest in bed and the avoidance of all heavy, fatty and spiced foods are necessary. The bowels must be regulated by saline purgatives. In simple cases of jaundice, when the returning yellow colour of the stools and disappearance of bile from the urine show that the bile-flow is becoming re-established, various substances, such as blue pill, euonymin, and rhubarb, which act as purgatives and as cholagogues, are given to quicken the expulsion of bile from the system. The affected person must exercise patience in waiting for the disappearance of the yellow colour from the skin, for in marked cases it generally lasts for several weeks.

In serious cases, where the jaundice is due to cancer, disorganisation of the liver by poison, etc., the treatment of the jaundice sinks into insignificance beside the treatment of the disease producing it.

JAUNDICE, EPIDEMIC (*see* HEPATITIS, EPIDEMIC INFECTIVE).

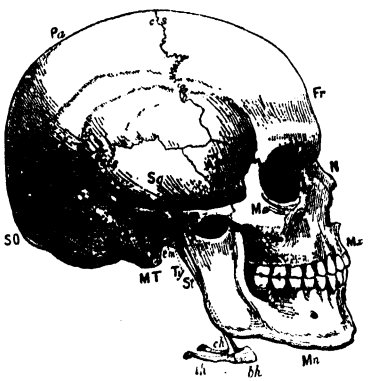


FIG. 276.—The side of the skull, showing the attachments of the jaws. *Mx*, The upper jaw, or superior maxilla: *Mn*, the lower jaw, inferior maxilla, or mandible. For other letters see SKULL. (Turner's *Anatomy*.)

JAW is the name applied to the bones that carry the teeth. The upper jaw-bones are two in number, and are firmly fixed to the other bones of the face. The lower jaw is shaped somewhat like a horseshoe, and, after the first year of life, consists of a single bone. It forms a hinge-joint with the squamous part of

the temporal bone, immediately in front of the ear. Both upper and lower jaw-bones possess deep sockets, known as 'alveoli', which contain the roots of the teeth. (*See* DISLOCATIONS, FRACTURES, GUMBOIL, MOUTH, TEETH.)

JEJUNUM (*jejunus*, empty of food) is the name given to part of the small intestine. (*See* INTESTINE.)

JELLY (*see* GELATIN).

JEQUIRITY is a plant known as *Abrus precatorius*, of which the seeds are poisonous when applied to a wound. It has been used in medicine to apply to parts where chronic inflammation is in progress, in order to produce an acute type of inflammation and permit of cure.

JIGGER is a popular term used to denote a parasite also known as the sand-flea. The term is also used to denote the small worm-like masses of fatty material which can be squeezed out of the sebaceous glands on the face of those suffering from acne, and which are popularly supposed to be worms. (*See* ACNE.)

JOINT-MOUSE is a popular term for a loose body in a joint. It is found especially in the knee. (*See* JOINTS, DISEASES OF.)

JOINTS.—A joint or articulation is the meeting-place between different parts of the skeleton, whether bones or cartilages.

Structure.—The great division of joints is into those which are fixed and those at which movement can take

FIG. 277.—Section through a fixed synarthrodial joint. *bb*, The two bones; *Sc*, the intervening cartilage; *l*, the ligaments. (Turner's *Anatomy*.)

place. In the *fixed joints*, a layer of cartilage or of fibrous tissue intervenes between the bones and binds them firmly together (synarthrodial joint). This type of joint is exemplified by the 'sutures' between the bones that make up the skull. Among these fixed joints, some have a thick disc of fibro-cartilage between the bones, so that, though the individual joint is really capable of very little movement, a series of these, like the joints between the bodies of the vertebræ, gives to the spinal column, as a whole, a flexible character (amphi-arthrodial joint).

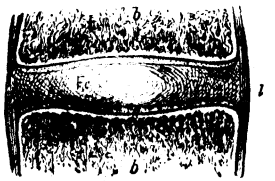


FIG. 278.—Section through an amphiarthrodial joint. *bb*, The two bones; *c*, the plate of cartilage on the surface of each; *Fc*, the intermediate fibro-cartilage; *ll*, the ligaments. (Turner's *Anatomy*.)

Into the formation of every *movable joint* four structures enter. These are the bones whose junction forms the joint; a layer of cartilage covering the end of each of these and rendering the ends smooth; a sheath of fibrous tissue known as the capsule, thickened at various points into bands or 'ligaments', which hold the bones together; and, finally, a membrane known as 'synovial membrane', which lines this capsule and

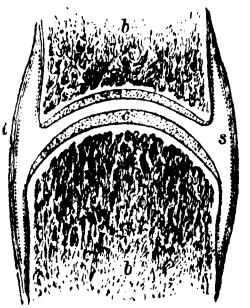


FIG. 279.—Section through a movable diarthrodial joint. *bb*, The two bones; *cc*, the plate of cartilage covering the surface of each; *ll*, the ligaments; the dotted line, *s*, shows the position of the synovial membrane. (Turner's *Anatomy*.)

produces a synovial fluid to lubricate the movements of the joint. Further, the bones are kept in position at the joints by the various muscles passing over them and by atmospheric pressure. This type of joint is known as a diarthrodial joint.

Some joints possess subsidiary structures, such as discs of fibro-cartilage,

which adapt the ends of the bones more perfectly to one another in places where these do not quite correspond. In others, movable pads of fat under the synovial membrane fill up larger cavities and afford additional protection to the joint.

Varieties.—Apart from the main division of joints into those which are fixed and those which are movable, the movable joints fall into several groups. Gliding joints are those in which, like the wrist and ankle, the bones have flat surfaces capable of only a limited amount of movement. In hinge-joints, like the elbow and knee, the chief movement takes place round one axis. The ball-and-socket type is exemplified by the shoulder and hip, in which free movement is possible in any direction. There are other subsidiary varieties, named according to the shape of the bones which enter into the joint.

JOINTS, DISEASES OF.—The larger joints, on account of their exposed position, are subject to constant injuries, and this, together with the wear they suffer and the richness of their blood supply, renders them liable to a number of serious diseases. The knee is the joint most frequently diseased, and after it, in order, the hip, ankle, and elbow. Though minor injuries may be followed by serious diseases, it is an important fact that very severe injuries, in which the skin remains unbroken, such as dislocations of and fractures into the joints, rarely occasion any serious disease beyond stiffness and other direct results of the injury. On the other hand, penetrating wounds of joints are among the most serious injuries, short of damage to vital organs, that can occur. A poisoned wound of a joint cavity is so difficult to render clean that such an accident is highly dangerous to the limb, and often even to life. The following are some of the conditions from which joints suffer.

SYNOVITIS is the name given to any inflammation of the membrane lining the joint cavity. It may be acute, subacute, or chronic.

Causes.—The joints being much exposed to blows, wounds, and strains, some injury usually precedes the onset of inflammation. In many cases, the condition is more dependent on constitutional causes, as, for example, when rheumatism, gout, or some infective disease is the nature of the malady. Apart from these and some other constitutional causes which impair the usefulness of a joint, tuberculous disease is responsible for the great majority of chronic cases of synovitis, which proceed so far as to destroy the functions of the joint altogether.

Symptoms.—In acute synovitis, following usually upon some injury, the synovial membrane becomes inflamed, thickened, and secretes an excessive amount of fluid into the joint. As a result, the joint becomes painful, red, swollen, and hot to touch. It is usually kept more or less bent, and is painful to straighten and to handle. If the synovitis remains of a simple nature, these symptoms last some days and then gradually subside. Or the condition may persist for a long time, getting better for a little and then relapsing; or it may become chronic, and, while the heat and redness disappear, the joint remains stiff and distended with fluid. This condition most frequently affects the knee, and is then popularly known as 'water on the knee'. On the other hand, in occasional cases which have begun in the simple form, and in cases due to a penetrating wound of the joint to which bacteria have gained entrance, a very serious inflammation occurs. Suppuration then takes place in the joint, an abscess forms with fever, great pain, and other aggravated symptoms of abscess. A joint cavity is very difficult to render free from suppuration, which may therefore last for months, weakening the patient, causing stiffness of the joint and disease in other organs, and even necessitating amputation of the limb in order to save his life.

Treatment.—In the early stages, complete rest of the joint, the limb being placed on a splint, together with the application of cold or of warm fomentations to soothe the pain, are alone necessary. Later, massage and compression of the joint by a bandage aid the absorption of the fluid and dispel the stiffness. When the condition becomes chronic, counter-irritation by iodine, blisters, etc., is necessary, and the joint is often punctured to draw off the fluid. Suppuration is, as already stated, a very serious matter, and is treated like an

abscess elsewhere by opening, irrigation with antiseptics, and drainage, though frequently a more serious procedure becomes necessary.

EPIPHYSITIS is the name given to an inflammation situated at the end of a long bone just outside the joint. Cases of painful inflammation of a joint in children may be situated in the bone, and many cases of tuberculosis begin here and later affect the synovial membrane of the joint. An important point regarding this type of inflammation in children is that if the inflammation be severe it may permanently damage the plate of cartilage, situated close to the end of the bone, from which increase in length takes place, so that the child's limb may be seriously impaired in growth. Treatment is much the same as for synovitis.

TUBERCULOUS DISEASE of a joint, though it begins in the synovial membrane or in the end of the bone, is considered under a separate heading, because of its great frequency and importance. It is popularly known as 'white swelling', on account of the characteristic appearance of the affected joint. In many cases there are other manifestations of the disease, the lungs, for example, being affected, or the glands of the neck enlarged. Tuberculosis of the joints is much commoner in children than in older persons, and is attributed to infection with tuberculous milk.

Symptoms.—The condition is very chronic, begins insidiously, sometimes being dated from a slight accident, and progresses slowly; it may even last for years. Slight stiffness, wasting of the muscles in the affected limb, and pain and tiredness brought on by slight exertion, are the earliest symptoms. The joint later on assumes its characteristic appearance, becoming enlarged, losing the natural hollows about it, and appearing white and glistening, with large veins showing through the skin. The wasting of muscle above and below the joint causes it to look still more enlarged than it really is. Gradually the use of the limb is lost, and, if the lower limb be the one affected, the person takes to bed, and at the same time the general health deteriorates. Later in the disease, when the joint is becoming thoroughly disorganised, starting pains at night, which waken the sufferer as he is dropping off to sleep, become troublesome. If the condition remains untreated after this stage is reached, an abscess forms in the joint and bursts through the skin, hectic fever develops, and the patient, if untreated thereafter, slowly sinks and dies.

The symptoms of *hip-joint disease* require special mention, because, owing to the importance of the joint to the body and its deep position, there are special symptoms in addition to the above general ones. The pain in early stages, instead of being felt at the hip, may be referred to the inner side of the knee or felt down the thigh. In the early stage the limb takes up the following position, because in this position the ligaments round the joint are most relaxed. The hip and knee joints are slightly bent, the limb rotated outwards and separated from the other. If the child is to walk he must remedy this by tilting up the pelvis on the sound side, and so bringing the sound leg parallel to the other. This has the effect not only of making him lame, but also of rendering the diseased limb apparently longer than the healthy one. Later in the disease, after the sufferer has become unable to use the limb and has taken to bed, quite a different position is assumed, the diseased limb being bent at the hip and knee as before, but now turned inwards and brought towards the other, so that the knee of the diseased limb

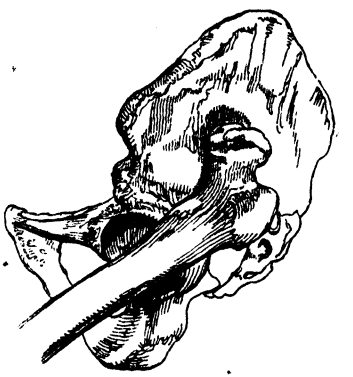


FIG. 280.—The bones in an advanced case of hip-joint disease, showing the erosion of the head of the thigh-bone and its consequent displacement upwards and backwards, to which the great shortening is due. (Miller's *Surgery*.)

lies on the top of the healthy knee or is even crossed beyond it. The change of position is ascribed to various causes, chief among which is slight giving way of the head of the thigh-bone and of the socket which holds it on the pelvis. When the joint recovers without operation, this is the position in which it is generally found fixed. An adjustment of the other limb must be made in order to permit of walking, and the pelvis is consequently tilted down upon the sound side, so as to bring the limbs parallel, thus making the diseased limb appear even shorter than it actually is. As the hip-joint is fixed in a bent position, the body must be inclined slightly forward and the back bent when the foot is placed on the ground, and the lameness in walking is therefore considerable, and very characteristic of the condition causing it.

Treatment.—In early cases of tuberculous disease rest of the joint is essential, the joint being fixed by a splint or other apparatus so that it cannot move to any great extent. As in all other tuberculous conditions, exercise and fresh air are of great importance, and therefore, when the disease affects a joint in the lower limb, some apparatus is devised whereby the patient can move about while the joint is still rigid. For the hip and knee this is secured by Thomas's splints, and for other joints by various pieces of apparatus. Fixation is sometimes effected by plaster bandages, though these have the great disadvantage of leaving the joint stiff and the limb weak. When a joint is thus fixed for a space of weeks or months, stiffness is apt to ensue, but the freedom of the joint must often be sacrificed with the object of checking the disease. Care is taken that the position in which the joint is fixed shall be the most useful one, the knee being kept straight, the ankle at a right angle, the elbow a little more bent than a right angle, as the case may be. Sometimes in the case of the hip, especially if the pain be severe, the child is put in bed, and extension by means of a weight applied to the limb; for by this means the deformity is corrected, the joint kept at rest, and the pressure of the diseased surfaces in the joint upon one another relieved. Massage, which is admirably adapted for the treatment of many joint conditions, is not suited for tuberculous disease while it is still advancing. Constitutional treatment must be energetically carried out, just as in the case of consumption.

Heliotherapy, which was first applied in the treatment of tuberculous joints by Rollier at Leysin, Switzerland, about 1903, has in recent years attained great success. The patient's whole body is exposed to air and sun for several hours daily; a vegetable diet is administered; and the affected part is protected from too free movement, injury or deformity by simple apparatus, which does not prevent the free access of the sun's rays. Stiffness after recovery is to a large extent avoided, partly because the sunlight prevents wasting of the muscles, and partly because the simple apparatus used permits, during treatment, movements short of producing any pain. Most bones and joints recover under this treatment, with re-formation of normally shaped, healthy bone, even when the disease has advanced to the formation of an abscess or of sinuses. The period of treatment is, however, prolonged, lasting from one year for the wrist or ankle to two or three years for the hip or spine. Of all the systems of treatment, this leaves the joint most nearly in a normal state when the disease has disappeared. It can, however, be carried out only in places where there is a great amount of sunshine without much accompanying heat, as, for example, in the High Alps, both in summer and in winter. (*See* CONSUMPTION.)

Operative treatment is advisable for some tuberculous joints. The treatment in this respect varies considerably with the social position of the patient. Those who wish to recover speedily, who cannot afford the long inaction and costly environment necessary for a rest cure, and for whom a useful limb is essential, may find it desirable to undergo an operation when the disease becomes advanced. On the other hand, those who shrink from an operation, who prefer to pass through a tedious illness, and are willing to devote a large amount of attention to their cure, may generally rest assured that, under constitutional treatment, the majority even of discharging joints recover in course

of time. Frequently attempts are made to check the disease in the synovial membrane by the injection of iodoform emulsion into the joint cavity, but this method is not attended with great success. The general operation performed is excision, in which the joint cavity is opened up, the diseased ends of the bones removed, all diseased synovial membrane, sinuses, etc., scraped away, and the bones then firmly fixed in the case of the knee, or allowed to form a new joint in the case of the elbow. This operation is generally successful, if not delayed too long, in completely removing the disease and leaving the patient with a useful, albeit damaged, limb. When a person has been allowed to get very weak and appears to be possessed of little recuperative power, it is sometimes necessary to remove the limb.

STIFFNESS OF JOINTS may be due to various causes. It may result from spasm of the muscles around the joint in cases of early tuberculous disease and of hysterical joints, or it may be due to permanent shortening in these muscles or contraction of the skin, due, for example, to a burn. Often a severe injury to the joint itself, such as a fracture of one of the bones that form it, or a dislocation, is followed by some stiffness. A very large number of slight injuries, which set up a mild degree of inflammation, are followed by some adhesion in the joint, often of a painful nature. These limit the use of the joint considerably, but, when they are broken by forcible movements of the limb, recovery and relief are immediate.

LOOSE BODIES IN JOINTS result from inflammation of various types, the bodies being developed as projections on the synovial membrane or on the cartilages of the joint, and later pulled off by its movements. They bring on repeated attacks of synovitis, and often cause sudden locking of the joint, so that for a time it is immovable. They are removed by operation.

GOUT, RHEUMATISM, AND RHEUMATOID ARTHRITIS are diseases of a constitutional nature which affect joints. (See under these headings.)

HYSTERICAL AFFECTIONS OF JOINTS are not uncommon, particularly in young women, though they are occasionally found in the opposite sex.

The knee and hip are most often affected, but the ankle, wrist, and elbow are also liable. The affection takes many forms: stiffness, pain on movement, swelling, weakness, wasting of the limb may be complained of, and the appearances of tuberculous disease may be closely mimicked. As a rule there are no signs of general constitutional weakness, and, on the other hand, various other hysterical manifestations present themselves. (*See* HYSTERIA.) One important point about such joints is that, occasionally, commencing disease forms the basis for hysterical symptoms, and, though the condition is rightly ignored by friends and medical adviser at the time, organic disease may develop at a later date.

SPRAIN is a vague popular term indicating the result of any slight wrench to a joint. A sprain consists generally of a mild attack of synovitis, or of tearing of ligaments with effusion of blood into or round the joint. At the ankle, a twist of the foot inwards is followed by some tearing of the outer lateral ligament of the joint constituting a severe 'sprain', but a more serious accident, consisting of fracture at the lower end of the fibula, is apt to follow a wrench or twist of the foot outwards. (*See* FRACTURES.) In the knee, a sudden twist is occasionally responsible for loosening and rumpling up the inner of the two fibro-cartilages found in that joint. This accident has the awkward consequence of producing at subsequent times attacks of synovitis, or of sudden locking of the knee-joint. Behind the wrist and at the ankle, a sprain results sometimes in the displacement of some of the tendons which should be bound firmly to the bone, leading to occasional pain and a sense of weakness till the tendon happens to get replaced by another twist.

Treatment.—When a sprain is of inflammatory character, the treatment is of the nature described under Synovitis, and in the case of a bad sprain rest for a week or two may be essential. A sprain consisting in tearing of the ligaments round a joint, accompanied by effusion of blood beneath the skin, may be treated at the very beginning by applying wet compresses, or by holding the joint in a stream of cold water, which materially checks the effusion.

After some time has elapsed, this form of treatment is of little use, and compression by a moderately tight or by an elastic bandage over the injured joint, together with elevation of the limb, forms a better line of treatment. When the pain is severe, fomentations of lead and opium lotion give relief. (*See* GOULARD'S WATER.) Massage is of great assistance in cases of sprain to prevent stiffness of the affected joint and to aid repair of injured tissues.

DISLOCATION (*see* DISLOCATIONS).

BURSITIS frequently occurs over the region of a joint. The prominences of several joints are protected by large bursæ, and inflammation of these structures is sometimes mistaken for inflammation of the joint. (*See* BURSITIS.)

JUGULAR (*jugulum*, neck) is a general name for any structure in the neck, but is especially applied to three large veins, the anterior, exterior, and interior jugular veins, which convey blood from the head and neck regions to the interior of the chest.

JUNKET is the name of a food consisting of milk which has been acted upon by rennet. This forms a soft curd of the casein which is more easily digested than the curd which would naturally form in the stomach, and junket, therefore, forms a more easily digestible food than natural milk. If the curd is strained through muslin, whey is obtained which contains simply the water, sugar, and albuminous materials of the milk and is very easily digestible. It is therefore much used in the treatment of gastric ulcer and similar conditions. Half a pint of whey has an energy value of about 60 calories.

K

KALA-AZAR, or DUMDUM FEVER, is a chronic disease resembling malaria in its febrile symptoms and enlargement of the spleen, but differing from it in being very fatal, death usually ensuing within some months of the time when symptoms become marked. It is found especially in Assam and India and in various parts of Central and Northern Africa, and is caused by a minute parasite, *Leishmania donovani*, which infests the blood, spleen, liver and bone marrow. The parasite is supposed to be transmitted to man by the bite of a bed bug or of a mosquito, but probably more frequently by that of the minute fly *Phlebotomus argentipedes*.

Symptoms.—The symptoms of the disease are chiefly progressive anæmia with raised, irregular temperature and feverishness, wasting, dropsy and enlargement of the spleen and liver.

Treatment.—The disease is very fatal, but cases which are recognised at an early stage and undergo treatment sometimes recover, especially if transferred to a temperate climate. A form of treatment in vogue is the intravenous injection of tartar emetic or of one of the organic arsenic preparations allied to salvarsan, especially a preparation known as neostam. Great promise is held out by the experimental effect on *L. donovani* of the new chemotherapeutic drugs introduced in 1940—namely, the aromatic diamidines, of which diamidino-stilbene may be given as an example.

KAMALA, a red powder derived from the fruits of *Mallotus philippinensis*, is taken in doses of 1 or 2 drams in syrup or gruel in order to expel tape-worms.

KAOLIN, or CHINESE CLAY, is a smooth white powder consisting of natural white aluminium silicate resulting from the decomposition of minerals containing feldspar. It is used as a dusting powder for eczema and other forms of irritation in the skin. It is also used internally in cases of diarrhœa due to various causes such as ptomaine poisoning, dysentery, cholera, tuberculosis. The dose is from ½ to 2 ozs., best taken in water or milk before meals.

Talc, French chalk, and Fuller's earth are similar silicates.

Kaolin poultice, which is used for the relief of pneumonia and various skin conditions, contains kaolin, boric acid, glycerin and various aromatic substances.

KATA-THERMOMETER.—A thermometer which shows the rate of loss of heat, or cooling power, of the air. It is a spirit thermometer with a large bulb and marks on the stem at 95° F. and 100° F. The thermometer having been warmed up to above 100° F. is suspended in the air and the time taken in cooling from 100° F. to 95° F. is observed. Each instrument has marked on the stem a factor proportional to the total heat lost per square centimetre of the bulb in cooling from 95° F. to 100° F. Dividing this factor by the number of seconds taken to cool gives a figure called the ' cooling power '.

KEFIR (*see* KOUMISS).

KELOID (*see* CHELOID).

KERATIN (κέρας, horn) is the substance of which horn and the surface layer of the skin are composed.

KERATITIS (κέρας, horn) means inflammation of the cornea in front of the eye. (*See* EYE, DISEASES OF.)

KERATOMALACIA means softening of the cornea, as a result of a severe lack of vitamin A in the diet.

KERION (κηρίον, honeycomb) is the term applied to a suppurating form of ringworm.

KERNICTERUS.—The staining with bile of the basal nuclei of the brain, with toxic degeneration of the nerve cells, which sometimes occurs in ICTERUS GRAVIS NEONATORUM (*q.v.*).

KERNIG'S SIGN is a sign found in cases of meningitis, consisting in the fact that, whereas a healthy person's thigh can be bent to a right angle with the body when the knee is straight, in cases of meningitis the knee cannot be straightened when the thigh is thus bent, or intense pain is caused to the patient by doing so.

KEROCAIN (*see* NOVOCAIN).

KETOGENIC DIET is one containing such an excess of fats that acetone and other ketone bodies appear in the urine. It is used especially in the treatment of epilepsy and chronic infections of the urinary tract by the *bacillus coli*. In this diet, butter, cream, eggs, and fat meat are allowed, while sugar, bread, and other carbohydrates are cut out as far as possible.

KETONE is another name for acetone or dimethyl ketone. The term 'ketone bodies' is applied to a group of substances closely allied to acetone, especially β-hydroxybutyric acid and acetoacetic acid. These are produced in the body from imperfect oxidation of fats and protein foods and are found in specially large amount in bad cases of diabetes. KETONURIA is the term applied to the presence of these bodies in the urine.

KIDNEYS are a pair of glands situated close to the spine in the upper part

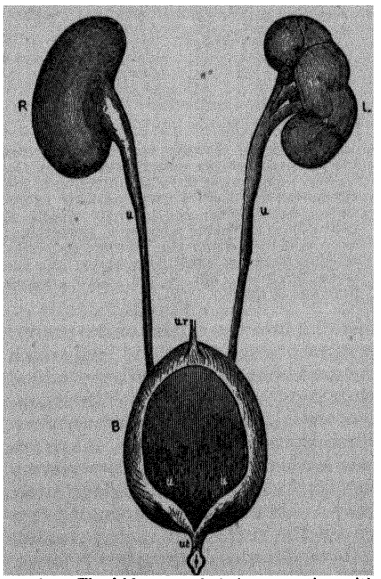


FIG. 281.—The kidneys and their connection with the exterior. *R*, The right, *L*, the left kidney; the left kidney is drawn with the fissures which sometimes divide its surface into lobules; *uu*, the ureters; *B*, the bladder, showing the openings of the ureters into its base; *ut*, commencement of the urethra; *ur*, urachus which attaches the bladder to the front of the abdomen. (Turner's *Anatomy*.)

of the abdomen. They are on a level with the last dorsal and upper two

lumbar vertebræ, and each is, to a great extent, covered behind by the twelfth rib of its own side. They are kept in this position by a quantity of fat and loose connective tissue, in which they are embedded, by the large vessels which

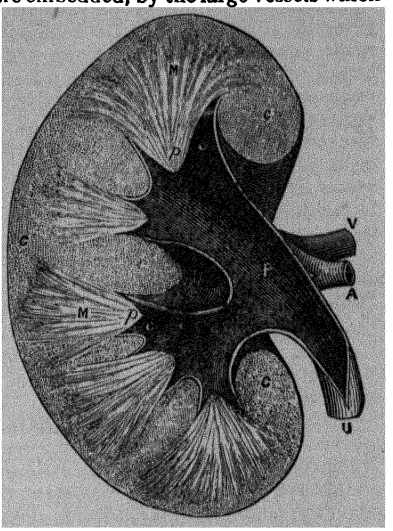


FIG. 282.—Vertical section through the kidney. *CCC*, The cortical part; *MM*, the medullary pyramids; *pp*, the papillæ; *cc*, the calices; *P*, the pelvis; *U*, ureter; *A*, renal artery; *V*, renal vein. (Turner's *Anatomy*.)

supply them with blood, by the peritoneal membrane stretched over their front surface, and largely by the pressure of the other abdominal organs against them.

Structure.—In size each is about 4 inches long, $2\frac{1}{2}$ inches wide, $1\frac{1}{2}$ inches thick, and weighs over 4 ounces. The size, however, varies a good deal with the development, and probably with the habits of the individual. The left kidney is slightly longer and narrower, and lies a trifle higher in the abdomen than the right.

The kidney in adult human beings presents a smooth exterior, though in early life, as in many animals, it is divided up into distinct lobes, corresponding to the pyramids found in the interior. Enveloping it is a tough fibrous coat, which, in the healthy state, is bound to the kidney only by loose fibrous tissues and by a few blood-vessels that pass between it and the kidney. This capsule, which does not permit of

much enlargement of the kidney, is an important factor with which to reckon when the kidney becomes congested in Bright's disease. The outer margin of the kidney is convex, the inner is concave, presenting a deep depression, known as the 'hilum', where the vessels enter its substance. At the hilum the renal vein lies in front of the renal artery, the former joining the inferior vena cava, and the latter springing from the aorta almost at a right angle. Here, too, the ureter, which conveys urine down to the bladder, is attached. The ureter is spread out into an expanded, funnel-like end, known as the 'pelvis', to which the capsule of the kidney is firmly attached, and which further divides into little funnels known as the 'calices'. On splitting open a kidney,

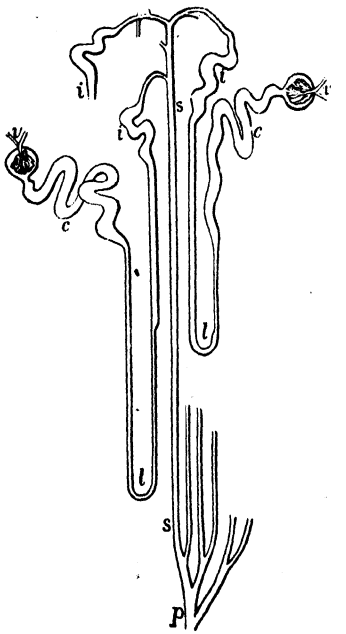


FIG. 283.—Diagram of the arrangement of the urinary tubules. *vv*, The vessels entering the glomeruli; *cc*, first convoluted tubules; *ll*, looped tubules with descending and ascending limb; *ii*, intermediary, or second convoluted tubules; *ss*, straight tubules collecting together at *p*, one of the papillæ of the kidney. (Turner's *Anatomy*.)

one finds it to consist of two distinct parts: a layer on the surface, about ¼ inch thick, known as the 'cortex', and a part towards the hilum known as the medulla. The latter consists of 'pyramids', arranged side by side, with their base on the cortex and their apex

FIG. 284.—Diagram showing the relation of the blood-vessels to the urinary tubules in the kidney. The arrows show the direction of the circulation and that of the urine after excretion. *aa*, Arteries and afferent vessels of glomerulus; *e*, efferent vessel from glomerulus; *cccc*, capillaries round the tubules; *vvv*, veins which collect the blood from them; *ggg*, are three glomeruli; *tttt*, is the tubule leading from one of them.

projecting into the calices of the ureter. The apex of each 'pyramid', of which there are about twelve in all, is studded with minute holes, which are the openings of the microscopic uriniferous tubes.

Each pyramid is in effect, taken together with the portion of cortex lying along its base, an independent little kidney. About a score of small tubes open on the surface of each pyramid, and these, if traced up into its substance, divide again and again so as to form bundles of tubes, known as medullary rays, passing up towards the cortex. If one of these be traced still farther back, it is found, after a very tortuous course, to end in a small rounded body, the 'Malpighian corpuscle' or 'glomerulus'.

If the blood-vessels now be traced through the kidney their course is found to be as follows. The renal artery splits

up into branches, which form arches at the line of junction of cortex and medulla, and from these again spring vessels that run up through the cortex, giving off small branches in every direction. Each of these last ends in a little tuft of capillaries enclosed in a capsule (Bowman's capsule), that forms the end of the uriniferous tube above described, and capillaries with capsule are known as a 'glomerulus'. The blood, after circulating in the glomerulus, emerges by a small vein, which again splits up into capillaries on the walls of the uriniferous tubes. From these it is collected finally into the renal veins and by them leaves the kidney. By means of the double circulation, first through the glomerulus and then around the tube, it comes to pass that a large amount of fluid is removed from the blood in the glomerulus, and then the concentrated blood passes on to the uriniferous tube for removal of parts of its solid contents. Other straight arteries come off from the arches above mentioned and supply the medulla direct, the blood from these passing through another set of capillaries and also finally into the renal veins. Though the circulation just described is confined entirely to the kidney, it has certain small connections both by arteries and veins which pass through the capsule and join the lumbar vessels communicating direct with the aorta. These connections are of importance in kidney disease, because through them the kidney circulation can be relieved by applications to the loins.

Function. — The chief function of the kidneys is to separate fluid and certain solids from the blood. Cushny's 'modern theory' is in the main accepted as an explanation how this is done. Briefly, the glomeruli filter from the blood the non-protein portion of the plasma. As this filtrate passes through the convoluted tubules varying parts of it are reabsorbed. It is estimated that in 24 hours the total human glomeruli will filter between 150 and 200 litres, 99 per cent of which is reabsorbed by the tubules. The constituents of the filtrate may be grouped according to the extent to which they are reabsorbed by the tubules: (1) substances actively reabsorbed, such as amino-acids, glucose, sodium, potassium, calcium, magnesium, and chlorine; (2) substances passing through the tubular epithelium by a simple process of diffusion when their concentration in the filtrate exceeds that in the plasma, such as urea, uric acid, phosphates; (3) substances not returned to the blood from the tubular fluid—*e.g.* creatine.

When the kidneys are diseased and the number of glomeruli and tubules decreased in consequence, this alternating action is not so readily carried out, and therefore the work of the diseased kidney becomes much embarrassed. When the blood-vessels of the kidney are partially closed by disease (arteriosclerosis), the general blood-pressure rises with the object of forcing more blood through the kidneys; and, in consequence, marked changes are produced upon the heart in this type of renal disease.

When the kidneys fail to act, these solid waste substances accumulate in the blood. The general 'poisoning' resulting from failure of renal function produces the clinical condition known as uræmia. This is not due to the action of retained nitrogenous products such as urea, uric acid, creatinine, but to, it is believed, putrefactive products absorbed from the intestine, especially phenols, which exert their ill effect owing to the failure of the defective liver to detoxicate them.

KIDNEY DISEASES.—The kidneys, being deeply buried in the abdomen, give little direct sign even when seriously diseased, though many of the effects upon the general constitution are sufficiently marked and serious.

General symptoms.—The following are some of the general symptoms common to various types of kidney disease.

PAIN, of an aching nature, situated high up in the loins, is occasionally a symptom of inflammation of the kidneys, but pain in the lower part of the back is found in so many other diseases, and is so generally absent in serious kidney affections, that it is of little importance as a symptom. When a stone lodges in the ureter, however, there is a very definite type of pain known as 'renal colic'. This pain is of an agonising nature, shoots down from the kidney region to the groin, and usually appears

KIDNEY DISEASES

with great suddenness. Also, when a kidney becomes movable and approaches the front of the abdomen, direct pressure upon it causes a sickening sensation of a peculiar type, quite different from ordinary tenderness.

WASTING and general ill-health are prominent symptoms of diseases which cause much destruction of the substance of the kidney, and sometimes a state of bad health, which has lasted for long, is found to be attributable to chronic and advanced kidney disease, which has given no sign till careful examination reveals its presence. The digestive and other internal organs are impaired also, and give rise to various complaints, while the resisting power of the body to disease becomes so much lowered that the victims of kidney disease fall a much readier prey to infectious maladies than do healthy people.

The URINE almost invariably shows changes in kidney diseases. In acute conditions it is diminished, generally contains albumin, and may be bloody. When unusual material is present in the kidney, careful examination of the urine generally discovers traces of it in this excretion; for example, pus in the urine points to a suppurative condition situated somewhere in the urinary tract; and when a stone is present in the kidney, its nature may often be conjectured by an examination of the crystalline deposit in the urine. In chronic Bright's disease, the urine is generally increased in amount, pale, and, as a rule, contains greater or less amounts of albumin. (*See* ALBUMINURIA.)

DROPSY, though due to many other conditions than Bright's disease, is a most important symptom of this and other kidney troubles. When dependent upon some defect in the kidneys, it appears generally in the morning after sleep, and affects the loose tissues of the body, like the skin beneath the eyes, and that on the back of the hands, which become swollen and puffy.

CHANGES IN THE CIRCULATION take place in chronic kidney disease. The signs of thickening in the arteries and in the heart-wall afford to the physician one of the most important signs both of the presence and of the severity of Bright's disease. These changes produce pain in the chest, loss of mental power, bloodlessness, impairment of vision, and very frequently lead to apoplexy.

URÆMIA is a condition which is present in all cases where the function of the kidneys is seriously impaired. It is a general poisoning of the system by waste products which the kidneys have failed to excrete, and may be acute or chronic in type. (*See* URÆMIA.)

The most important class of diseases affecting the kidneys is that comprising the changes grouped together as Bright's disease, in which albumin is excreted in the urine and dropsy is very often present. (*See* BRIGHT'S DISEASE.) The following are some of the other important affections of the kidney.

GRAVEL and STONE are produced by the deposit in the urinary passages of solid substances which are naturally present in the urine, and whose deposition depends upon their presence in excessive amount, or upon the failure of some condition which in general keeps them in solution. The commonest crystalline deposits are of three sorts: (*a*) urates and uric acid; (*b*) oxalates; (*c*) phosphates.

(*a*) Urates are naturally present in the urine in large amounts, but remain dissolved, unless under the following conditions they are thrown down or converted into uric acid. This is apt to occur if the urine be very acid (*see* ACIDITY), or if it be poor in salts, as in people who live too entirely upon rice and similar diet, or if it be very pale in colour from lack of urinary pigment, or, finally, if the diet be very rich in animal food. (*b*) Oxalate of lime is contained in most vegetable foods, and it may possibly be derived from uric acid also. The presence of an excessive amount in the urine is often associated with the condition of dyspepsia, melancholy, etc., known as 'hypochondriasis'. (*c*) Phosphates are seldom deposited in the kidney unless the urine is alkaline and decomposing; and therefore gravel and stones of this substance are found, as a rule, only with serious suppurative conditions of the kidney, and are of little importance compared with the condition leading to their formation. In cases where the presence of a stone is suspected, X-ray examination is an important procedure in diagnosis.

Treatment.—When attacks of renal colic, blood in the urine, etc., have led

to the supposition that a stone is forming in the pelvis of the kidney, it is usual, in addition to any surgical means which may be taken with the object of removing the stone, to treat the patient with a view to diminishing its size if possible, and, at all events, to preventing the formation of other stones. When the stone is of uratic nature, the general treatment, mentioned under ACIDITY, is adopted; larger quantities of common salt and other salines are taken; the bowels and liver are regularly stimulated to action, and foods of a highly albuminous nature are diminished. When the stone is oxalic, careful attention is paid to the digestive organs, but such a stone will not dissolve. When the stone is phosphatic the condition causing its formation must be treated.

SUPPURATION within the kidney either follows upon suppuration in the lower urinary passages, spreading upwards from the bladder by way of the ureters, or infection may be carried by the blood-stream to the kidney from this or other regions. It is not of such frequent occurrence now as it was in the days before the use of antiseptics, when it went by the name of 'surgical kidney', owing to the frequency with which this condition followed surgical operations on the urinary tract. The symptoms are much the same as those of inflammation in the bladder (*see* BLADDER, DISEASES OF), with, in addition, pain in the loins, a hectic temperature, and shivering fits or 'rigors'.

Treatment.—The condition is very serious, and is apt to end in death. Urotropin, ammonium benzoate, and sulphanilamide are administered internally with the view of purifying the urine. If the person be strong enough to stand the operation, an opening is made into the kidney through the loins, and the suppurating cavity either drained, or the whole kidney removed.

TUBERCULOSIS also is frequently secondary to tuberculous disease of the testicle or bladder, and the disease advances slowly, giving but little sign of its presence. It is treated by the general regimen for cases of tuberculosis in other parts, viz. good food, rest, and fresh air. When it is evident from pus in the urine, a swelling in the abdomen, and other signs, that the kidney disease is advancing, excision of the kidney is the only operative measure which promises much success. Since, in a certain number of cases, both kidneys are diseased, the surgeon often examines the bladder by means of the cystoscope and passes a fine catheter along this instrument, up each ureter into the kidney. He thus draws off the urine from each kidney separately. By this means, combined with the injection of dye which is excreted by the kidneys, the surgeon can tell to what extent each is active, and whether he may safely remove one of them.

MOVABLE KIDNEY is commoner in women than in men and probably less common in the thirties and forties of the twentieth century than at the beginning. The undue mobility of the kidney is part of a general visceroptosis, and treatment should be directed to this. One risk of an abnormally mobile kidney is hydronephrosis from kinking of the ureter. Occasional kinking of the ureter may cause what are known as 'Dietl's crises'—sudden attacks of intense abdominal pain radiating down the ureter, shivering, nausea, vomiting, fever, collapse. They are not common. If hydronephrosis develops, operation may be necessary.

INJURIES OF THE KIDNEY are very serious, though one of these organs may be completely shattered without a necessarily fatal result if the other kidney be healthy and uninjured. The kidney may be ruptured by a blow in the small of the back or when a person is run over, and death may result from the consequent loss of blood, which may appear in the urine.

TUMORS of the kidney are not common, and, as a rule, they give little or no trouble till they have reached a large size. In the case of tumors growing in the pelvis of the ureter, large quantities of blood may be passed now and then in the urine with, however, no pain or other symptom referable to the kidney. Congenital cystic kidney is a form of tumor in the kidney which may last for many years with little trouble to the person in whom it occurs. Hypernephroma is a form of destructive tumor that occasionally develops in the kidney, being composed of cells resembling the suprarenal gland in appearance.

KINÆSTHETIC SENSATIONS is the descriptive term for those sensations which underlie tension and position of joint and muscle. These sensations send impulses along nerves to the brain, and thus inform it of the position of the limb in space and of the relative position to each other of individual muscles and muscle-groups and of joints.

KING'S EVIL is a popular name for scrofula, which was in olden times supposed to be curable by the touch of the royal hand. (*See* CONSUMPTION *and* SCROFULA.)

KINO is the dried juice of the *Pterocarpus marsupium*, an Indian tree. It contains an astringent principle, and its powder is useful in the treatment of diarrhœa, the tincture being also used as a gargle for relaxed throat.

KLEPTOMANIA is a psychological disorder in which the person afflicted has an irresistible compulsion to steal things, without necessarily having any need for the object stolen.

KNEE is the joint formed by the femur, tibia, and patella. It belongs to the class of hinge-joints, though the movements that take place are much more complex than the simple motion of a hinge, the condyles of the femur partly rolling, partly sliding over the flat surfaces on the upper end of the tibia, and the acts of straightening and of bending the limb being finished and begun respectively by a certain amount of rotation. The cavity of the joint is very intricate, and it consists really of three joints fused into one, but separated in part by ligaments and folds of the synovial membrane. The ligaments which bind the bones together are extremely strong, and include the internal and the external lateral ligaments, a weak posterior ligament, a very strong patellar ligament uniting the patella to the front of the tibia, two crucial ligaments in the interior of the joint, and two fibro-cartilages which are interposed between the surfaces of tibia and femur at their edge.

All these structures give to the knee-joint a great degree of strength, so that it is very seldom dislocated. Its exposed position and the intricacy and consequent difficulty in cleansing its cavity, render this joint liable to be wounded, and make wounds of it very serious. The knee is also often affected by tuberculous disease. A comparatively slight but very troublesome condition frequently found in the knee consists of the loosening of one of the fibro-cartilages lying at the head of the tibia, especially of that on the inner side of the joint. The cartilage may either be loosened from its attachment and tend to slip beyond the edges of the bones, or it may become folded on itself. In either case, it tends to cause locking of the joint when sudden movements are made. This causes temporary inability to use the joint until the cartilage is replaced by forcible straightening, and

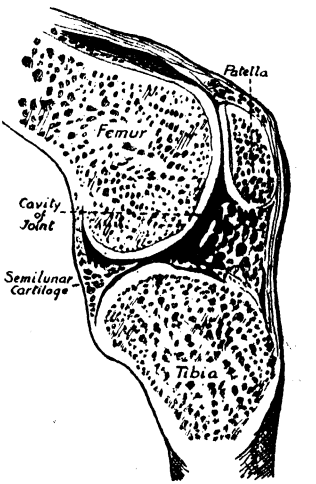


FIG. 285.—Vertical section of knee-joint.

the accident is apt to be followed by an attack of synovitis, which may last some weeks, causing a certain amount of lameness with pain and tenderness especially felt at a point on the inner side of the knee. This condition can be relieved by wearing for a prolonged period of some months a bandage with pad or knee-truss which presses upon the inner side of the joint, or it may be more quickly remedied by an operation to remove the loose portion of the cartilage. (*See* JOINTS, DISEASES OF.)

KNEE JERK (*see* REFLEX ACTION).

KNOCK-KNEE, or GENU VALGUM, is a deformity of the lower limbs in such a direction that when the limbs are straightened the legs diverge from one

another. As a result, in walking, the knees knock against each other. Sometimes one knee only is affected, more commonly both, or sometimes one knee is bent in, the other bent out.

Causes.—Sometimes the deformity results in young children from rickets, occasionally it comes on a little later in life associated with flat-foot, as the result of excessive standing or hard work in weak, under-fed persons. The internal ligament stretches, and the inner condyle of the femur increases greatly in length as the chief part of the weight in standing is borne by the outer side of the bones.

Treatment.—In early life the child should be kept off his feet, a splint applied to the leg, and the condition of rickets treated, if present. In older patients, an operation is necessary, consisting in the division of the femur from the inner side with a chisel, in such a way as to render the inner condyle less prominent, after which the broken bone is carefully set, so that when union takes place the limb is straight.

KOILONYCHIA is the term applied to nails that are hollow and depressed like a spoon, a condition sometimes associated with chronic anæmia in women.

KOLA is the nut of *Kola acuminata*, a tree growing in various parts of Africa. It contains caffeine, upon which its action mainly depends, and also an astringent principle. Its action is a stimulating one, almost identical with that of tea or coffee (*see* COFFEE), and it is often prescribed in cases of debility.

KOPLIK'S SPOTS are bluish-white spots appearing on the mucous membrane of the mouth in cases of measles about the third day, and forming the first part of the rash in this disease.

KORSAKOF'S SYNDROME is a term applied to a form of mental disturbance occurring in chronic alcoholism and other toxic states, such as uræmia, lead poisoning, cerebral syphilis. Its special features are talkativeness with delusions in regard to time and place, the patient, although clear in other matters, imagining that he has recently made journeys or been in distant places.

KOUMISS, or KEFIR, is a beverage made originally among the Kalmucks by fermenting mares' milk. It may be prepared from other kinds of milk also, and forms a stimulating and refreshing food which is sometimes better borne in weak states of the stomach than any other food. A home-made form of koumiss may be prepared as follows: mix 2 pints of buttermilk thoroughly with 3 pints of sweet milk, and add five lumps of white sugar. Place the milk in a bowl, covered with a towel, and let it stand in some warm corner of the kitchen for twenty-four hours. Then pour it into small bottles, cork them, and tie down the corks. Leave the bottles in the kitchen for three days, shaking occasionally. After this the koumiss is ready for use and should be kept in a cool place.

KRAMERIA (*see* RHATANY).

KREATINE and KREATININE (*κρέας*, flesh) are two substances closely allied in chemical composition and derivable from meat. (*See* CREATINE.)

KÜMMELL'S DISEASE is the description of a condition resulting from undiagnosed 'crush fracture' of a vertebra, due to injury. The patient complains of backache, persistent rigidity of the spine, and deformity.

KUPFFER CELLS are the star-shaped cells present in the blood-sinuses of the liver. They form part of the reticulo-endothelial system and are to a large extent responsible for the breakdown of hæmoglobin into the bile pigments.

KYPHOSIS (*κυφός*, bent) is the term applied to curvature of the spine in which the concavity of the curve is directed forwards. (*See* SPINE, DISEASES OF.)

L

LABIUM is the Latin word for a lip or lip-shaped organ.

LABOUR, or PARTURITION (*parturio*, I bring forth), often popularly spoken of as the 'confinement', is the act of bringing forth young, and forms the end of the period of gestation or pregnancy during which the new individual is nourished from the maternal body. Parturition is a comparatively easy matter in lower animals and amongst savage races. In the former the ease is dependent mainly upon the size and shape of the pelvic bones. In the latter this element is of course not present, but, apart from purely anatomical differences, there is evidence that the higher we pass in the scale of civilisation, the more difficult and more liable to be attended by serious complications does the act of parturition become.

It is difficult to define an absolutely *normal labour* because individual labours differ so much in small details. Generally speaking, however, a 'normal' labour is one in which the vertex of the child's head is born first, and the whole process ends favourably to mother and child within twenty-four hours, and without any operative interference. In the case of a first baby the confinement usually lasts from fifteen to twenty hours, while the births of second and subsequent children tend to become progressively shorter processes. There are, of course, considerable variations in individual cases from these general statements. The majority of confinements end between midnight and 6 A.M. In 96 per cent of all cases the vertex of the child's head 'presents' (that is, leaves the womb and descends through the vagina to the exterior first). In some cases, owing to a faulty position of the head or to the presentation of the child's face, the labour is considerably delayed, while for various reasons operative assistance may be necessary, in which case the labour is known as an 'instrumental' one. The child may present quite another part than the head, the second most frequent presentation being the breech. A rarer and more serious presentation is a 'transverse presentation' or cross-birth, where the child lies obliquely across the womb. In these cases skilled assistance is specially necessary for the sake of both mother and child, and in the latter case assistance is imperative if the mother's life is to be saved. Finally, various complications, such as deformities of the mother and child, an excessive amount of bleeding, the birth of twins, and various general conditions of the mother, such as heart or kidney disease, convulsions, etc., may influence the progress of the labour to an extreme degree.

Stages of labour.—The process of labour is naturally divided into three stages. The *first stage* is that of dilatation of the neck of the womb to permit of the subsequent descent of the child. This is ushered in by the onset of the 'pains' caused by the powerful intermittent contractions of the muscular wall of the womb. At first the pains come at considerable intervals—ten to twenty minutes—but as time passes the intervals become shorter and the pains become stronger. This stage is much the longest but is at the same time the least liable to complications or dangers to either mother or child. It is sometimes accompanied by sickness and vomiting which are on the whole favourable in so far as they tend to shorten the first stage. The full dilatation of the mouth of the womb is usually accompanied by the rupture of the amnion, the membrane containing the fluid in which the fœtus moves, and the sudden escape of the amniotic fluid or 'waters'. The two events, however, do not necessarily take place at the same time, and sometimes the amnion ruptures at a much earlier, and sometimes at a later period.

The *second stage* is the stage of expulsion of the child, during which the child's head, followed by the body and limbs, descends through the bony girdle of the pelvis and passes down through the vagina to the exterior. This process usually occupies three or four hours in a first labour, but, in the case of a woman who has had several children before, it may occupy a much shorter time. During its passage through the

pelvis, the child's head goes through certain movements by which it adapts itself to the alterations in the shape of the pelvic canal as it passes down. The size of the head of an average child is such that there is just room for it to pass through the pelvis and no more. Accordingly the head is liable to be considerably pressed upon during this stage of labour, and this pressure manifests itself in the 'moulding' of the child's skull. This moulding, which is rendered possible by the softness of the bones and by the presence of spaces between the bones, is a valuable provision of nature, and enables the head to pass down with the minimum of damage to the child and to the mother. In most cases the moulding disappears in the first day or two after birth, but in extreme cases, where the labour has been long and difficult, some degree of moulding may persist throughout life. The second stage is one of strenuous muscular exertion, as not only the muscular wall of the womb, but the abdominal muscles and the diaphragm are all involuntarily called into play to aid the expulsion of the child. Pains are more severe, but at the same time the patient has a consciousness that she is making progress and this sometimes makes them more easily tolerated than the pains of the first stage. It is towards the end of the second stage that an anæsthetic usually administered, the actual birth of the head being the time of greatest agony. Immediately thereafter there is a pause for a moment or two, and then the child's body is born, thus completing the second stage of labour. As soon as it is born the child usually cries loudly and in doing so establishes the function of respiration. The tying and cutting of the umbilical cord (*see* AFTERBIRTH) finally sever the child's vital connection with its mother. The *third stage* is the stage of delivery of the afterbirth. It begins immediately the child is born and rarely lasts more than half an hour. It is associated with the loss of a certain amount of blood, but this is not usually more than about 25 oz. or thereby. The great danger is from excessive hæmorrhage associated with the separation of the afterbirth from the wall of the womb, and although the stage is much the shortest, yet this danger makes it imperative that it should be conducted with the greatest care.

Management of labour. — In the absence of skilled assistance a normal labour will in all probability conduct itself to a successful issue, but it is always desirable that trained assistance should be obtained, both for the comfort as well as for the safety of the mother and the child. Obstetrical complications have a habit of arising suddenly and sometimes unexpectedly.

Where trained assistance is not at once available the untrained person can still do much to help the prospective mother. As soon as the labour begins the patient should, if possible, have the lower bowel washed out with a soap and water enema, and if there is time it is advisable for the patient to have a warm bath, or at least to have the genital regions thoroughly washed with soap and water. The bed upon which she is to be delivered should be prepared with a mackintosh sheet if possible, or failing that, one or two sheets of glazed brown paper, placed across the middle of the bed and drawn well over the right-hand edge of it. A draw-sheet should be placed over this which can be changed afterwards. The clothing for the infant should be hung before the fire to be aired and warmed, and provision should be made for an ample supply of hot water and clean basins for the doctor or nurse who should have been sent for. Ligatures should be prepared for tying the umbilical cord and these are best made of 3-ply linen thread twisted together and knotted at the ends so as to form a ligature of about ten inches in length. Two of these are required, and should be sterilised by being boiled. The patient may with advantage remain up, either sitting or moving about her room as may be most comfortable for her, during the first stage; but when she feels fatigued and desires to lie down, and in any case when the membranes rupture and the 'waters' escape, she should lie down on the bed on her left side. During the second stage the patient will tend involuntarily to hold her breath and press down during the pains, and this 'down-bearing', as it is called, is helpful and should be encouraged, as it will expedite delivery. It is a mistake to urge a woman to bear down during the first stage, as it does no good

and merely exhausts her strength. It helps the patient to be given something to hold on to during the down-bearing pains of the second stage, and it is a customary thing to tie a roller towel to the head of the bed and give her that to pull upon. This enables her to fix her abdominal muscles and to use her strength to the greatest advantage. As soon as the child's head is born its eyes should be gently wiped clean with a little pledget of cotton wool or a clean soft linen handkerchief moistened in clean boiled water. After the child is born the cord should not be ligatured for two or three minutes until the pulsation in it is beginning to cease. One of the linen ligatures should then be tied tightly round the umbilical cord at a distance of about two inches from the child's navel. The other should be applied a few inches nearer the mother. With a clean pair of scissors which has been boiled, the cord should then be divided between the two ligatures. It is essential to make sure that there is no bleeding from the child's end of the cut umbilical cord. The infant should then be wrapped in a soft flannel or shawl and laid aside in some warm place until arrangements can be made for bathing it. After the delivery of the child there will be an interval of some minutes before the uterine contractions start once more, and as a rule only a few contractions are needed to bring about the expulsion of the afterbirth or placenta. This should be placed in a basin with some clean water and kept for inspection by the doctor or nurse. All that now remains to be done is to clean the patient by gently swabbing her with pledgets of cotton-wool wrung out of clean boiled water, the hands of anybody who comes in contact with the patient having been previously most carefully and scrupulously scrubbed. A clean pad of cotton-wool, preferably scorched in front of a hot fire to sterilise it, should then be placed over the genitals and a firm binder drawn round the hips and over the lower part of the abdomen. A clean bolster slip serves this purpose admirably. After the confinement is over, the patient should be encouraged to sleep, or at least to rest quietly, and anything in the nature of excitement is to be avoided. For this reason friends and neighbours should as far as possible be excluded until the patient has had a good sleep.

Abnormalities and dangers of labour.—These may arise in connection with the presentation or position of the child, with the uterus or maternal pelvis, or from the general conditions of the mother's health. ABNORMAL PRESENTATIONS are relatively uncommon. The most frequent is a *breech presentation* (3½ per cent of all labours). Here the labour is apt to be slow, but while there should be no increased risk to the mother (unless the labour happens to be a first labour), there is considerably greater danger to the child. Skilled assistance should always be obtained, but in the absence thereof the labour should be allowed to conduct itself without interference, until the lower limbs are born. These should then be wrapped in a warm flannel and gently supported, while steady pressure is applied to the top of the womb through the mother's abdominal wall. The after-coming head is thus gently pressed down into and through the pelvis. The main risk to the child is pressure on the umbilical cord during this stage, as it lies between the head of the child and the hard bony pelvis. If this pressure is sufficient to impede the child's circulation for more than 8 or 10 minutes, the probability is that the child will be suffocated before it is born. (It must be understood that until the head is born, the child obtains the necessary oxygen by interchanges taking place between its blood and the blood of the mother in the placenta or afterbirth, and that pressure on the cord prevents the passage of the fœtal blood between the body of the fœtus and the placenta.)

Face presentations occur but seldom (0·4 per cent of all labours). Usually the mother is able to deliver herself after a prolonged and tedious labour. The outlook is tolerably good for the child and should be satisfactory for the mother. There are, however, possibilities of serious danger, and medical help should always be sought.

The most dangerous mal-presentation is a '*cross-birth*', where the child lies across the womb and the pelvis. None but an extremely premature child can be born in this position. If the

condition is not corrected, the womb goes on trying to expel the child until it either becomes utterly exhausted and ceases to contract, or else it ruptures. In the former event, sufficient time may be gained before the womb starts to contract again in which to obtain skilled assistance to change the position of the child. In this way the mother's life may be saved, although the child will almost certainly have succumbed. In the second event, the shock and internal bleeding from the ruptured womb involve very grave risk to the mother's life, and delivery is impossible except by skilled assistance.

DEFORMITIES AND CONTRACTIONS of the mother's pelvis create great difficulty and may make natural labour impossible. The pelvis of every woman pregnant for the first time should be measured by a medical practitioner prior to labour, with a view to the exclusion of any such possibility. Sometimes labour has to be induced early in these cases; in others, operative delivery at full time has to be arranged.

HÆMORRHAGE during the last three months of pregnancy, or during labour, is always fraught with serious possibilities. It is due to the premature detachment of some portion of the placenta, which in many cases is situated too low down in the womb (*placenta prævia*). In the absence of skilled assistance, all that can be done is to keep the patient quite quiet in bed with the head low. No alcoholic stimulants should be given.

Bleeding during the third stage of labour or immediately after (*post partum hæmorrhage*) can be alarming and even fatal. In the absence of skilled assistance, an attempt should be made to compress the womb forcibly by grasping it through the abdominal muscles. The foot of the bed may with advantage be raised and the patient provided with ample fresh air. Again no alcoholic stimulants should be given, as these only serve to increase the bleeding. Very hot applications to the vulva may help, and the doctor or nurse may administer a hot vaginal douche. (*See* DOUCHE.)

CONVULSIONS in association with pregnancy or labour, or occurring immediately after labour (*eclampsia*), constitute one of the most grave complications. Medical advice should be obtained without fail, and in the absence of such, the patient should be kept absolutely quiet in a darkened room, surrounded with blankets and hot-water bottles to stimulate the action of the sweat glands. The bowel should be washed out thoroughly with repeated enemata of plain warm water, and if the patient is conscious and able to swallow, liberal doses of purgative medicine should be given. No food either solid or liquid should be given. The actual convulsion should be treated on the ordinary lines, and if labour ensues, it also should be treated on the ordinary lines. (*See* ECLAMPSIA.)

PUERPERAL INFECTION is the most frequent and one of the most serious complications of labour. This is in essence the same as the infection of a wound, there being always a large raw surface in the interior of the uterus (the placental site), and in most cases innumerable small lacerations of the birth canal. All or any of these may be invaded by bacteria which subsequently tend to invade the blood-stream of the mother and give rise to acute septicæmia. About half the puerperal infections are due to the hæmolytic streptococcus and about half to other organisms. The hæmolytic streptococcus reaches the genital tract from the doctor, nurse, or midwife, from one of the patient's own household, or from the patient's own nasopharynx. The swabbing of throats, the exclusion from the patient's presence of streptococcal carriers and of anyone with a cold or sore throat, strict aseptic precautions during labour, will all help to diminish the incidence of hæmolytic streptococcal puerperal infections. If infection occurs in spite of all precautions then the sulphonamide drugs and penicillin are at hand as sovereign remedies. (*See* PUERPERAL FEVER.)

LACRIMAL (*lacrima*, a tear) apparatus is the arrangement attached to the eye for moistening and cleansing the front of this organ. (*See* EYE.)

LACTATION (*lac*, milk) is the period during which an infant is suckled on the mother's breast. (*See* BREASTS, DISEASES OF, INFANT-FEEDING.)

LACTIC ACID (*lac*, milk) is a colourless, syrupy, sour liquid, which is pro-

duced by the action of a bacterium upon the sugar of milk. The growth of this organism and consequent formation of lactic acid causes the souring of milk, and the same change takes place to a limited extent when food is long retained in the stomach.

Lactic acid (CH_3. CHOH . COOH) is produced in the body during muscular activity, the lactic acid being derived from the breakdown of glycogen. Muscle fatigue is associated with an accumulation of lactic acid in the muscle. Recovery follows when enough oxygen gets to the muscle, part of the lactic acid being oxidised and most of it then being built up once more into glycogen.

LACTIC ACID BACILLI have been introduced by Metchnikoff to prepare milk as a special article of diet, similar to koumiss. The bacilli, which are issued in various forms, as tablets, in fluid, etc., are added to fresh milk, allowed to act upon it in a warm place for several hours (according to the degree of sourness desired), and the milk is then consumed with the active bacilli. These, after a course of such treatment, come to replace the bacteria naturally found in the intestines, and are supposed to be less injurious to the system. Sour milk forms a healthy article of diet; and the bacilli, which are harmless, have, in some cases of intestinal disease or of rheumatism, a highly beneficial action. Buttermilk has a similar effect.

LACTOFLAVIN(E) is now usually called RIBOFLAVIN (*q.v.*).

LACTOMETER is the name of an instrument for ascertaining the specific gravity of milk.

LACTOSE is the official name for sugar of milk. (*See* SUGAR.)

LACUNA (*lacuna*) means a small pit or depression. Lacunar tonsillitis is a form of inflammation of the tonsils. (*See* TONSILLITIS.)

LAGOPHTHALMOS is the term describing the condition in which the eye cannot be completely closed.

LAMBLIA is the name of a genus of parasitic organisms found in the intestine, which are probably harmless but are sometimes blamed for causing diarrhœa.

LAMELLA is a small disc of glycerin jelly, ¼ inch in diameter, containing an active drug for application to the eye. It is applied by inserting behind the lower lid. The four official lamellæ are those containing atropine, cocaine, homatropine, and physostigmine.

LAMENESS (*see* GAIT *and* JOINTS, DISEASES OF).

LAMINECTOMY is the term applied to an operation in which the arches of one or more vertebræ are removed so as to expose a portion of the spinal cord for removal of a tumor, relief of pressure due to a fracture, or similar reason.

LANOLIN is a fat derived from the wool of the common sheep. It is much used for ointments because it does not become rancid, and because it is supposed to have a special power of penetrating the skin. It is very sticky, and for use is mixed generally with an equal quantity of vaseline to make it softer. Lanolin also possesses the valuable property of being able to mix with and absorb water to a considerable extent.

LAPAROTOMY (λαπάρα, the flank; τομή, an operation) is a general term applied to any operation in which the abdominal cavity is opened.

LARCH BARK is an astringent, and is used in the form of tincture of larch, both in chronic bronchitis and in bleeding from the lungs, in doses of 20 or 30 drops.

LARDACEOUS DISEASE (*lardum*, bacon) is another name for waxy disease.

LARYNGISMUS STRIDULUS, or SPASMODIC CROUP (λάρυγξ, the windpipe; *stridor*, noise), is a spasmodic condition peculiar to children, in which great difficulty of breathing, accompanied by a crowing noise, comes on as the result of partial closure of the larynx. The children affected by it are generally not in the best of health, and may be suffering from rickets, teething, worms, or similar irritative disorders. The attack may come on at any time during the day, or even during sleep; and the spasm may amount only to difficulty of breathing or the stoppage may be almost complete.

Treatment is similar to that for croup. (*See* CROUP.)

LARYNGITIS (λάρυγξ, the windpipe) means inflammation of the larynx. (*See* THROAT, DISEASES OF, *and* CLERGYMAN'S SORE THROAT.)

LARYNGOFISSURE is the term applied to the operation of cutting the thyroid cartilage or Adam's apple down the middle in order to get access to the larynx, for example, in operating on cancer of the larynx.

LARYNGOLOGY is that branch of medical science which is concerned with disorders and diseases of the larynx and those parts of the respiratory tract immediately above and below it.

LARYNGOSCOPE (λάρυγξ, the windpipe; σκοπέω, I examine) is an instrument introduced by Signor Manuel Garcia, a London teacher of singing, about the middle of the nineteenth century, and first used for medical purposes by Türck and Czermak about 1858. The essential parts of the laryngoscope are a small mirror set upon a long stem at an angle of about 120°, for introduction into the back of the patient's throat, and a source of bright light placed close to the observer's eye. The light is most conveniently got from a lamp placed by the side of the patient's head; the beam from this lamp is reflected by a mirror attached to a forehead-band or spectacle frame worn by the observer. Or the light may proceed from a small electric lamp directly attached to the observer's forehead. For the uses of the instrument, and the appearances observed by its help, see Figs. 286, 287, 288, 289, and 290, and THROAT DISEASES.

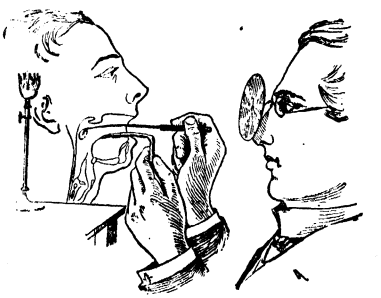


FIG. 286.—Arrangements for obtaining a view of the larynx by the laryngoscope. (After Bennett.)

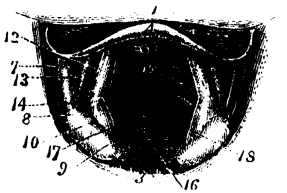


FIG. 287.—View of the larynx with the larnygoscope during the taking of a deep breath. The figures in this and the following three figures indicate structures as follows: 1, base of tongue; 2, back wall of throat; 3, entrance to the gullet; 4, epiglottis; 5, arytenoid cartilages; 6, cushion of the epiglottis; 7, aryteno-epiglottic ligament; 8, 9, cartilages of Wrisberg and Santorini above the arytenoid cartilage; 10, intervening tubercle; 11, vocal process of arytenoid cartilage; 12, true vocal cord; 13, false vocal cords; 14, entrance to ventricle; 15, front wall of windpipe; 16, back wall of windpipe; 17, 18, entrances to the right and left bronchial tubes. (Bennett's *Medicine*.)

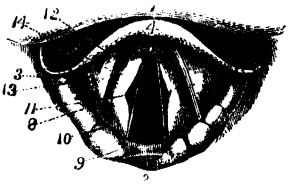


FIG. 288.—View of the larynx during ordinary breathing. (Bennett's *Medicine*.)

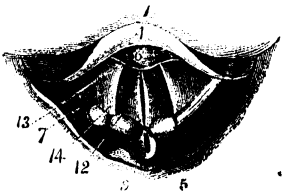


FIG. 289.—View of the larynx when the voca cords are closed, as in sounding a high note. (Bennett's *Medicine*.)

FIG. 290.—View of the larynx showing complete closure of the glottis, as in the act of swallowing. (Bennett's *Medicine*.)

LARYNX (λάρυγξ) is the organ of voice, and also forms one of the higher parts of the air passages. It is placed

high up in the front of the neck, and there forms a considerable prominence on the surface. It is covered in front by the skin, a layer of fibrous tissue, and a thin layer of muscle, while its sides are protected by the lateral lobes of the thyroid gland, and by the large sterno-mastoid muscles.

The larynx is almost 2 inches in height, and forms a sort of box, well protected in front by cartilages, rather more open behind, and communicating

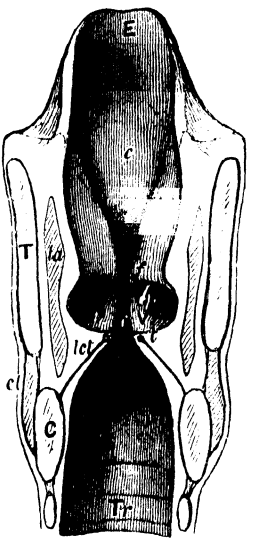


FIG. 291.—The front half of the larynx as shown by a vertical transverse section. *E*, Epiglottis; *c*, its cushion-like prominence; *T*, thyroid cartilage; *ta*, thyro-arytenoid muscle; *C*, cricoid cartilage; *ct*, crico-thyroid muscle; *f*, false vocal cord; *t*, true vocal cord; *p*, points to its prolongation forwards; *V*, ventricle of the larynx; *r*, rima of the glottis; *lct*, lateral crico-thyroid membrane, of which the true cord forms the edge; *Tr*, trachea. (Turner's *Anatomy*.)

above with the throat at the root of the tongue, below with the windpipe. The larynx is enclosed by five large cartilages: the thyroid cartilage, whose prominent pointed front forms the Adam's apple; the cricoid cartilage, a ring placed beneath it; the epiglottis, a leaf-like cartilage standing on the upper edge of the thyroid cartilage, and projecting up into the interior of the throat at the root of the tongue; and a pair of arytenoid cartilages jointed to

the top edge of the cricoid cartilage behind, where the thyroid is deficient.

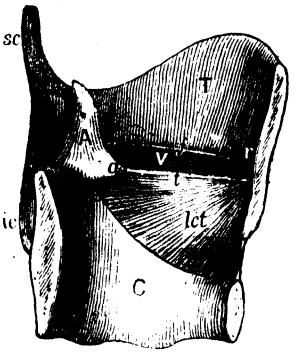


FIG. 292.—View of the interior of the left side of the larynx, the mucous membrane having been removed. *T*, Thyroid cartilage; *sc*, its superior, and *ic*, its inferior horn; *r*, its front angle, to which the cords are attached; *A*, arytenoid cartilage; *a*, its vocal process, to which the true cord is attached; *t*, true cord; *f*, false cord; *V*, ventricle of the larynx; *C*, cricoid cartilage; *lct*, lateral crico-thyroid membrane. (Turner's *Anatomy*.)

There are also four small nodules of cartilage above the arytenoids. The edges of the laryngeal cartilages do not fit closely together, and the spaces between are filled up by membranes. Certain of the ligaments which bind the

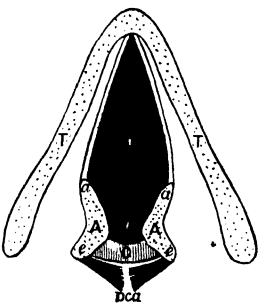


FIG. 293.—Diagram of the opening of the larynx to show the action of the muscles. A horizontal section has been made at the level of the true vocal cords. *TT*, Thyroid cartilage; *AA*, arytenoid cartilages with *aa*, vocal processes, and *ee*, muscular processes; *C*, upper border of cricoid cartilage; *v*, the vocal, and *r*, the respiratory part of the opening. The two cords are widely separated by the action of *pca*, the posterior crico-arytenoid muscles. (Turner's *Anatomy*.)

cartilages together are of great importance. There pass along each side of the larynx, from the arytenoid cartilage

behind to the thyroid cartilage in front, two bands of elastic fibres covered by the mucous membrane which lines the whole larynx. One pair of these bands lies directly above the other, the upper pair being known as the false vocal cords ; the lower pair are the true vocal cords. The latter are capable of various degrees of tenseness and slackness, and

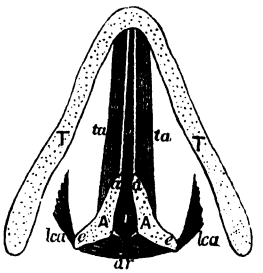


FIG. 294.—Diagram of the opening of the larynx to show the action of the muscles. The letters indicate the same structures as in the last figure, but the cords are now almost close together, by the action of *ta*, the thyro-arytenoid, *lca*, the lateral arytenoid, and *ar*, the arytenoid muscles. (Turner's *Anatomy*.)

of approximation and separation, these results being achieved by several small muscles, which are attached to the arytenoid cartilages, and governed in their movements through branches of the vagus nerves. Between the true and false cord is a deep depression on each side, the ' ventricle ' or ' sinus ' of the larynx, from which a pouch, half an inch long, leads upwards exterior to the false cord. The larynx is lined throughout by mucous membrane, which generally is covered by ciliated cells (*see* EPITHELIUM) ; but over the true cords, which are subject to much friction in the production of the voice, the surface consists of flattened cells similar to those of the skin.

The vocal cords vibrating in different notes, according to their tenseness, etc., produce the sounds of voice and speech. (*See* VOICE AND SPEECH.)

LARYNX, DISEASES OF (*see* THROAT DISEASES).

LASSAR'S PASTE is the name given to a preparation very extensively used as a remedy for eczema. It has a combined softening, antiseptic, astringent, and soothing action, and is made up as follows : oxide of zinc, 2 drams ; starch, 2 drams ; vaseline, 4 drams. To this 5 or 10 grains of salicylic acid are usually added.

LATHYRISM is the term applied to a disease in which stiffness, pains in, and trembling and paralysis of the legs are caused by varieties of chick-pea.

LAUDANUM is the popular name for tincture of opium. (*See* OPIUM.)

LAUGHING-GAS is a popular name for nitrogen monoxide gas which is used as an anæsthetic for short operations.

LAUREL is the name applied to two plants ; one of these, *Laurus nobilis* or bay tree, affords leaves and berries from which an oil is extracted which is used for application in rheumatic and similar pains ; the other, *Prunus laurocerasus* or cherry laurel, affords cherry laurel water, containing a small quantity of hydrocyanic acid, and is much used for making up soothing solutions.

LAURYL THIOCYANATE (*see* INSECTS IN RELATION TO DISEASE, *under* LICE).

LAVAGE (French word) is the name applied to the washing out of the stomach. (*See* DYSPEPSIA.) It is particularly employed in cases of dilatation of this organ.

Lavage of the blood is the name applied to a process in which children suffering from blood-poisoning receive an injection, into the veins, of blood from a healthy person, while at the same time blood is extracted from a distant vein in equal amount.

LAXATIVES (*see* PURGATIVES).

LEAD has no action itself upon the system, but its salts, when absorbed in any quantity, or for any length of time, have very important effects. When a lead salt comes in contact with a wound or with any mucous surface, it combines with the albuminous material of the discharge or secretion to form a whitish glaze, which affords a great degree of protection to the surface. Further, the lead salt has an astringent action upon the blood-vessels, and therefore helps to stop bleeding or relieve the congestion

of inflammation. If one of the soluble lead salts be taken internally, in large amount, it has an irritant action, and the acetate (sugar of lead), subacetate, and nitrate of lead are irritant poisons when taken into the stomach, though their action is comparatively feeble.

Uses.—Externally, subacetate of lead is used in the form of Goulard's water for application to painful areas, such as inflamed joints, bruises, sprains. (*See* GOULARD'S WATER.) In eczema, this solution sponged upon the affected area often gives relief from itching. Liniment of subacetate of lead and glycerin of subacetate of lead are similarly used. Litharge or oxide of lead is used as a basis for many adhesive plasters, which are known as 'Diachylon' plasters. Internally, the main use of acetate of lead is to check diarrhœa, and the favourite form in which it is used for this purpose is in lead and opium pill. It is also used, in suppositories, for the treatment of bleeding piles.

LEAD-POISONING.—Acute poisoning by sugar of lead is an accident which sometimes, though rarely, happens to a child, and is treated, like cases of irritant poisoning generally, by administering diluents such as milk together with Epsom salts, which form an antidote, followed by emetics.

Chronic poisoning is apt to affect those who come in contact with lead or its salts, either in the production of these or in the course of their use in various arts and manufactures. Thus lead-smelters, plumbers, typefounders, compositors, file-makers, pottery workers who use lead in glaze, painters, dyers, above all, those who make white-lead, and also persons following various other callings, are liable to suffer. Lead may also be introduced into the system through the food, in those who have nothing to do with the metal in their work; for example, drinking-water is sometimes contaminated by lead which it has dissolved off the pipes through which it passes, or tinned fruits may dissolve lead out of the solder with which the tins are sealed, or cider, made in leaden presses, may so readily take up lead that 'Devonshire colic' was once a name given to lead-poisoning occurring in this part of the country, where cider forms a favourite beverage. As regards drinking-water, there is in general no danger, because the minerals in the water form, with the lead, insoluble compounds which are deposited in a thin coat upon the inside of the pipes. Pipes of bright untarnished lead, as in newly-built houses, or an absolutely pure water which does not contain any mineral ingredients, may introduce an element of danger. But a greater danger exists in peaty water or in water contaminated by organic impurities, both of which give the water a high power of dissolving lead. Sufficient organic impurity may be derived from small quantities of sewage, or even from the body of a bird or small animal drowned in a cistern. Not only may the lead be introduced into the system through the skin of those who constantly handle lead-containing materials, and by way of the stomach, but in some of the most rapidly produced and serious cases—for example, among white-lead workers, and glazers of pottery—the lead is inhaled as dry dust. Lead is often similarly inhaled by men engaged in cutting up iron plates which have been fitted by the aid of red lead; this, being driven off by the heat of the blow-pipe employed, is apt to be inhaled.

Symptoms.—Among the early symptoms of a chronic and insidious case are constipation, muscular weakness, and pallor of the skin. A blue line on the margin of the gums, due to deposit of lead sulphide in this locality, is also an important sign of the condition. Colic of a very painful nature, affecting the centre of the abdomen and lasting often for several days at a time, appears and forms one of the most prominent symptoms in almost every case. Lead has a specially injurious action upon the nervous system, causing an inflammatory process in the nerves, which results in tremors and paralysis, usually affecting the muscles on the back of the wrist first of all, and later those on the front and outer side of the leg, and causing wrist-drop and foot-drop. Convulsions, which may develop rapidly and may end in death, are also produced by poisoning of the nervous system, and occasionally, though fortunately rarely, affection of the optic nerve leads to blindness, which is either temporary or permanent. Owing to interference with the kidney functions, the urine becomes

scanty, while a destructive action on the blood leads to anæmia. Gout, as is well known, may result from lead poisoning, the lead forming a very insoluble compound with uric acid, which might but for its presence have been excreted.

Treatment.—With regard to workers in lead and its salts, Government regular tions have been introduced which very effectively protect them. For example, personal cleanliness in washing the hands and changing the clothes before partaking of meals, the use of respirators by those who come in contact with white-lead dust, the provision of exhaust flues and electric fans beneath the tables at which pottery glazers work, and the use of Epsom salts or lemonade containing sulphuric acid to render innocuous any lead accidentally taken into the stomach—these and other measures confer a great degree of protection upon those engaging in these otherwise dangerous trades. Workers who begin to show symptoms of lead poisoning should at once undergo treatment, while a frequent recurrence of symptoms shows a special liability to this form of poisoning, and indicates that the worker should seek some totally different employment. In the case of drinking-water, the source of contamination must of course be removed. The drug which is of special use in treatment of lead poisoning is potassium iodide, by which lead salts deposited in the tissues are dissolved, to be afterwards excreted from the body in the stools, urine, and perspiration. At the same time, Epsom salts are given to combine with the lead in the stools and prevent its re-absorption. Colic is treated by hot fomentations, belladonna, morphia, and the other usual remedies.

LEADERS is a popular name for the tendons or sinews at wrist, ankle, etc. (*See* TENDON.)

LEBER'S DISEASE, or HEREDITARY OPTIC ATROPHY, is a hereditary disease in which blindness comes on at about the age of twenty.

LECITHIN (λέκιθος, the yolk of an egg) is a very complex fat found in various tissues of the body, but particularly in the brain and nerves, of which it forms a large part. It is also found in large quantities in the yolk of an egg.

LEECHES are animals belonging to the class Vermes, provided with suckers and living a semi-parasitic life, their food being mainly derived from the blood of other animals. They abstract blood by means of a sucker surrounding the mouth, which is provided with several large sharp teeth. The medicinal leech, *Hirudo medicinalis*, was formerly employed to a large extent for the abstraction of small quantities of blood in inflammatory and other conditions.

LEG (*see* DROPSY, FRACTURES, KNOCK-KNEE, LIMBS, VEINS, DISEASES OF, etc.). This term is generally applied to the whole lower extremity but, properly speaking, includes that part between the knee and ankle joints. The lower limb is attached to the pelvic bones by strong muscles, especially the gluteal and hamstring muscles behind and the adductor muscles on the inner side of the thigh. The head of the femur or thigh bone lies in a deep cup-shaped hollow, the acetabulum, on the outer side of the pelvis. The femur, which is the longest and strongest bone in the body, forms at its lower end the joint of the knee with the tibia. The knee-joint is protected in front by the patella or knee-cap. Along the outer side of the tibia lies the smaller fibula, which does not extend up to the knee but which, along with the tibia, forms the ankle joint. The two prominences on the ankle (*malleoli*) are formed by the tibia on the inner side and fibula on the outer side. Seven tarsal bones comprise the hinder part of the foot of which the astragalus takes the weight of the body from the tibia and fibula. There are five metatarsal bones in the front portion of the foot and each toe has three phalangeal bones, excepting the great toe, which has two. The powerful quadriceps extensor muscle in front of the thigh is attached to the knee-cap, which in turn is attached to the front of the tibia by the patellar tendon. This muscle straightens the knee and keeps the body in an erect posture. Below the knee the muscles of the calf, attached to the heel through the tendon of Achilles, raise the heel off the ground in walking. In front of and to the outside of the leg lie the tibial and peroneal muscles which bend

the ankle upward and raise the toes. In the sole of the foot are a number of small muscles which bend the toes downwards. The arch of the foot is a very important structure (*see* FOOT). Most of the blood supply to the lower limb is carried by the femoral artery, which issues from the abdomen in the middle of the groin where its pulse can be felt. This passes down the inner side of the thigh to reach the middle of the back of the knee, where it is known as the popliteal artery. Below the knee it divides into anterior and posterior tibial vessels. The former of these runs down the front of the leg and upper surface of the foot, and the latter, which is the larger, passes behind the inner ankle where its pulse can be felt about a finger's-breadth behind the bony prominence. The chief nerve in the lower limb is the great sciatic nerve which runs down the middle of the back of the thigh deeply embedded in muscles. Behind the knee it divides into two parts, the internal and external popliteal nerves. The former of these runs down the back of the leg, deeply embedded in muscles, to the foot, and the latter passes round the upper end of the fibula on the outer side of the leg, where it can be felt and is liable to be damaged. The blood returns from the leg partly by deep veins lying alongside the arteries, but to a large extent by the saphenous vein, which can be seen or felt under the skin for most of the distance from the inner ankle up the inside of the leg and thigh to the inner side of the groin, where it joins the femoral vein.

The arch of the foot is very liable to give way, especially in debilitated or overworked persons, thus producing flat foot. The ankle joint is very liable to sprains which consist of tearing of the ligaments especially on the inner side. The fibula is very liable to be fractured near its lower end, either by twists of the foot or by a blow on the outer side of the leg. Fracture of the tibia is also a very common accident and, as the tibia lies immediately beneath the skin, this fracture is in danger of becoming compound. The knee-joint, by reason of its great strength, is very seldom dislocated, but the partial displacement of a cartilage in the knee is a common occurrence. Fracture of the femur is a rare but serious accident requiring a period of several months for complete union of the bone. The long and poorly supported vein on the inner side of the leg and thigh is very apt to become distended along with its branches, producing the condition known as varicose veins with resultant eczema and ulcer. The bursa in front of the knee-cap, in persons who kneel much, readily becomes inflamed and thickened in the condition known as 'Housemaid's Knee'.

LEGUME is the pod or seed of a leguminous plant such as the pea or bean. As foods, these are particularly noteworthy in containing a large quantity of protein. Peas in the fresh state may contain from 3 to 6 per cent of protein, which is from one-sixth to one-third the amount of protein contained in fish, beef, and similar animal foods. Beans contain rather more, and string or French beans somewhat less protein. They differ from meat foods in two important respects, however, one being that they contain from 5 to 15 per cent of carbohydrate, and the second difference being that vegetable protein is not quite so suitable for assimilation by the body as are animal proteins. Leguminous vegetables are very useful in supplementing small amounts of animal food.

LEIOMYOMA is the term applied to a tumor made up of unstriped or involuntary muscle fibres.

LEISHMANIASIS is the general name applied to a group of diseases, of which kala-azar is the chief, caused by a genus of minute protozoan parasites. (*See* KALA-AZAR.)

LEMON is used in the form of the fresh peel, tincture, syrup and oil. The chief uses are found under CITRIC ACID. Lemon, because it contains vitamin C, is used as a preventive of scurvy.

LENS OF THE EYE is one of the refractive media through which light passes before reaching the retina. The lens is important, because its bulging and flattening, brought about by the ciliary muscle, automatically adjust the eye for focussing correctly on the retina rays of light from objects at varying distances. The lens begins to lose this power at the age of forty, hence the

need of spectacles for near work as age advances. (*See* ACCOMMODATION.) The lens is the seat of the opacity which constitutes a cataract. (*See* CATARACT, EYE, *and* EYE, DISEASES OF.)

LENTIGO is another name for freckles.

LEPROSY (λεπρός, scaly) is a chronic disease which affects particularly the skin, mucous membranes, and nerves.

History.—Leprosy was one of the few diseases recognised and described by ancient writers apart from mere symptoms. In India, leprosy has existed from the beginning of history to the present day. References to it are found in the writings of the early Hindoo physicians, and mention of the disease is found in early Sanskrit literature. In China, the southern part of which has been called the 'cradle of leprosy', this disease and syphilis seem to have existed for at least 2000 years, though the two were confused together in early writings. The papyri of ancient Egypt contain numerous references to a very intractable disease which is apparently leprosy. The disease was certainly held in great fear and detestation by the Jews, as may be judged by the strict inspection of suspected lepers, but it is highly probable that many persons affected with slight or even harmless skin diseases may have suffered isolation in consequence.

The Greeks do not seem to have been greatly affected by the disease, for Hippocrates in 400 B.C. gives it only a passing reference among other skin diseases, though Aristotle, fifty years later, describes it under the name of 'Satyriasis', probably naming it by reason of the animal or satyr-like change which its ravages produce in the countenances of the afflicted. Galen and other writers, probably for a similar reason, conferred upon leprosy the names of 'Leontiasis' and 'Elephantiasis', the latter term being still applied to it.

The disease appeared in Western Europe before the sixth century A.D., while from this date to the tenth century various enactments, and the existence of leper hospitals, show that the disease was viewed with great concern, and that it had by then extended as far west as Ireland and Wales. It is a popular, though mistaken, idea that leprosy was first brought back to Britain by the crusaders.

At the present day, Western Europe (with the exception of Norway), the British Isles, and Northern United States are free of the disease except for occasional sporadic cases. In all the known parts of Africa, especially West Africa, Cape Colony, Abyssinia, and the Sudan, the disease has many victims. In Syria, India, and Southern China, it is more prevalent than anywhere else. The parts of the Western Hemisphere specially affected are Guiana, Brazil, and Mexico.

Causes.—A bacillus was discovered by Hansen in 1874, which is supposed to be the actual cause of the changes in the body, and, as it is always found in great numbers in the diseased tissues and in the secretions of lepers, though nowhere else, it is generally accepted that this *Bacillus lepræ* produces the disease. How the bacillus gets from person to person, and what are the conditions necessary for its growth in a body into which it has been introduced, have still to be explained.

Leprosy most commonly starts between the ages of twenty-five and thirty years, and seldom, if ever, before the age of three years. Leprous persons are not often born of leprous parents, and at the settlement on Robben Island it was found that 95 per cent of the lepers had been born of healthy parents, while of the children born to the lepers on the island only 3 per cent afterwards became leprous. These facts, together with the fact that Europeans resident in India, China, and other leprous countries occasionally contract the disease, sufficiently disprove the idea that the disease is hereditary.

The fact that many persons come into intimate contact with lepers for years, and yet do not become affected, is not strange, when one reflects that the same applies to the closely allied disease, tuberculosis, and, in a less sense, to all infectious diseases.

There is a tradition that fish diet is one of the necessary causes, either through bad fish containing some substance which stirs the bacilli into activity, or through the bacilli growing in fish, and thus being taken into the stomach. The disease, however, exists among inland peoples who never eat

fish, and does not seem specially prevalent among those members of leprous peoples who eat most fish. Infection can apparently take place through the clothes of lepers, for cases have been recorded of persons who have worn a coat or lived in a house previously used by a leper, and who have contracted the disease, although they had never come into contact with his person. Poverty, dirt, and bad food appear to be important factors. Sex is an important factor, for it is found that, in most places where the disease occurs, three men are affected for every woman, and in some places, as for example Hong-Kong, the disproportion is far greater. The dark-skinned races are, at the present day, much more widely affected and more apt to contract the disease than those of light skin.

Symptoms.—There are two distinct types of leprosy: the nodular or tuberculated form, in which the disease produces irregular thickenings of the skin; and the anæsthetic or mutilating variety, in which the nerves are affected, causing loss of sensation over large areas, white patches on the skin, and death of outlying parts of the body. There may also be mixed cases, in which the two are combined.

There is a lengthy period after infection, before the disease appears, which seems to be not less than three years, though it may be longer, and cases have been recorded in which persons have developed the disease fifteen years or more after removal from a leprous country.

In the *nodular form*, a state of general bad health and feverishness may precede the beginning of the disease. The first characteristic sign is the appearance of red blotches on the face and ears, or on the limbs. These deepen gradually in colour and become raised above the surface, but after a time they fade again, though they seldom disappear completely. After a lapse of some weeks or months, a fresh eruption appears, and fades, and this is repeated many times, each attack leaving the skin more irregular and thickened than it was before the attack. Finally, the face and limbs become studded with nodules from the size of a pea to that of a pigeon's egg, which give the face a repulsive and 'lion-like' appearance. These nodules form also within the mouth and air passages, causing blockage of the nose, and huskiness or complete loss of voice. Some of the nodules sooner or later ulcerate, and this spreading to the eyes frequently causes blindness. The internal organs after a few years become affected, and it is not uncommon for consumption to appear in addition. Finally, after five or ten years of suffering the leper dies.

Nerve-leprosy begins more insidiously with pains in the limbs and faint blotches, where the skin loses its pigmentation. Later, these blotches increase in size, become white in colour, the hair upon them first changing to white, and then falling out, while sensation both to touch and to pain is lost over wide areas. For this reason, severe burns and wounds are often sustained through the leper being unable to feel painful sensations. Later, muscular weakness and paralysis in various parts of the body appear, due also to implication of nerves, and the special feature of this form of the disease consists in the shrivelling up, or dropping off of toes, fingers, or even larger portions of the limbs, owing to loss of vitality. In this process, unsightly ulcers and horrible deformities are produced, but the lease of life to the sufferer is long, many lepers surviving for twenty or thirty years.

Treatment. — Naturally the chief object in the treatment of so hopeless a disease is to prevent its spread, and throughout the whole history of the malady the separation of lepers from the healthy has been more or less stringently enforced. This process of segregation was continued in Europe through the Middle Ages, and probably had much to do with the disappearance of the disease; though it appears as if certain Western races share, with all the lower animals, and with certain localities, the privilege of immunity. In India and China at the present day, the process of isolation is only partial. There are many leper villages, but the people from these are free to come and go, and to trade with their healthy neighbours. Probably, if the restrictions on their movements, and prohibition of the use by healthy people of articles made by lepers, were more rigidly enforced, leprosy would not be so widespread in these countries. Children born in leper com-

munities should certainly be at once removed from the source of infection. Those measures which are of special benefit in tuberculosis, viz. fresh air, plentiful food, healthy surroundings, and personal cleanliness, help to prolong the leper's life and mitigate his sufferings considerably. Chaulmoogra oil has long been used in the East as a remedy. Recently it has been found that sodium chaulmoograte derived from the oil, and ethyl esters of the fatty acids of the oil have a specially destructive action on the leprosy bacilli, and great improvement in cases of leprosy follows upon hypodermic injection of these substances. Many cases appear to be cured in the course of some months' treatment by these means.

LEPTANDRA is the root of *Veronica virginica*, from which extracts are made that have a stimulating action on the liver and intestinal functions, and are used in certain cases of dyspepsia.

LEPTAZOL (*see* CARDIAZOL).

LEPTOMENINGITIS (λεπτός, thin; μῆνιγξ, membrane) means inflammation of the inner and more delicate membranes of the brain or spinal cord.

LESION (*lædo*, I hurt) meant originally an injury, but is now applied generally to all diseased changes in organs and tissues.

LETHANE (*see* INSECTS IN RELATION TO DISEASE, *under* LICE).

LETHARGY (λήθη, oblivion; ἀργία, idleness) is a term applied to various disorders in which the affected person remains constantly asleep, though capable of being roused for short periods. It is a symptom of concussion of the brain and various mental diseases. (*See* BRAIN, HYPNOTISM, CATALEPSY.) Its most remarkable form is that observed in negro-lethargy or sleeping sickness. (*See* SLEEPING SICKNESS.)

LETTUCE is a green vegetable consisting of leaves of *Lactuca sativa*. It contains about 5 per cent of carbohydrate and is largely used as a food in cases of diabetes, both because of its small carbohydrate content and because it forms a useful vehicle for taking oil. Various species of lettuce have a mild hypnotic and sedative effect, and tincture of lactucarium in doses of 30 minims and syrup of lactucarium in doses of 2 dr. are used as a remedy for insomnia. Lettuce is a rich source of vitamin A.

LEUCIN (λευκός, white) is a crystalline substance which is formed in most of the glands in the body as a result of decomposition of proteins. It is found in the urine in large amount along with tyrosin when the liver is diseased.

LEUCOCYTE (λευκός, white; κύτος, a cell).—White blood cell. A colourless cell in the blood. A leucocyte differs from an erythrocyte in having a well-formed nucleus and no hæmoglobin. Most white blood cells are larger than the red, and there are much fewer of them—normally about 9000 per cubic millimetre of blood. There are two classes of white cells: (1) those with a single nucleus and clear, non-granular cellular protoplasm—monocytes and lymphocytes; (2) cells with a lobed nucleus and a granular cytoplasm—the granulocytes. The lymphocytes, arising from lymphoid tissue (as the lymph nodes or glands and the spleen), are small and large, the former constituting about 20 per cent of the total white cells in the blood and the latter an insignificant proportion. The monocytes are bigger than the lymphocytes, are motile and phagocytic, are probably derived from the fixed tissue cells, and make up about 5 per cent of the white blood cells. Of the granulocytes, one type stains with acid dyes (such as eosin) and comprises the eosinophils, one with basic dyes (methylene blue) comprising the basophils, and the third stains with neutral dyes (mixtures of acid and basic). Eosinophils make up about 5 per cent of the white cells, basophils 0·5 per cent, and neutrophils 65-70 per cent—the most numerous of all white cells. (*See* ABSCESS, BLOOD, INFLAMMATION, LEUCOCYTOSIS, PHAGOCYTOSIS, WOUNDS.)

LEUCOCYTHÆMIA, or LEUKÆMIA (λευκός, white; κύτος, a cell; αἷμα, blood), is a disease of chronic type, in which the number of white corpuscles in the blood is permanently increased. The disease is also characterised by great enlargement of the spleen and changes in the marrow of the bones, or by enlargement of the lymph glands all over the body.

The history of the disease is interesting by reason of the curious fact that the condition was first described by Virchow in Germany and Hughes Bennett in Scotland, within a few weeks of one another, in the year 1845, the former giving it the name of leuchæmia, the latter that of leucocythæmia. According to the type of corpuscles chiefly present the disease is called (1) Lymphatic leukæmia, lymphocythæmia, or lymphemia, and (2) Splenomedullary leukæmia, myelocythæmia, or myelemia. The condition may be either acute or chronic, the acute cases generally being of the lymphatic type and being relatively rare.

Causes.—The causes of the disease are quite unknown. It may occur at any age, though most frequently in middle life, and among males. Malaria and syphilis appear in some cases to have been connected with the disease, which is also known occasionally to set in after some wound or abscess has occurred.

Symptoms.—In the acute cases, which are, however, rare, the patient shows pallor, occasional purpuric rash, and enlargement of the lymphatic glands and spleen. The temperature is raised, and the condition is liable to be mistaken for general tuberculosis. Such cases usually run a rapid course, lasting a few weeks or months. In the chronic type of the disease, which is the usual form, the onset is gradual, and the first symptoms which occasion discomfort are either swelling of the abdomen and shortness of breath, due to painless enlargement of the spleen, or the enlargement of glands in the neck, armpits, etc., or the pallor, palpitation, and other symptoms of anæmia which often accompany the malady. Occasional hæmorrhages from the nose, stomach, gums, or bowels may occur, and may be severe. Dropsy of the feet and legs is not uncommon, from obstruction of the lymphatic vessels by the enlarged glands and spleen. Diarrhœa also may become very troublesome. Generally, there is a slight degree of fever. When the blood is examined microscopically, not only is there an enormous increase of the white corpuscles, which may be multiplied thirty- or sixty-fold, but various immature forms of corpuscles are found. In the lymphatic form of the disease the white corpuscles consist chiefly of corpuscles resembling in some measure the lymph corpuscles, which, in healthy blood, are present only in small numbers. In the splenic form, myelocytes, or large immature corpuscles out of the bone-marrow, which are never present in healthy blood, appear in large numbers, and there may also be seen large numbers of immature, nucleated, red blood corpuscles.

The disease progresses slowly, and, especially if treated, may show several remissions in which the blood may become almost completely normal again, and the liver, spleen, and glands revert to nearly their normal dimensions. With each relapse, however, the condition of the patient becomes less satisfactory, and the disease usually has a total duration of not more than a few years.

Treatment.—Fresh air, good diet, and rest are essential. No drug or other agency has been found which will cure the disease, though it sometimes abates for some time spontaneously, and though arsenic and benzole have been found to check it, temporarily. The enlarged spleen has been removed by operation, though the result gives no encouragement for future trial. Recently the application of X-rays or of radium to the abdomen and to the limb bones has been tried, and has been successful, in some cases, both in reducing the size of the spleen and in improving the condition of the blood and thus prolonging the patient's life.

LEUCOCYTOSIS (λευκός, white; κύτος, cell) means a temporary condition in which certain of the white cells in the blood are increased in number. The condition occurs in many different circumstances, and forms a valuable means of diagnosis in certain obscure diseases. It takes place, for example, after every meal, the number of white corpuscles, which amounts usually to 6000-8000 per cubic millimetre of blood, rising at these times to double that figure. During many acute infective diseases, such, for example, as pneumonia, the number is largely increased. Indeed, if it be found upon examination of the blood during a case of pneumonia that the number of white blood corpuscles is not largely increased, the sign is an ominous one, pointing to weakness in

the body's power of resistance to the disease, and indicating a probably fatal result. In all suppurative conditions there is also a 'leucocytosis', and if it seems that an abscess is forming deep in the abdomen, or in some other site where it cannot be readily examined, as, for example, an abscess resulting from appendicitis, the examination of a drop of blood gives an invaluable aid in the diagnosis, and may be sufficient, in the absence of other signs, to point out the urgent need of an operation. Measles and typhoid fever constitute almost the only exceptions to the statement that acute infective diseases show this increase of white corpuscles in the blood, and, accordingly, in the case of these diseases, the presence of an increase is a specially reliable sign of abscess formation, or other severe complication.

LEUCODERMA, or LEUCODERMIA (λευκός, white; δέρμα, skin), means a condition of the skin in which areas of it become white, as the result of various skin diseases.

LEUCOPENIA (λευκός, white; πένης, poor) is a condition in which the white corpuscles of the blood are greatly reduced in numbers.

LEUCOPLAKIA (λευκός, white; πλάξ, a flat stone) means a chronic condition of the tongue in which, as the result of various forms of irritation, hard, smooth, whitish patches develop on its surface.

LEUCORRHŒA (λευκός, white; ῥέω, I flow). (*See* WHITES.)

LEUCOTOMY.—Literally, cutting the white fibres. The operation of cutting the white nerve fibres in the frontal lobes of the brain. This operation severs the connections of the frontal cortex with other parts of the nervous system, especially the thalamus and the hypothalamus. The operation is done in psychotic patients who suffer from severe depression or tense obsessional states. It appears to relieve the symptoms, the patient becoming 'friendly, cheerful, agreeable, relaxed, and interested in what goes on about him'.

LEVULOSE is the name of a sugar which forms one of the constituents of grape-sugar. It is reputed, unlike ordinary grape-sugar and cane-sugar, to be completely assimilated by the tissues of persons suffering from diabetes. Accordingly, it has been given to such invalids in large quantities as a food, though the contention that it is superior to the other sugars is doubtful.

LICE (*see* PARASITES *and* INSECTS IN RELATION TO DISEASE).

LICHEN (λειχήν) is a term applied to a group of chronic skin diseases, in which the eruption consists of solid, reddened pimples or papules, with no tendency to suppurate.

LIEN is the Latin name for the spleen.

LIENTERIC DIARRHŒA (λεῖος, smooth; ἔντερον, the intestine) means diarrhœa caused by irritability or inflammation in the small intestine. The food passes through the stomach and bowels to a large extent unchanged, the bowels being opened a short time after every meal.

LIGAMENTS are strong bands of fibrous tissue which serve to bind together the bones entering into a joint. They are, in some cases, cord-like, in others flattened bands, while most joints are surrounded by a fibrous capsule or capsular ligament. (*See* JOINTS.)

LIGATURE (*ligo*, I bind) means a cord or thread used to tie round arteries in order to stop the circulation through them, or to prevent escape of blood from their cut ends. Ligatures are generally made of catgut or silk, and are tied

FIG. 295.—A reef-knot or surgeon's knot half tied. This is the knot with which all ligatures are tied. (Miller's *Surgery*.)

with a reef-knot. When an artery is ligatured, the blood-stream through it is permanently stopped, and circulation in the part supplied by the artery is restored by anastomosis. (*See* ANASTOMOSIS.)

LIGHT TREATMENT.—The visible

spectrum of white light, extending from red to violet, gives waves of different character, and beyond these, in the

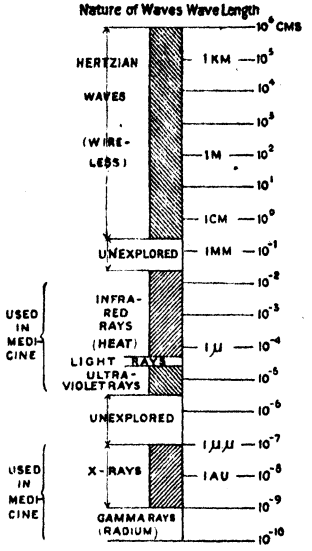


FIG. 296.—Table showing nature of waves of various wave-length.

infra-red and ultra-violet regions, are numerous varieties of waves. Thus in the infra-red region we have radiant heat and electric waves, which are used for practical purposes in the high-frequency apparatus and wireless telegraphy; in the ultra-violet region we have the chemically active rays used in Finsen light, N-rays of several kinds, and then, much higher in the series, cathodal rays, X-rays, and some of the radiations of radium bodies.

Rays of radiant heat have great power in stimulating the sweat glands of the skin, and in increasing the absorptive powers of the underlying tissues, while the ultra-violet rays, applied to the skin, have a general stimulating action, increase the power of the blood and tissues to destroy bacteria, and improve the general health in weakly children and neurasthenic persons. The beneficial action of sunlight and of incandescent light baths depends upon the action of both kinds of rays. Recently, lamps have been devised which depend for their action almost entirely upon ultra-violet radiation with a minimum of heat.

From the point of view of treatment, radiant energy is utilised in the following ways:

(1) *Sunlight treatment* or heliotherapy.

(2) *Radiant heat*, obtained by artificial means from incandescent or arc lamps, or by diathermy.

(3) *Ultra-violet radiation.*

(4) *X-ray and radium applications.*

The first three are treated here. For the fourth see X-RAYS AND RADIUM.

SUNLIGHT TREATMENT, or HELIOTHERAPY.—Sunlight is essential to the well-being of all living things, both vegetable and animal. In the smoke-laden towns of Britain some 95 per cent of the therapeutic efficiency of the solar rays is filtered out by moisture, dust, and smoke. This has a specially harmful effect upon child life, and various disabling diseases, such as tuberculosis and rickets, are traceable in part to lack of sunlight. On the other hand, in the clear air of high mountains, especially over snow, which acts as a reflector, the ultra-violet rays are at a maximum. Sunlight treatment is therefore specially carried out at certain places in the High Alps, the greater part of the body being exposed to the sun's rays for several hours daily. Pigmentation gradually results, and the patient's powers of resisting disease are greatly raised. This result can be attained, not only in persons going about, but even in persons confined to bed by such conditions as tuberculosis. In these cases great benefit is obtained by lying out in the open air, exposed to the sun's rays, but protected from bad weather. Shelters may be surrounded by vita glass which cuts off less of the ultra-violet rays than does ordinary glass. (For further details *see* JOINTS, DISEASES OF.)

SUN-BATHS have also been found useful in obesity, in diabetes, and in gout and other diseases associated with the formation of uric acid. They are taken, as a rule, at health resorts, where the naked skin is exposed to the direct beams of the sun in the open air, and frequently accompanied by exercises.

ARTIFICIAL WHITE LIGHT TREATMENT. — Owing to climatic conditions, sunlight treatment is often impracticable, but similar results can be obtained by artificial means.

White light consists of (*a*) calorific, or

heat rays ; (*b*) luminous, or light rays ; (*c*) actinic, or chemical rays. These are employed in the various electric-light baths, and their effect on the chemical changes proceeding in the body is undoubted. They also exert a great effect on the skin circulation.

Electric light, derived from incandescent or arc lamps, possesses properties very similar to those of sunlight. In both of these, heat and luminous rays predominate, but there is a certain proportion of ultra-violet rays. The action and uses of the electric-light bath are mentioned under BATHS. Electric light cabinets are of great value in the treatment of rheumatic diseases, fibrositis, neuritis, lumbago, etc., as well as nephritis, skin diseases, and corpulence.

INFRA-RED RADIATIONS employed in treatment are those with wave lengths immediately below those of luminous rays. Infra-red rays are emitted by all warm bodies, but the useful rays are given out only by bodies at a dull red or glowing temperature. The best source of these is sunshine, and they are also derived from incandescent light bulbs with tungsten filament, carbon arc lamps, and ordinary electric radiators at a red heat. These infra-red rays penetrate through the skin to a depth of ¼ to 1 inch, and their action in moderate dosage is to dilate blood vessels and so produce an increased blood supply to the exposed part, and to exert a soothing action on its sensory nerves. They are useful therefore in conditions of inflammation or injury near the surface to promote absorption and relieve pain. Apparatus is obtainable which supplies infra-red rays without luminous rays, but this has no advantage over sunshine or electric bulbs, which supply both infra-red and luminous rays, except in cases where strong light is objectionable, as for example in treatment of conditions near the eyes. When deep penetration of heat is required, diathermy apparatus is used. (*See* DIATHERMY.)

ULTRA - VIOLET RADIATIONS stimulate the natural defensive powers of the body and enable it to combat disease. It produces an erythema of the skin and, acting upon 7-dehydrocholesterol in the skin, converts it into vitamin D_3, the natural vitamin D present in skin, milk, and fish-liver oils. Calcifefol, or vitamin D_2, generally used in preventive and therapeutic medicine, is obtained by ultra-violet irradiation of ergosterol. The effect of ultra-violet light is greater, in proportion to the area of the body exposed to the rays. Several patients can be treated at one time, seated round a large arc-lamp at a distance of about three feet, stripped to the waist.

Professor Finsen's discovery in 1893 that the rays in this part of the spectrum were bactericidal in their action induced him to try their local effect on lupus, in which disease he recorded very happy results. At first sunlight was employed as the source, but subsequently the electric arc-lamp and the spark from two electric condensers were used. Sunlight is undoubtedly best, but the other two sources have been largely used.

Blue, indigo, violet, and ultra-violet comprise the radiations which are desired, and accordingly arrangements were required to cut out the other rays. This, in the original apparatus, was effected by passing sunlight through a tube containing copper sulphate dissolved in water, then through quartz

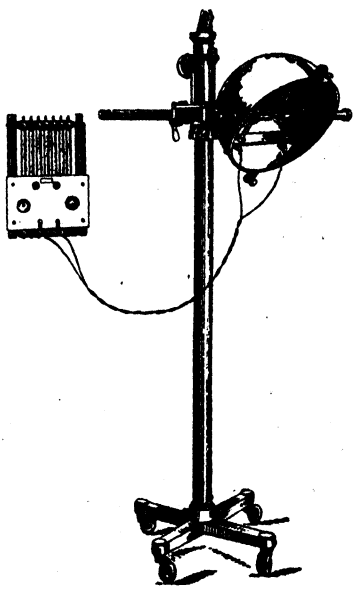


FIG. 297.—Apparatus for ultra-violet radiation.

lenses to concentrate the rays. As blood prevents penetration, the part under treatment had to be made bloodless by pressing it against another quartz lens, so that the rays could reach the deeper layers of the skin. Further, cooling effects were ensured by arranging for the circulation of cold water between the lenses. After about an hour's exposure, a blister forms over the part treated, and subsequent applications leave it healthy, with a soft pliable scar. The disadvantage is that only small areas are treated on each occasion; therefore, if the disease be extensive, treatment takes a long time. An arc-lamp at 100 volts pressure, with arrangements to treat four patients at once, gives fair results. Smaller arc-lamps have also been devised, but these all seem to lack penetrative power, although the more recent Finsen-Reyn pattern was more effectual.

In addition to the original Finsen lamps, the mercury vapour lamp, and especially the Tungsten arc-lamp, which gives a very high proportion of ultra-violet rays, are favourite forms. In the use of these lamps, the patient's eyes are protected by wearing coloured glass goggles. A few minutes' exposure at a time is usually sufficient.

Excellent results have been obtained by ultra-violet radiation in the treatment of lupus and other forms of tuberculosis. It is of great use in hastening the cure of septic skin diseases, such as ulcers. Ultra-violet rays are useful in the treatment of rheumatic conditions, but a better result in such cases is got from their combination with heat rays, as mentioned above. Exposure to ultra-violet light is one way of treating rickets as it converts the 7-dehydrocholesterol of the skin into vitamin D_3. Ultra-violet light is bactericidal, and ultra-violet-light 'barriers' have been used in children's wards to prevent the spread of infection from one part of the ward to another. Irradiation of the upper part of the atmosphere of schools has been very successful in controlling the spread of common infections among school children.

LIGHTING and WARMING. — The chief points of medical importance connected with light and heating concern the effects upon the eyes, and the presence or absence of poisonous gases in the air.

Daylight from a clear sky is the best illuminant, and in schools, etc., the position of those working at desks should be arranged so that the light falls from behind, or from behind and to the left, and is not reflected straight up into the worker's eyes. Abundance of light, properly placed, is important, in order to avoid habitual strain of the eyes.

Open fires afford a very healthy but wasteful source of warmth. The usual temperature of a room is from 60° to 65° F., though in the case of nurseries, sick-rooms, and the rooms of old people 65° to 70° F. is often more suitable. An open fire sends about five-eighths of its heat up the chimney; about two-eighths is used to heat the walls; and only one-eighth is available to warm the air of the room. Further, the heat diminishes rapidly as one recedes from the fire (proportionately to the square of the distance), so that the room is unequally warmed. The fire has, however, advantages in being cheerful and in supplying a means of ventilation and a means of destroying refuse.

Large numbers of open coal fires in towns foul the air with smoke, and central heating and heating by gas and electricity would go some way to removing this nuisance, as would the use of smokeless fuel. The smoke from factory chimneys creates a bigger nuisance than the smoke from private houses.

Closed stoves act mainly by causing a current of warmed air to pass through the room, so that the air becomes uniformly heated after a time. They have the advantages in offices, warehouses, etc., of heating the whole space more uniformly than open fires, and of economising fuel. Thin iron stoves are objectionable, because they allow the poisonous gases of combustion to escape when they become heated, and china stoves are much better. Stoves act best where there is little draught, and it is essential that they should have a wide ventilating flue. They diminish the humidity of the air, and thus cause dryness of the skin, crispness of the hair, and a feeling of general discomfort, which is avoided by placing water in a wide shallow dish on the stove or at various places in the room.

Gas light and fires are used in various ways. COAL GAS, in which the principal constituent is ethylene or olefiant gas, was formerly much used as an illuminant. In addition it raises temperature, discharges soot into the air which soils walls and ceilings, is dangerous because of the carbon monoxide it contains, and, if impure, irritates the throat and lungs by sulphurous compounds. Gas fires which 'strike back' have a similar irritating effect by discharging acetylene, etc., into the air. The gas now supplied in most cities consists of a mixture of coal gas and water gas which may contain from 18 to 38 per cent of carbon monoxide. This gas is excellent for use with incandescent mantles, by which it is completely consumed, and for heating and cooking in gas fires. It is, however, excessively poisonous. ACETYLENE GAS is often used for small private installations. It has the disadvantage of being irritating to the air passages, but gives a good white light.

Any gas fire should be ventilated by a wide flue leading to the outer air; this both prevents fouling of the air and, in the event of the gas escaping unburned, avoids risk of poisoning by carbon monoxide.

Lamp-light by burning oil is much used for illumination in country places. It is a healthy light when sufficiently bright; but, like unventilated gas stoves, lamps pollute the air with carbonic acid, though the great danger of gas, which is poisoning by carbon monoxide, is not present in the case of oil lamps.

Hot-air furnaces form a healthy system often used to supply warm air from a heating-chamber in the basement of buildings. The air is introduced through apertures in the floors, but should be moistened as in the case of stoves.

Hot-water installations form another system of central heating, either on the LOW PRESSURE SYSTEM, when the water circulates from a boiler in 4-inch iron pipes over the house, or on the HIGH PRESSURE SYSTEM of circulation in thick but narrow pipes. On the former system 12 feet of piping are necessary for every 1000 cubic feet of space to be warmed, and on the latter 8 or 9 feet. This type of heating has no prejudicial effect on the air, and is eminently suited for buildings with much space in corridors, halls, etc.

Electricity is for lighting purposes by far the healthiest system obtainable. On animals and plants the electric light has the same stimulating effect, though weaker in degree, as daylight, and it is free from any polluting or drying effect on the air. As a warming agent electric radiators require no ventilation and have no hurtful action.

LIMBS are outgrowths from the sides of the body, which in man, as in all the higher animals, number four. The limbs of all the higher animals, though differing much in outward appearance, are constructed on a similar plan, modified to suit the requirements of the owner, the forelimb for example developing in birds into a wing, in seals into a flipper. In all, however, the various muscles,

FIG. 298.—Diagram showing the manner of connection of the upper limbs to the body. *V*, A dorsal vertebra; *C*, a rib; *St*, the breast-bone; *Sc*, shoulder-blade; *Cr*, coracoid process; *Cl*, collar-bone; *H*, humerus. (Turner's *Anatomy*.)

bones, and blood-vessels, though differing in size and shape, correspond in arrangement. Also, between the upper and lower limb, a strict comparison is possible, and the bones, muscles, and main arteries of the arm, forearm, and hand have all representatives in the thigh, leg, and foot. (*See* ARM *and* LEG.)

The union of the lower limb with the body is, however, more intimate than that of the upper limb. For, while the shoulder-blade and collar-bone of the upper limb are separated from the organs of the chest by the ribs and their muscles, the haunch-bone is applied on each side directly to the spine, and forms the side of the pelvis. Thus it is quite possible to amputate the upper limb completely, though in the case of the lower limb such an operation would not be compatible with life.

In structure, each limb consists of four segments, the shoulder, arm, forearm, and hand in the case of the upper limb, corresponding to the haunch, thigh, leg,

and foot in the lower limb. Upon the surface, the limb is enveloped by skin which, over the hand, is specially rich in its supply of sensory nerves. Beneath the skin is a layer of loose cellular tissue containing an amount of fat which varies with the corpulence of the individual. Next comes a strong layer of fibrous tissue, known as 'fascia', which provides a complete investment for the limb, and supplies a separate sheath for

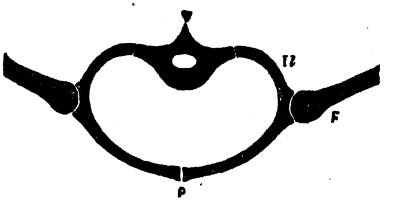


FIG. 299.—Diagram showing the manner of connection of the lower limbs to the body. *V*, A sacral vertebra; *Il*, the iliac, and *P*, the pubic parts of the haunch-bone; *F*, the femur. (Turner's *Anatomy*.)

each muscle. The chief bulk of the limb is made up by the muscles or flesh. Finally, in the centre of the limb lie the bones which give it rigidity; and in general the large arteries and nerves are embedded among the muscles close to the bones.

The diseases affecting the limbs are those of the skin, muscles, bones, etc., forming them. For injuries of the limbs see FRACTURES; HÆMORRHAGE; JOINTS, DISEASES AND INJURIES OF; and WOUNDS.

LIME, CALX, QUICK-LIME, or OXIDE OF CALCIUM, is a caustic, highly infusible solid which is prepared by calcining white marble, Iceland-spar, lime-stone, shells or other forms of calcium carbonate ($CaCO_3$). Heating calcium carbonate drives off carbon dioxide, leaving lime or CaO. If water be sprinkled on it, the lime swells up, becomes hot, and breaks down into a white powder, known as calcium hydroxide or hydrated lime or 'slaked lime', the chemical formula of which is $Ca(OH)_2$. If a large quantity of water be added to this, a thick, white liquid is formed, known as 'milk of lime', which is much used for whitewashing walls, alleys, etc. If the milk of lime be filtered, a clear liquid, having an alkaline reaction, and known as 'lime-water', is obtained. This lime-water contains a small amount of slaked lime in solution, about 1 part in 700 of water. Chlorinated lime is prepared by passing chlorine gas over slaked lime, and is much used for bleaching powder, for disinfection, etc. (*See* CHLORINATED LIME.) When slaked lime is exposed to the air for some time, it gradually hardens, as in mortar and plaster, changing into carbonate of lime. Carbonate of lime exists extensively also in a state of nature, being used in medicine in the form of 'chalk'.

Action.—Quick-lime has a caustic action upon parts of the body with which it is brought in contact, being, however, little used. It is a fairly common accident for quick-lime or slaked lime to get into the eye, upon the delicate surface of which it exerts a destructive influence. (*See* EYE, DISEASES OF.) Internally, lime-water and chalk exert a soothing and powerfully astringent action upon the bowels, though lime is absorbed only to a small extent into the blood.

Uses.—Externally, lime is occasionally used as a caustic, though it has gone greatly out of vogue. Lime-water and olive oil, or lime-water and linseed oil, mixed in equal parts, form a creamy emulsion known as 'Carron oil', which has a very soothing action upon burns. Internally, lime-water has a very wide use, being mixed with milk administered to invalids and children in order to make the curd less hard and so render this food more easily digested, and also in order to exert a soothing action upon the stomach when there is a tendency to vomit. For this purpose two or three tablespoonfuls are generally added to a tumblerful of milk. (*See* INFANT-FEEDING.) As an astringent in diarrhœa, lime-water is too weak, and chalk mixture is generally used in doses of two or three tablespoonfuls for an adult, and one or two teaspoonfuls for a young child. Calcium is a most important element in diet, and the chief sources of it are milk, cheese, and green vegetables. Calcium is especially needed by the growing child and the pregnant and nursing mother.

LIME-JUICE is a yellow liquid obtained by squeezing lime-fruit, *Citrus limetta*. In common with lemon-juice, it contains a large quantity of citric acid

(30 or 40 grains in every ounce of juice), and is used as a refreshing drink and as a preventive of and remedy for scurvy. (*See* SCURVY.) Lime-juice which has been boiled or preserved for a prolonged period loses its antiscorbutic properties.

LINCTUS (*linctus*, licking) is a term applied to any thick syrupy medicine to be taken by licking. Most of these are remedies for excessive coughing, of which the best is Gee's linctus, consisting of equal parts of paregoric, oxymel of squills, and syrup of tolu.

LINEA ALBA is the name given to the line of fibrous tissue stretching down the mid-line of the belly from the lower end of the sternum to the pubic bone. The linea alba gives attachment to the muscles of the belly wall.

LINEA NIGRA. During pregnancy the linea alba (*q.v.*) becomes pigmented and appears as a dark line down the middle of the belly, and is called the linea nigra.

LINIMENTS, or EMBROCATIONS (*linio*, I anoint), are preparations intended for external application, generally with rubbing. Almost all are of an oily nature, and are highly poisonous, being dispensed therefore in green or blue bottles. Liniments should never be kept alongside medicines intended for internal use, because many fatalities occur through carelessness of administration, a dose being poured out of the wrong bottle. Among the chief liniments are aconite, belladonna, and chloroform liniments, often mixed together in equal parts to form A.B.C. liniment, which is extensively used for neuralgia, rheumatism, and other painful conditions; linimentum calcis or 'Carron oil', used for burns; iodine liniment, used to paint over enlarged glands, swollen joints, etc.; opium liniment, used to apply in various acutely painful conditions; turpentine and acetic turpentine liniments, used especially for sprains, bruises, and rheumatic conditions; liniment of ammonia, popularly known as 'hartshorn and oil', used for the same purposes; and soap liniment, known also as 'opodeldoc', of like application.

LINSEED is used either as the seeds or in the form of linseed meal obtained by grinding the seeds of *Linum usitatissimum*, the common flax. Linseed contains an oil, and also a mucilaginous substance, which is capable of considerable power in soothing and softening inflamed tissues.

Uses.—Externally, linseed meal is used in poultices (*see* POULTICES); and for internal use an infusion is made from the seeds which has a wide domestic use for colds, coughs, and various internal inflammations. The infusion is made by steeping two teaspoonfuls of linseed and about half a teaspoonful of dry liquorice root in half a pint of boiling water, and letting it stand two hours.

LINT was originally made of teased-out linen; now it consists of a loose cotton fabric, one side of which is fluffy, the other being smooth and applied next the skin when the surface is broken. Marine lint consists of tow impregnated with tar, and is used where large quantities of some absorbent and deodorising dressing are required. Cotton lint is impregnated with various substances, the most common being boracic lint. Lint containing perchloride of iron (15 per cent) is valuable as a styptic.

LIPÆMIA means the presence of an excessive amount of fat in the blood.

LIPASE is an enzyme widely distributed in plants, and present also in the liver, and gastric and pancreatic juices, which breaks down fats to the constituent fatty acids and glycerol.

LIPIODOL, or iodised oil, is a preparation of poppy-seed oil with iodine, containing about 40 per cent of the latter. It is a yellow, oily liquid which is used in X-ray examination by injection to show up cavities and spaces in internal organs.

LIPOCAIC is the name given by Dragstedt to a new hormone in the pancreas which plays a part in the metabolism of fat. In the absence of this hormone fat accumulates in the liver and seriously interferes with its function. Other workers think that choline can prevent this accumulation in the liver.

LIPODYSTROPHY means any disturbance of the body's economy which results from faulty metabolism of fat.

LIPOMA (λίπος, fat; *-oma* meaning tumor) is the name given to a tumor

mainly composed of fat. Such tumors arise in almost any part of the body, developing in fibrous tissues, particularly in that beneath the skin. They are simple in nature, and seldom give any trouble beyond that connected with their size and position. (*See* TUMORS.)

LIPPITUDO (*lippitudo*) means a chronic condition of inflammation at the margins of the eyelids, which ultimately renders the person ' blear-eyed '.

LIPS form a pair of curtains before the mouth, each composed of a layer of skin and of mucous membrane, between which lies a considerable amount of fat and of muscle fibres.

The diseases to which the lips are liable are not numerous. *Fissures*, coming on in cold weather, form a troublesome condition often very hard to get rid of. *Herpes* often develops on the lip as a result of a cold or other feverish condition, but quickly passes off. (*See* HERPES.) *Ulcers* may form on the inner surface of the lip, usually in consequence of bad teeth or of dyspepsia, while in infants ulceration on the lips is a common sign of inherited syphilis. *Boils* sometimes form on the upper lip, and if large they produce a serious condition. (*See* BOILS.) *Cysts* of small size sometimes form on the inner surface of the lip, and are seen as little bluish swellings filled with mucus ; they are of no importance. *Hare-lip* is a deformity sometimes present at birth. (*See* PALATE, MALFORMATIONS OF.) *Cancer* of the lip sometimes occurs, almost always in men, and usually on the lower lip. It is said to be due to the irritation set up by smoking clay pipes. (*See also* MOUTH, DISEASES OF.)

LIQUOR is a solution of a drug in water. The majority of liquors are intended for internal use, but some of them are for external application only. (*See also* ALCOHOL.)

LIQUORICE is the root of *Glycyrrhiza glabra*, a plant of Southern Europe and Asia. It is a mild laxative, but is mainly used to cover the taste of disagreeable and more powerful drugs. Solid and liquid extracts are made from it, but the most commonly used preparation is compound liquorice powder, which contains also senna and sulphur.

LISTERISM is a general term derived from the name of Lord Lister (1827–1912) for the principles and practice of antiseptic and aseptic surgery.

LITHÆMIA (λίθος, stone ; αἷμα, blood) is a general term applied to those conditions in which uric acid is developed or retained in excess in the system. (*See* ACIDITY, GOUT.)

LITHAGOGUE is the term given to any agent which expels calculi from the body.

LITHIASIS (λίθος, stone) is a general name applied to the formation of calculi and concretions in tissues or organs, *e.g.* cholelithiasis means the formation of calculi in the gall-bladder.

LITHIC ACID (λίθος, stone) is another name for uric acid.

LITHIUM.—A soft, rare, widely distributed, silver-white metal. Owing to a mistaken notion of the action of salts of lithium in the body, it was formerly prescribed for the treatment of gout.

LITHOLAPAXY is the term applied to the procedure of crushing a stone in the bladder and washing out the crushed fragments.

LITHONTRIPTICS (λίθος, stone ; τρίβω, I rub down) are substances which dissolve stones in the urinary passages. (*See* BLADDER, DISEASES OF.)

LITHOPÆDION is the term applied to a fœtus which has died while in the mother's body and has become calcified.

LITHOTOMY (λίθος, stone ; τέμνω, I cut) is the term applied to the operation of cutting for stone in the bladder. The operation is of great historic interest, because more has probably been written about it in early times than about any other department of surgery, and because, until quite a recent date, it formed almost the only operation in which the surgeon dared to attack diseases of the internal organs. It seems, from the fact that large numbers of people were cut for stone, and also from the fact that this operation remained, in France at least, in the hands of a special class of surgeons, referred to as ' lithotomists ', that stone in the bladder must have been far commoner two or three centuries ago than it is to-day.

The bladder lies within the pelvis, protected in front by the pubic bones, but accessible above these through the lower part of the abdomen, or below them through the perineum. Operation by the former route is known as suprapubic lithotomy, and by the latter route as perineal lithotomy.

The earliest form of *perineal lithotomy* was the operation described by Celsus, and known as 'cutting on the gripe', or operation with the 'apparatus minor'. Two fingers of the operator's left hand were passed into the bowel, and the stone, pressed down from above, was directly cut upon by a transverse incision, across the perineum and through the base of the bladder. The only apparatus required was a knife and a hook to remove the stone.

The Marian method came into vogue sometime early in the sixteenth century, and consisted in cutting through the perineum into the urethra, and then tearing or stretching an opening into the bladder by a number of guides and dilators. The operation was known, therefore, as the operation by the 'apparatus major'. It was founded on the false idea that wounds so made heal better than cuts in membranous structures. That it was a serious, as well as a painful and tedious operation, may be gathered from the fact that the mortality from it in the Charité Hospital, Paris, early in the eighteenth century, was over 50 per cent.

In 1697 Frère Jacques professed himself able to remove stone by a totally new and rapid method. Encouraged by Louis XIV., and by several of the court physicians and surgeons, he devoted himself to studying anatomy for a time, and later achieved brilliant results. His operation, known as 'lateral lithotomy', in which an oblique incision is made from the side of the perineum, upon a grooved metal 'staff' previously passed into the urethra, the incision being continued down the groove of the staff into the bladder, was for long the operation in vogue, after being improved and placed on a scientific basis by the English surgeon Cheselden (1727) and others.

In the *suprapubic* operation a vertical opening is made through the lower part of the abdomen to reach the upper part of the bladder, and, with improved modern methods, it has practically displaced the perineal route for all bladder operations.

From the shortness of the female urethra and the ease with which it can be dilated, lithotomy is comparatively seldom necessary in this sex.

LITHOTRITY, or **LITHOLAPAXY** (λίθος, stone; τρίβω, I rub down; λάπαξις, evacuation), is the term applied to the operation in which a stone in the bladder is crushed by an instrument introduced along the urethra, and the fragments washed out through a catheter. The latter name was applied by Bigelow of New York to cases in which the fragments are all removed and the operation completed at once. The operation was first performed by the French surgeon Civiale in 1824, and has now, to a great extent, replaced lithotomy, except in cases where a stone is very hard and very large, and in boys, whose urethra is too small to admit the passage of a lithotrite. The lithotrite, or stone-crusher, consists of two blades, one of which fits into a groove in the other, so that, when the inner blade is screwed home, the lithotrite is little larger than and similar in shape to a catheter, and can be easily passed along the urethra. The instrument is made of tough steel and provided with a powerful screw, so that when fragments of stone are caught between the blades they are easily crushed. The operation is a tedious one, and is performed under an anæsthetic, but no wound results from it.

LITMUS, which is prepared from several lichens, and especially from *Lecanora tartarea*, is a vegetable dye-substance, which on contact with alkaline fluids becomes blue, and on contact with acid fluids, red. Slips of paper, impregnated with litmus, form a valuable test for the acidity of the secretions and discharges.

LIVE-FLESH is a popular term applied to fine muscular tremors or twitchings seen especially in the eyelids and muscles of the hands. It is due usually simply to tiredness caused by over-use of the twitching muscles, but when persistent it may be a sign of some serious nervous disorder, such as progressive muscular atrophy.

LIVER

LIVER.—The liver is a solid organ of dark-brown colour and the largest gland in the body. It discharges, in all probability, several functions, acting both as an excreting organ and as an elaborator and storehouse of nourishment.

Form.—The shape of the liver is generally described as that of a right-angled triangular prism, with the right angle rounded off. It has five surfaces, upper, lower, front, back, and right, of which the front and back surfaces are triangular, with the base towards the right side and tapering off to the left. The surfaces are separated from one another by rounded margins, except in the case of the lower surface, which is divided from the right, front, and upper surfaces by a sharp edge. This edge in the living body can be felt rising and falling with respiration if the hand is pressed upon the upper part of the abdomen, a little below the margin of the ribs, towards the right side of the abdomen. The organ is divided also into five lobes. The great bulk of it constitutes the right lobe; the left lobe is small and extends a little way into the left half of the abdomen, to end in a sharp left border, while the Spigelian, quadrate, and caudate lobes are three small divisions upon the back and under surface. About the middle of the under surface, towards the back, is placed the 'transverse fissure', or 'portal fissure', by which the hepatic artery and portal vein carry blood into the liver, and by which the right and left hepatic ducts emerge, carrying off the bile formed in the liver. The 'gall-bladder' is attached to the under surface of the right lobe and projects from beneath the lower margin, where, if distended, it can be felt during life as a rounded swelling immediately beneath the end of the ninth rib. The connection of the gall-bladder, in which bile is stored, with the liver is rather complicated. The hepatic ducts emerge, as stated above, at the transverse fissure, one coming from the right and one from the left lobe. They immediately join, and the single hepatic duct, which is about an inch long, joins the 'cystic duct', coming from the gall-bladder, at an acute angle. The hepatic and cystic ducts by their union form the 'common bile-duct', which is about 3 inches in length, and opens into the small intestine. Bile, which passes down from the liver by the hepatic duct, may either pass directly into the common bile-duct and so into the intestine, or it may pass upwards through the cystic duct into the gall-bladder, to be stored there, and later retrace its way through the cystic duct to the bile-duct, and so to the intestine. The cystic duct and gall-bladder, therefore, together form a cul-de-sac upon the bile passages.

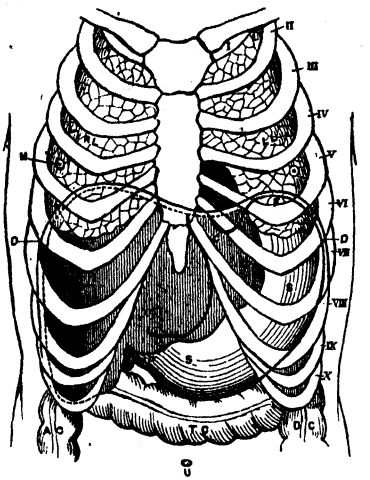


FIG. 300.—Diagram showing the position of the liver and its relations to surrounding organs. The ribs are indicated by Roman numerals; the dotted line shows the extreme right and upper limits of the liver. *D*, *D*, Diaphragm; *RL*, right, and *LL*, left lung; *P*, pericardium; *S*, stomach; *L*, liver; *G*, gall-bladder; *AC*, *TC*, *DC*, parts of the large intestine; *M*, right nipple; *U*, umbilicus. For other letters see STOMACH. (Turner's *Anatomy*.)

Position.—The liver occupies the right-hand upper portion of the abdominal cavity. Its upper surface is in contact with the diaphragm, which also separates its right surface from the right lower ribs. About four-fifths of the organ lies to the right of the middle line of the body. As it is of a rounded shape it fills up the dome of the diaphragm, the lower part of the right lung being hollowed out to receive the liver, from which it is separated only by the diaphragm and pleural membrane. The liver, in turn, rests upon various abdominal organs, the right kidney and suprarenal body, the large intestine, the duodenum, and the stomach all making

impressions upon it, and helping to support its weight. In addition, the liver is swung from the walls of the abdomen by five ligaments, four of which consist of thickened parts of the peritoneal membrane lining the whole abdominal cavity, and reflected from the upper part of the liver to its walls. These are the coronary ligament, right and left lateral ligaments, falciform ligament, and a dense fibrous cord, the round ligament.

Dimensions.—The vertical thickness of the liver amounts, towards the right side, to over 5 inches, and its extent from side to side is considerably more. Its weight is over 50 ounces, varying with the size of the person, but making up about $\frac{1}{40}$ or thereabout of the whole body-weight. In young children it is relatively much larger, accounting, to a large extent, for their protuberant abdomen, and making up about $\frac{1}{18}$ of the whole body.

Vessels.—The blood supply of the organ differs from that of any other part of the body, in that the blood collected from the stomach and bowels into the portal vein does not pass directly to the heart, but is distributed to the liver, in the substance of which the portal vein breaks up into capillary vessels. The effect of this is that some harmful substances, absorbed from the stomach and bowels, are abstracted from the blood-stream and destroyed, while various constituents of the food are stored up in the liver for gradual use. In addition, the liver receives a large hepatic artery from the cœliac axis, which also distributes branches to the stomach and pancreas, this blood supply serving to nourish the organ. After the blood has circulated through capillaries, it is collected together from both sources and emptied into the hepatic veins, which pass directly from the back surface of the liver into the inferior vena cava.

Minute structure.—The liver is enveloped in a capsule of fibrous tissue, Glisson's capsule, from which strands run along the vessels, and, penetrating to the farthest recesses of the organ, bind its structure together. The hepatic artery, portal vein, and bile-duct divide and subdivide, the branches of each lying alongside corresponding divisions of the other two, till the finest divisions of artery, vein, and bile-duct, known as interlobular vessels, lie between the lobules, of which the whole gland is

FIG. 301.—Diagram showing the organs from which blood is collected by the portal vein to be discharged into the liver. 1, Portal vein; 2 to 13, its various branches; *a*, liver; *b*, stomach; *c*, duodenum; *d*, pancreas; *e*, spleen; *f*, part of small intestine; *g*, *h*, *k*, *l*, large intestine; *m*, gall-bladder; *n*, cystic ducts; *o*, *o*, hepatic ducts; *p*, where bile-duct and pancreatic duct enter the duodenum; *q*, the pancreatic duct; *r*, hepatic artery; *s*, round ligament. (Turner's *Anatomy*.)

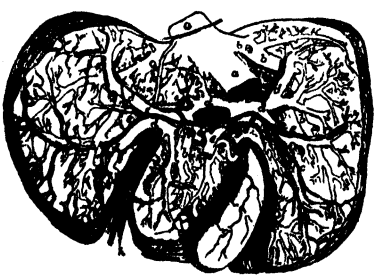


FIG. 302.—The under surface of the liver dissected to show the branching of the vessels in its substance. *a*, Inferior vena cava; *b*, *b*, hepatic veins; *c*, *c*, hepatic artery; *d*, *d*, portal vein; *e*, *e*, hepatic duct; *g*, gall-bladder; *h*, round ligament. (Turner's *Anatomy*.)

built up. These lobules, each of about the size of a small pin's head, form each in itself a complete secreting unit, and the liver is built up of many hundred thousands of such exactly similar lobules.

A lobule has the following structure. From the small vessels lying round its margin capillaries are given off which

run in towards the centre of the lobule, where they empty into a small 'central vein'. These central veins from neighbouring lobules collect together, and ultimately the blood passes into the hepatic veins, and so leaves the liver. Between the capillaries, which radiate from the central vein to the edge of the lobule, lie rows of large liver cells, these forming the distinctive tissue of the organ, upon which its activity depends. Between the rows of cells also lie fine bile capillaries, which collect the bile produced by the cells and discharge it into the bile-ducts lying along the margins of the lobules. The liver cells

FIG. 303.—Transverse section through the hepatic lobules. *i*, *i*, *i*, The interlobular branches of the portal vein ending in capillaries; *c*, *c*, central veins joined by these capillaries; at *a*, *a*, the connection of capillaries in neighbouring lobules is shown. Between the capillaries lie the rows of liver cells. (Turner's *Anatomy*.)

are among the largest cells in the body, and each contains one or two large, round nuclei. In the cells can often be seen droplets of fat or granules of glycogen, *i.e.* animal starch.

Functions. — The liver is a vast chemical factory. The heat produced by the chemical changes taking place in it forms an important contribution to the general warming of the body. The liver secretes bile, the chief constituents of which are the bile salts (sodium glycocholate and taurocholate), the bile pigments (bilirubin and biliverdin), cholesterol, and lecithin. The bile acids from which the salts are obtained are formed in the liver by the junction of glycocoll and taurine with cholic acid. The bile salts are absorbed from the intestine and so find their way back to the liver again. The bile pigments are the iron-free and globin-free remnant of hæmoglobin, being formed in the Kupffer cells of the liver. Bile pigments can, however, be formed in many

other parts of the body—in the spleen, the lymph glands, bone-marrow, connective tissues (giving the colour to a bruise). Bile, then, serves to excrete pigment, the result of breakdown of

FIG. 304.—Section through three lobules of the human liver to show the columns of secreting cells. *i*, Interlobular vein; *c*, *c*, *c*, central veins. Magnified 10 times. (Turner's *Anatomy*.)

old red blood corpuscles, and to aid the digestion of fat. Bile salts aid digestion of fat by emulsifying the fat, by activating pancreatic lipase, and by promoting fat absorption. Bile is necessary for the absorption of vitamins D and E.

In addition to forming bile the liver has a number of important functions.

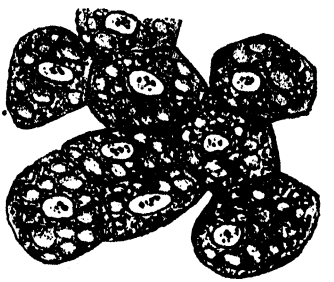


FIG. 305.—A group of liver cells showing infiltration with glycogen. The clear areas show the nuclei of the cells; the numerous mottled areas represent masses of glycogen. Magnified by about 600. (Thoma's *Pathology*.)

These are enumerated briefly: (1) In the embryo it forms red blood corpuscles and in the adult stores a substance necessary for the proper functioning of the bone-marrow in the manufacture of red corpuscles. (2) It manufactures the fibrinogen of the blood, and probably also the albumin and the globulin. (3) It stores iron and copper, necessary for the manufacture of red corpuscles. (4) It produces

heparin and, with the aid of vitamin K, prothrombin. (5) Its Kupffer cells in the liver blood-sinusoids are an important element in the reticulo-endothelial system, which breaks down red corpuscles, and probably manufactures antibodies. (6) It detoxicates noxious products made in the intestine and absorbed into the blood. (7) It stores carbohydrate in the form of glycogen, and maintains the two-way process glucose $\rightleftarrows$ glycogen. (8) It forms vitamin A from carotene and stores the B vitamins. (9) It splits up amino-acids and manufactures urea and uric acid. (10) It plays an essential part in the storage and metabolism of fat.

LIVER DISEASES.—The liver may be extensively diseased without any very urgent symptoms, unless the circulation through it be impeded, the outflow of bile checked, or neighbouring organs implicated. Jaundice, which is a symptom of several liver disorders, is treated of elsewhere. Dropsy, which may be caused by interference with the circulation through the portal vein of the liver, as well as by other causes, is also considered separately. The presence of gall-stones is a complication of some diseases connected with the liver, and is treated under GALL-BLADDER, DISEASES OF. For cirrhosis of the liver, or 'gin-drinker's liver', see CIRRHOSIS; for waxy degeneration see WAXY DISEASE; and for hydatid cyst of the liver see PARASITES. There are various methods of varying degrees of reliability of testing liver function.

INFLAMMATION OF THE LIVER is not a common condition in temperate climates, but in hot countries, and particularly in India, it gives rise to the condition popularly known as 'tropical liver', which is of great importance because of the frequency with which Europeans who have been resident in that country are affected by it.

Causes.—The cause which renders white people in India so specially liable to inflammation of the liver is the failure to adapt their habits as to food, drink, and exercise to the new conditions under which they live. Persons who eat the same rich food that can be tolerated or is necessary in a cold climate, those who fail to take exercise in the cooler parts of the day, and, above all, those who drink strong alcoholic liquors in large quantity, are prone to suffer. This disorder is, for these reasons, somewhere about ten times more common among English soldiers than it is among the native troops. Two diseases also lead very specially to inflammation of the liver, viz. malaria and dysentery, the latter of which not infrequently produces abscess. It is said that inflammation of the liver was three times as frequent twenty years ago as it is to-day in India, and this is attributable partly, no doubt, to better modern hygienic conditions, and largely to the fact that the heavier wines and stronger spirits are less drunk now than formerly.

Symptoms.—There are various degrees and types of this disorder. In the first place, the condition may amount only to a passing acute attack, from which the patient recovers perfectly, or, after numbers of these attacks, the liver may become permanently damaged and the condition chronic. On the other hand, particularly as a result of dysentery, an abscess or abscesses may form and give rise to a dangerous condition.

In the acute attacks, feverishness, tenderness over the site of the liver, and pain extending up to the right shoulder, together with digestive derangements, such as furred tongue, loss of appetite, and constipation, are the chief symptoms. The condition is rarely fatal, and, after some days' illness, recovery usually takes place.

When the condition has become chronic, the liver is permanently enlarged and painful, the bowels are costive, and sleeplessness and loss of appetite cause much annoyance. Piles are almost always troublesome, in consequence of the interference with circulation in the liver. The face of such a person has a very typical appearance, the skin being jaundiced and earthy-looking, and the whites of the eyes yellow, his temper is apt to be irritable, and he suffers not infrequently from great mental depression. If the habits of such a person have been very intemperate and cirrhosis of the liver be present, the condition becomes much worse, and may, before long, end fatally.

Treatment.—In the acute attacks, rest in bed, a very simple diet, and avoidance of all alcoholic liquors are the essentials. Counter-irritation over the

liver by mustard leaves, painting with iodine, or blisters, give great relief. Recourse is often had, with benefit, to cupping over the liver. A smart saline purge of phosphate of soda or some aperient water in the morning, or a blue pill at night, is also of importance, and, as the condition is passing off, various tonics of quinine and iron are prescribed.

In chronic cases, what has been said under the head of Causes indicates the line of treatment. Over-eating, and the drinking of heavy wines and strong spirits, must be abandoned. In fact, persons suffering from this complaint would do well to become total abstainers from alcohol, and to eat only the simplest foods. When the condition is attributable to malaria or dysentery, these conditions must in addition receive treatment. The drugs which have been specially advocated for this condition are chloride of ammonium and nitro-hydrochloric acid, and special benefit is obtained from a course of treatment by aperient waters at Carlsbad or some other spa.

ABSCESS OF THE LIVER.—When an abscess develops in the liver, it is usually a manifestation of dysentery, appearing sometimes late in the disease, even after the diarrhœa is cured ; it may also follow upon inflammation of the liver due to other causes ; and abscesses may form in this organ as in other sites in cases of blood-poisoning. The symptoms of abscess are much the same as in other types of inflammation, only they are more pronounced, and accompanied often by rigors, and by great enlargement of the liver. It is usual for the physician in a case of suspected abscess to make exploratory punctures in the liver with a hollow needle, when, if brown or reddish pus be found, the diagnosis is established. The treatment of such an abscess consists in immediate opening, so soon as the diagnosis is made.

CONGESTION OF THE LIVER is a term sometimes applied to the slighter forms of inflammation, in which the liver is said to be ' actively congested '. But the term is generally reserved for a state of ' passive congestion ', quite distinct from any inflammatory process, which frequently affects the liver to a marked extent in persons who are the

subject of heart disease and some forms of lung disease. It arises in consequence of the close connection of the liver with the right side of the heart, through the inferior vena cava and the wide hepatic veins, which open into this vessel just before its entrance to the heart. When the right side of the heart is dilated, or there is some obstruction to the circulation through the lungs, or some valvular disease of the heart, the circulation of the blood is retarded and thus congestion of the liver results.

Symptoms.—The liver becomes enlarged and causes a sense not so much of pain as of fullness and discomfort in the abdomen, which may be tender to the touch. The complexion is yellowish, the tongue furred, the appetite lost, and there are often both vomiting of bile and looseness of the bowels. There may also be headache, languor, and depression of spirits. At the same time the lung or heart condition which is responsible for the liver-congestion gives rise to symptoms of its own.

Treatment.—The condition is usually a very chronic one, with exacerbations from time to time. It is treated, in the first place, by alleviating so far as possible the cause producing it, and when the cause consists in faulty action of the heart, the various cardiac tonics are particularly useful. An occasional dose of calomel or blue pill, combined with some of the drugs like podophyllin or euonymin, which increase the flow of bile, will relieve the condition for a time. Chloride of ammonium, iodide of potassium, and nitrohydrochloric acid are other drugs whose use is often advocated.

FATTY DISEASE OF THE LIVER may consist of an infiltration of the cells of the liver with fat in those who eat to excess, particularly of rich, fat, or oily foods ; or in wasting diseases there may be a degeneration in the liver-cells of this character. The liver is enlarged, and, though usually painless, it gives rise to discomfort and to embarrassment of breathing, particularly after meals. When due to over-eating, other organs, such as the heart, and the body generally are also loaded with fat. A certain amount of indigestion and constipation are often present, and a person affected in this way can offer but feeble resisting power to any disease by which he may

be attacked. (For treatment see under CORPULENCE.)

ACUTE YELLOW ATROPHY is a destructive and fatal disease of the liver which is very rare, but which appears suddenly and apparently without cause. From the fact that a very similar state of the liver is produced by phosphorus poisoning, it is supposed that the condition is due to some poison of unknown nature circulating in the blood. Women are more often affected than men, and especially during pregnancy. It comes on with a slight degree of jaundice, which cannot be distinguished from simple jaundice, and lasts several days. Then the jaundice suddenly deepens, there is pain in the region of the liver, convulsions and delirium appear, the heart grows very weak, and death ensues in a day or two. If the liver be examined after death, it is found to be shrunken and soft; the cut surface is of mottled yellow and red colour, the liver-cells being in places shrivelled and degenerated, in other places completely broken down; crystals of leucine and tyrosine are found here and there; and the capsule and remaining liver-cells are stained with bile. The destruction of the liver as a secreting organ may be complete, but occasionally areas here and there only are affected, and recovery may then take place with restoration of the damaged areas after a prolonged illness.

CANCER OF THE LIVER is not uncommon, although it is rare for the disease to begin in the liver, the involvement of this organ being usually secondary to disease situated somewhere in the stomach or bowels. Cancer originating in the liver is very rare in earlier life, and most of the cases arise in old people in connection with the gall-bladder, and some appear to be produced by long-continued irritation of a gall-stone. There is great emaciation, which increases as the disease progresses. The liver is much enlarged, and its margin and surface are rough, being studded with hard cancer masses of varying size, which can often be readily felt through the abdominal wall. Pain may be present. Jaundice and dropsy often make their appearance.

LIVER EXTRACT is prepared from minced ox or sheep liver by treatment with several changes of alcohol. The dry extract is mixed with salt and stored in glass tubes, each containing the extract from about ½ lb. of fresh liver, which forms a single dose. The liquid extract is formed by dissolving this in a mixture of glycerin, alcohol and water, so that one fluid ounce is equal to ½ lb. of fresh liver. Liver extract is used especially in the treatment of pernicious anæmia.

LIVER-FLUKE is the popular name of *Distoma hepaticum*, a parasite which infests the sheep, and which is occasionally found in the bile-passages and liver of man. (*See* PARASITES.)

LIVER PILLS (*see* CHOLAGOGUES).

LIVER SPOT is a popular term applied to brownish marks which appear on the skin, especially of the face. This is sometimes caused by the growth of a parasite (*tinea versicolor*) in the surface layers of the cuticle. It also frequently accompanies pregnancy or the presence of abdominal tumors. It may also be due simply to some long-continued form of local irritation.

LOBE (λοβός) is the term applied to the larger divisions of various organs, such as to the five lobes of the liver, to the three lobes of the right and two lobes of the left lung, which are separated by fissures from one another, and to the lobes or superficial areas into which the brain is divided. The term lobar is applied to structures which are connected with lobes of organs, or to diseases which have a tendency to be limited by the boundaries of lobes, such as 'lobar pneumonia'.

LOBECTOMY is the operation of cutting out a lobe of the lung in such diseases as cancer of the lung and bronchiectasis.

LOBELIA is the name of a remedy frequently used for asthma. It consists of the leaves and tops of *Lobelia inflata*, a common weed in the United States. In very large doses, it causes vomiting and paralyses the heart's action, being a dangerous poison, but in moderate doses it relieves the spasm to which asthma is due. It is a constituent of many burning powders made for smoking by asthmatics, but it is more frequently used in the form of tincture of lobelia combined with other drugs.

LOBOTOMY.—The cutting of a lobe. (*See* LEUCOTOMY.)

LOBULE (*lobulus*, a little lobe) is the term applied to a division of an organ smaller than a lobe; for example, the lobules of the lung are of the size of millet seeds, those of the liver slightly larger. Lobules form the smallest subdivisions or units of an organ, each lobule being similar to the others, of which there may be perhaps several hundred thousand in the organ. The term 'lobular' is applied to structures such as small blood-vessels belonging to individual lobules, or to disease which occurs in a scattered manner in organs, affecting lobules here and there.

LOCHIA (λόχια) is a term applied to the discharge which takes place during the first week or two after child-birth. During the first four days it consists chiefly of blood; after the fifth day the colour should become paler, and after the first week the quantity should diminish and the appearance be purulent. There should at no time be any putrid odour, the presence of this being an indication of dangerous septic infection. The presence of blood after the second week indicates that the patient has been too active or that the natural absorptive changes are not duly taking place. (*See* PUERPERIUM.)

LOCK-JAW is a prominent symptom of tetanus and is the popular name for this condition.

LOCOMOTOR ATAXIA (ἀ, neg.; τάξις, order), also called PROGRESSIVE LOCOMOTOR ATAXIA, TABES DORSALIS, POSTERIOR SPINAL SCLEROSIS, is a disease of the nervous system, manifesting itself principally by disordered movements of the limbs in walking. This disorder is not, as was once supposed, a form of paralysis (there being no diminution of muscular strength), but is dependent on the loss of the power of co-ordinating the muscles into harmonious action, which is essential to the proper performance of the voluntary movements of the body, and the maintenance of its equilibrium. Although the disease had been previously noticed both by Romberg and Dr. R. B. Todd, it was first fully described and named by Duchenne in 1858.

Causes.—The pathological condition giving rise to locomotor ataxia is disease of a certain portion of the spinal cord, viz. the posterior columns and the posterior nerve roots. These undergo various chronic inflammatory changes, which result in their ultimately becoming atrophied and indurated. When affecting, as this lesion most commonly does, the lower dorsal and lumbar regions of the cord, the ataxic symptoms are chiefly confined to the legs; but when it affects the cervical portion, the arms are involved. Occasionally the whole posterior columns of the cord are found diseased. The exciting causes of the malady were, formerly, supposed

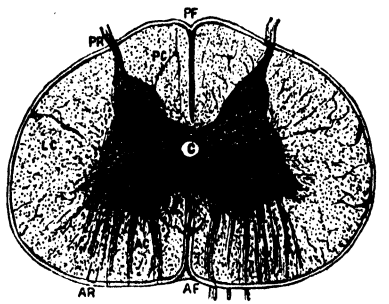


FIG. 306.—Transverse section of the spinal cord in the lumbar region. *AF*, *PF*, Anterior and posterior fissures; *AR*, *PR*, anterior and posterior nerve roots; *AC*, *LC*, *PC*, anterior, lateral, and posterior columns; *C*, central canal of the cord. The dark mass in the interior of the cord is the grey matter. *PC* and *PR* are the parts specially affected in locomotor ataxia. (Turner's *Anatomy*.)

to be, in different cases, exposure to cold and privation, intemperance, over-exertion, and mental anxiety, but it is now held that it is a late result of syphilis, although the above-named conditions may hasten its development. The changes in the spinal cord begin as a chronic inflammatory condition of the fine membrane (pia mater) covering the cord. As a result, some of the nerves entering the cord become compressed and the seat of inflammatory and degenerative changes, which affect these nerves after their entrance to the cord. The posterior nerves (sensory nerves) are specially affected in this way, and as these pass into the posterior horns of grey matter and ultimately upwards in the posterior columns of white matter in the cord, the change is particularly

LOCOMOTOR ATAXIA

seen in the posterior columns upon a cross-section of the cord. Locomotor ataxia is much more common among men than among women, over 90 per cent of cases being males. It is a disease of middle life, being most frequently observed to occur between the ages of thirty and fifty.

Symptoms.—Locomotor ataxia usually begins insidiously, and advances slowly. Among the earlier symptoms observed are a tendency to stagger in walking or standing, especially when the eyes are closed, disorders of vision, with occasionally temporary or permanent paralysis of some of the cranial nerves, violent shooting pains down the limbs, decreased or perverted sensibility in various parts of the body, and disturbance of the genito-urinary functions. Among the early signs of the disease discovered by the physician, two of the most important are—loss or diminution of the knee-jerks obtained on tapping the patellar tendon; and a sluggish condition of the iris of the eye, which, though altering the size of the pupil as the eye accommodates itself for vision of near objects, fails to contract normally when a bright light falls upon the eye. These initial symptoms may continue without much change for a long period, but generally, in the course of time, others are superadded, which give more definite intimation of the existence of the disease, and render its diagnosis a matter of little difficulty. The sufferer begins to be aware that he cannot walk with the same freedom as before, and he feels as if some soft substance were interposed between his feet and the ground. His gait assumes a peculiar and characteristic appearance. He begins the act of walking with evident difficulty, and his steps are short and hurried. Each foot is lifted well from the ground; but as he moves forward it is thrown out from him, and his heel descends forcibly, and is followed at a longer than the normal interval by the sole. In walking, he requires the aid of his vision to preserve his equilibrium, and he therefore looks at his feet, or rather at the ground a little in front of them, as he advances. He cannot turn about suddenly without the risk of falling. If asked to stand erect with his feet together, and then directed to close his eyes or to look upwards, he immediately begins to sway and totter, and would fall if not supported—a symptom known as Rombergism. These various symptoms are the result, not of any weakness of motor power, but simply of defective muscular co-ordination. Along with this there usually exists markedly diminished sensibility to touch and to painful impressions, such as a pin prick or the approach of some unusually hot or cold object. This is noticeable particularly in the feet and legs. Sometimes the disorder implicates the upper extremities, and then the hands and fingers cease to perform their functions with precision, so that the patient is unable to pick up any small object from the ground, to button or unbutton his clothing, and even sometimes to feed himself, although at the same time there is no weakness in the muscular power of the hand, which is capable of grasping as firmly as before. With the advance of the disease, the disorder of movements increases. The patient's efforts to walk become more and more difficult, for his limbs are jerked about without restraint, while even the aid of his vision and the support of a stick are insufficient to prevent him from falling. Ultimately, all efforts of this kind have to be abandoned, and he is compelled to lie in bed. In the later stages of the disease, all the symptoms become aggravated. Owing to the involvement of other nerves, the functions of several organs of the body are liable at times to be carried out in an irregular and spasmodic manner; thus the patient has attacks of violent vomiting (gastric crises), of laryngeal spasm and difficulty in breathing (laryngeal crises), of inability to retain the urine (bladder crises). The shooting pains and violent jerkings of the limbs increase, motor power becomes impaired, and the patient sinks under the prolonged and exhausting course of discomfort, or dies from some intercurrent disease. Although usually progressive to a fatal termination, locomotor ataxia is sometimes arrested, particularly in its early stages, even for a period of many years, and attention has been directed by Dejerine among other authorities to the fact that if the optic nerves be early affected, causing partial or total blindness, the progress of the disease may be delayed for many years. In such cases, however, there is a tendency for the

patient to develop the closely related disease of general paralysis.

Treatment.—From the nature of the structural changes affecting the spinal cord in locomotor ataxia, it is evident that, beyond the employment of means to alleviate the various painful symptoms, little can be done towards its complete cure. Numerous medicines have from time to time been brought forward, as supposed to possess special efficacy in the treatment of this disease, but none of them has proved to be of much value. In the earliest stages of the disease the remedies appropriate to syphilis, viz. salvarsan, mercury, and iodide of potassium, may be employed. Probably most good will be found to result from careful efforts to maintain the general health by a well-appointed diet and regimen. A form of treatment introduced by Professor Frenkel consists in making the patient perform several times daily, with great care, a series of co-ordinated movements, such as walking carefully along a board in the floor, putting his toes exactly on a series of marks, etc. As he becomes gradually more expert, the exercises, which were at first very simple, are made more and more difficult, and thus new paths in the spinal cord are educated to take the place of those which the disease has destroyed. As a result the symptoms may be temporarily abolished, and even patients who have become bed-ridden may regain the power of walking.

LODAL is the name of a preparation derived from opium and used in prolonged uterine hæmorrhage.

LOGWOOD (*see* HÆMATOXYLON).

LOIN is the name applied to the part of the back between the lower ribs and the pelvis. (For pain in the loins see BACKACHE and LUMBAGO.)

LONG-SIGHT (*see* SPECTACLES).

LORDOSIS (λόρδωσις) means an unnatural curvature of the spine forwards. It occurs chiefly in the lumbar region, where the natural curve is forwards, as the result of muscular weakness, special disease, etc. (*See* SPINAL COLUMN.)

LOSS OF BLOOD (*see* HÆMORRHAGE).

LOTION (*lotio*, a fluid application) means a fluid preparation intended for bringing in contact with or for washing the external surface of the body. Lotions are generally of a watery or alcoholic composition, and many of them are known as 'liquors'. Those external applications which are of an oily nature, and intended to be rubbed into the surface, are known as liniments.

LOUSE (*see* PARASITES, *and* INSECTS IN RELATION TO DISEASE).

LOZENGES (λοξός, crosswise; γωνία, a corner), also known as TROCHES, or TROCHISCI, consist of small tablets containing drugs mixed with sugar, gum, glycerin-jelly, or fruit-paste. They are used in various affections of the mouth and throat, being sucked and slowly dissolved by the saliva, which brings the drugs they contain in contact with the affected surface. Some of the substances most commonly used in lozenges are benzoic and tannic acids, marshmallow, potassium chlorate, eucalyptus, guaiacum, rhatany, morphia, cocaine, carbolic acid, and menthol.

LUES is the Latin word for a serious infectious disease, the term being especially applied to syphilis.

LUGOL'S SOLUTION is a compound solution of iodine and potassium iodide.

LUMBAGO (*lumbi*, the loins) is a term applied to a painful ailment affecting the muscles of the lower part of the back, generally regarded as of rheumatic origin.

Cause.—Lumbago seems to be brought on by exposure to cold and damp, and by the other exciting causes of rheumatism. Sometimes it follows a strain of the muscles of the loins. The pain accompanying rheumatic manifestations in this region is believed to be due to an inflammatory condition in the connective tissues of the muscles, causing congestion of the blood-vessels and consequent pressure upon the endings of the sensory nerves. To this condition the term 'fibrositis' is applied. Lumbago is specially apt to occur in the back muscles after they have been the seat of a strain or other injury leading probably to a tear in the muscle fibres, and the pain in such a case is largely produced

by violent spasm of the surrounding muscle. In other cases lumbago occurs in gouty subjects and the attacks take the place of an ordinary attack of gout.

Symptoms.—An attack of lumbago may occur alone, or be associated with rheumatism in other parts of the body at the time. It usually comes on as a seizure, often sudden, of pain in one or both sides of the small of the back, of a severe cutting or stabbing character, greatly aggravated on movement of the body, especially in attempting to rise from the recumbent posture, and also in the acts of drawing a deep breath, coughing, or sneezing. So intense is the suffering that it is apt to suggest the existence of inflammation in some of the neighbouring internal organs, such as the kidneys, bowels, etc., but the absence of the symptoms specially characteristic of these latter complaints, or of any great constitutional disturbance beyond the pain, renders the diagnosis a matter of no great difficulty. The attack is in general of short duration, but occasionally it continues for a long time, not in such an acute form as at first, but rather as a feeling of soreness and stiffness on movement.

Treatment.—The treatment includes that for rheumatic affections in general (*see* RHEUMATISM), and the application of local remedies of counter-irritant nature. Of these the best are hot fomentations with turpentine or laudanum applied by means of flannel or spongio-piline to the part; or the rubbing in, if this can be borne, of liniments, such as those of opium, belladonna, chloroform, aconite, etc. The old and homely plan of counter-irritation by applying a heated iron to the part with a sheet of brown paper or blanket interposed is often beneficial in chronic cases, as is also, on similar principles, Corrigan's button cautery. The subcutaneous injection of morphia or atropine is called for when the attack is very severe and prevents sleep. Of late the hot-air bath, and various electrical applications, including faradisation, static breeze, diathermy, and high-frequency currents, have been used with at least temporary alleviation of the pain. (*See* BATHS, ELECTRICITY IN MEDICINE.)

LUMBAR (*lumbi*, the loins) is a term used to denote structures in or diseases affecting the region of the loins, as, for example, the lumbar vertebræ, lumbar abscess, etc.

LUMBAR PUNCTURE.—A procedure for removing cerebro-spinal fluid from the spinal canal in the lumbar region in order (1) to diagnose disease of the nervous system; (2) to relieve pressure when too much cerebro-spinal fluid is being formed, as in meningitis; and (3) to introduce medicaments—spinal anæsthetics, or drugs, or serum.

LUMBRICUS (*lumbricus*, a worm) is a name sometimes applied to the 'round-worm' or *Ascaris lumbricoides*. (*See* PARASITES.)

LUMINAL, or PHENOBARBITAL, is a sedative drug used particularly in epilepsy, but also in neurasthenia, exophthalmic goitre, and other nervous conditions. It is given in doses of ½ to 2 grains. Luminal sodium is a soluble preparation given in similar doses for the same purposes.

LUNAR CAUSTIC (*lunaris*, moonlike, silver being the moonlike metal) is another name for nitrate of silver.

LUNATIC (*luna*, the moon) is a general term applied to persons of disordered mind, because lunacy was supposed at one time to be largely influenced by the moon. (*See* INSANITY.)

LUNGS.—The lungs form a pair of organs situated in the chest, and discharge, perhaps, the most important function of vital activity, viz. respiration. (*See* RESPIRATION.) The air, which enters through the nose and passes down the throat, larynx, and windpipe in succession (*see* AIR PASSAGES), reaches the lungs by the right and left bronchial tubes, into which the windpipe divides within the chest, at the level of the second rib. The texture of the lungs is very highly elastic, so that when the chest is opened each lung collapses to about one-third of its natural bulk.

Form and position.—Each lung is roughly conical in shape, with an 'apex' projecting into the neck, and a base resting upon the diaphragm. The rounded outer surface of each is in contact

with the ribs of its own side, while the heart, lying between the lungs, hollows out the inner surface of each to some extent. There is an anterior border, along which the outer and inner surfaces meet, and the borders of the two lungs touch one another for a short distance behind the middle of the breast

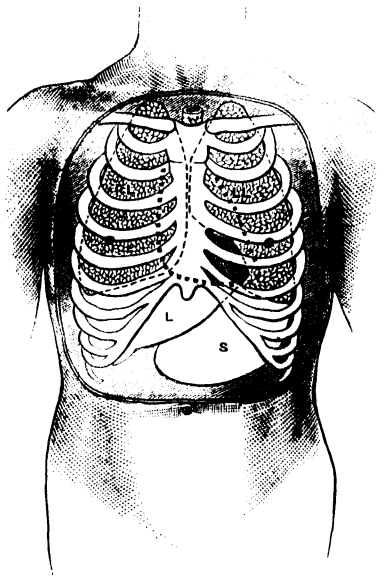


FIG. 307.—Chest with the skin and muscles removed from the front, showing the position of heart and lungs. *H*, Heart; *LL*, left lung; *RL*, right lung; *W*, windpipe; *L*, liver; *S*, stomach.

bone. The apex, which is blunt, extends 1½ inches or more into the neck above the line of the collar-bone, being covered here by the muscles of the neck. The base is deeply hollowed, in correspondence with the domed shape of the diaphragm, which is pushed up by the liver on the right side, and by the stomach and spleen on the left. The right lung is split by two deep fissures into three lobes; the left has two lobes divided by a single fissure. The weight of the two lungs together is about 40 ounces, the right being rather heavier than the left, and the lungs of men much heavier than those of women. Each lung is enveloped in a membrane, the 'pleura' or 'pleural membrane', in such a way that one layer of the

membrane is closely adherent to the lung, from which indeed it cannot be separated, while the other layer lines the inner surface of one half of the chest. These two layers form a closed cavity, the 'pleural cavity', which everywhere surrounds the lung except at the point where the bronchi and vessels enter it. This cavity is, in the natural state, a merely potential space, the two layers of pleural membrane being separated only by a thin layer of fluid, which enables them to glide with very little friction over one another, as the lung expands and retracts in breathing; but, in certain states, the fluid collects in the pleural cavity, so that several pints of fluid may be effused there, compressing the lung. In some circumstances air escapes into the pleural cavity, and the lung then collapses temporarily upon its root, but air in the pleural cavity is very quickly absorbed and

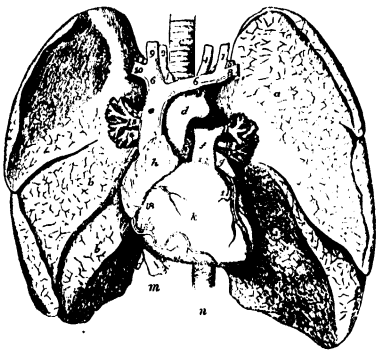


FIG. 308.—The organs of the chest. The lungs are turned outwards to show the heart and the intimate connections between heart and lungs. *a*, Upper, *a'*, lower lobe of left lung; *b*, upper, *b'*, middle, *b''*, lower lobe of right lung; *c*, trachea; *d*, arch of aorta; *e*, superior vena cava; *f*, pulmonary artery; *g*, left auricle; *h*, right auricle; *k*, right ventricle; *l*, left ventricle; *m*, inferior vena cava; *n*, aorta; 1, innominate artery; 2 and 4, carotid arteries; 3 and 5, subclavian arteries; 6, 6, innominate veins; 7 and 9, internal jugular veins; 8 and 10, subclavian veins; 11, 12, 13, left pulmonary artery, bronchus, and vein; 14, 15, 16, right bronchus, pulmonary artery, and vein; 17 and 18, coronary arteries. (Turner's *Anatomy*.)

the lung speedily comes to occupy its original volume.

Colour.—In children, the colour of the lungs is rose-pink, but, as life advances, they become more and more of a slaty hue, mottled with streaks and patches of dark-grey and black, which

are due to deposits in the lymph spaces of dust inhaled on the breath. Esquimaux and others who live in an atmosphere free from dust retain the colour of childhood, while, on the other hand, the lungs of coal-miners become often of a uniform jet-black shade.

Changes at birth.—Prior to birth, and in still-born children, the lungs are of a yellowish colour, of solid gland-like appearance, and packed away in the back of the chest. Further, such lungs do not float in water, and their weight amounts to about $\frac{1}{70}$ of the whole body-weight. Immediately upon birth a remarkable change takes place; the tissue of the lungs expands, like the petals of an opening flower; the colour changes to rose-red, and the weight is suddenly doubled in consequence of the inrush of blood; the consistence becomes spongy, as air is drawn into the lungs, and if the child should die after drawing a few breaths, any portion of the lung which may be cut off floats in water. These changes are of

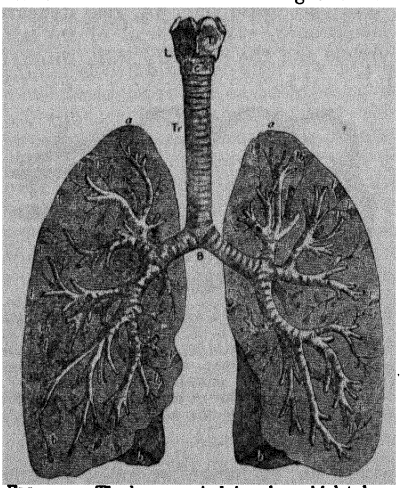


FIG. 309.—The larynx, windpipe, bronchial tubes, and lungs. *L*, Larynx; *T*, thyroid cartilage; *C*, cricoid cartilage; *Tr*, trachea splitting at *B* into the two bronchi; *a*, apex; *b*, base of each lung; *lb*, *lb*, the finest bronchial tubes; *l*, *l*, *l*, lobules. (Turner's *Anatomy*.)

importance, from the medico-legal point of view, in determining whether a dead infant has been born alive or not.

Connections with heart.—Not only does the heart lie in contact with the two lungs, so that changes in the volume of the lungs cannot fail to have an effect upon the heart's action, but the heart is also connected by vessels with both lungs. The pulmonary artery passes

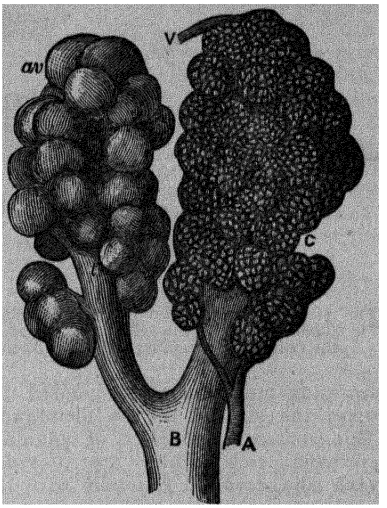


FIG. 310.—The outer surface of two infundibula in a lobule of the lung. *B*, The little bronchial tube of the lobule; *av*, air vesicles; *A*, branch of the pulmonary artery; *C*, capillaries; *V*, small pulmonary vein. (Turner's *Anatomy*.)

from the right ventricle and divides into two branches, one of which runs straight outwards to each lung, entering its substance along with the bronchial tube at the 'hilum' or 'root' of the lung. From this point also emerge the pulmonary veins, which carry the blood purified in the lungs back to the left auricle.

Minute structure.—Each main bronchial tube, entering the lung at the 'root', divides into branches, which subdivide again and again, to be distributed all through the substance of the lung, till the finest tubes, known as 'bronchioles', or 'capillary bronchi', have a width of only $\frac{1}{1\,0\,0}$ inch. In structure, all these tubes consist of a mucous membrane surrounded by a fibrous sheath. The windpipe, as well as the larger and medium bronchi, has in the fibrous layer large pieces of cartilage which in the windpipe and largest bronchial tubes form regular hoops, and in the medium-sized tubes are disposed as irregular plates. These pieces of cartilage have the function of preventing the tubes from closing or being

compressed, and so obstructing the passage of air. The larger and medium bronchi are richly supplied with glands like the latter into finer and finer branches, and ending in a dense network of capillaries, which lies every-

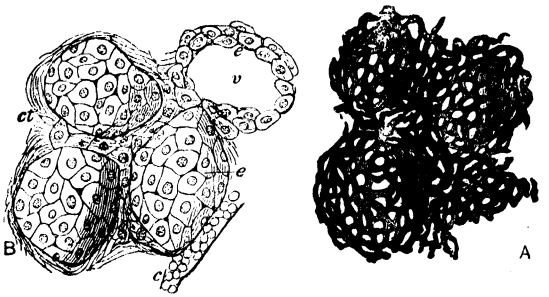


FIG. 311.—The arrangement of the capillaries and air-vesicles. *A* shows the dense arrangement of capillaries; in *B* the cells lining the air-vesicles, *e*, are shown; *ct*, connective tissue between the vesicles; *c*, a capillary containing blood corpuscles. Magnified by 450. (Turner's *Anatomy*.)

secreting mucus, which is poured out upon the surface of the membrane. This surface is composed of columnar epithelial cells, which are provided with cilia, credited generally with the power of moving expectoration upwards towards the throat, but is probably also designed to load the air passing into the lungs with warm moisture before it reaches these organs. The wall of the bronchial tubes is very rich in fibres of elastic tissue, and immediately beneath the mucous membrane is a layer of circularly placed unstriped muscle fibres, which is specially well developed in the smaller bronchi. To this muscular layer probably is due the removal of expectoration, and it is certainly of great importance in connection with the causation of asthma. (*See* ASTHMA.)

The smallest divisions of the bronchial tubes open out into a number of dilatations, the 'infundibula', each measuring about $\frac{1}{20}$ inch in width, and these are covered with minute sacs, known as 'air-vesicles' or 'alveoli'. Each air-vesicle consists of a delicate membrane composed of flattened plate-like cells, strengthened by a wide network of elastic fibres, to which the great elasticity of the lung is due; and in these thin-walled air-cells the important function of the lungs is carried on.

The branches of the pulmonary artery accompany the bronchial tubes to the farthest recesses of the lung, dividing where between the air-vesicles, the capillaries being so closely placed that they occupy a much greater area than the spaces between them. The air in the air-vesicles is separated, therefore, from the blood only by two delicate membranes, viz. the wall of the air-vesicle and the capillary wall, through

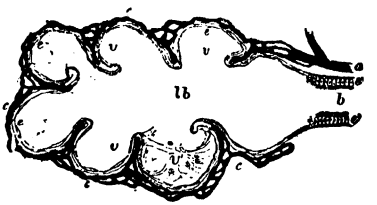


FIG. 312.—Diagram of a section lengthwise through an infundibulum. *b*, Bronchial tube; *lb*, lobular passage; *v*, *v*, air-vesicles; in *v'* the side wall is shown; *a*, branch of pulmonary artery; *c*, *c*, pulmonary capillaries; *e'*, ciliated epithelium of bronchial tube; *e*, flat epithelium lining the air-vesicles. (Turner's *Anatomy*.)

which an exchange of gases readily takes place. The blood from the capillaries is collected by the pulmonary veins, which also accompany the bronchi to the root of the lung.

Another and much smaller set of bronchial blood-vessels runs actually upon the walls of the bronchial tubes, and these serve the purpose of nourishing the lung tissue.

There is in the lung also an important system of lymph vessels, which commence in spaces situated between the

air-vesicles, under the pleural membrane, and in the walls of the bronchial tubes. These vessels leave the lung along with the blood-vessels, and are connected with a chain of bronchial glands, lying near the end of the windpipe.

LUNG DISEASES. — The general symptoms and signs produced by disease of the lungs are mentioned under CHEST, DISEASES OF, and the chief affections to which these organs are liable are also treated under special headings. (*See* BRONCHITIS; CHEST, DEFORMITIES OF; CHILLS AND COLDS, CONSUMPTION, EMPHYSEMA, EXPECTORATION, HÆMOPTYSIS, HÆMORRHAGE, PLEURISY, PNEUMONIA, TRADE DISEASES.)

INFLAMMATION OF THE LUNGS is generally known as pneumonia, but may be of several different types. (*See* PNEUMONIA.) The most common form is that of *lobar pneumonia*, in which one or more lobes of the lung become inflamed and consolidated, generally as the result of infection by a particular bacterium, the *Diplococcus pneumoniæ*. Inflammation may also arise in a diffuse form throughout one or both lungs, in consequence of bronchitis, and this form of the disease, known as lobular pneumonia, or *broncho-pneumonia*, is very fatal to young children and the aged. (*See* BRONCHITIS.) Inflammation of the lungs is a serious complication of typhoid fever and various other weakening infectious diseases, and when it is of this *secondary* type it is very often fatal. Inflammation may be of a localised nature in one part of the lung, due, for example, in aged or weakly persons, to inhaling some food or drink, and may result in abscess. (*See* ABSCESS.) Again, the disease may be of a *chronic* nature in those who constantly inhale irritating particles, such as stone-masons, or those who have had an acute attack which has not healed completely; and consumption is a very chronic form of inflammation caused by the tubercle bacillus.

ABSCESS OF THE LUNG is a comparatively rare condition, and consists, like abscesses elsewhere, of a collection of pus in one or more spots of the lung. It may result from an acute pneumonia which does not clear up properly, or it may be due to a wound of the lung from without, or to the presence of foreign bodies, such as buttons, pins, or fragments of food, which have been sucked down the air passages. An abscess may also occur in the lung, as in other organs, during the course of blood poisoning (pyæmia), or may be produced by the bursting of an abscess into the lung after its formation in some neighbouring organ. The condition is in practice hard to tell from cavity formation due to consumption; though the failure to find tubercle bacilli in the expectoration, after repeated examination, is an important point against the latter condition.

An abscess in the lung may burst into one of the bronchial tubes, and, after the pus is spat up, healing and recovery may take place. On the other hand, an abscess in one of these organs is apt to go on constantly discharging, and thus to undermine the general health. For this reason it is sometimes sought to evacuate the abscess through the side, portions of two or three ribs being removed and the lung fixed to the chest wall by sutures. The operation is a dangerous one, but if successful may result in a complete cure.

GANGRENE OF THE LUNG is another result which may follow pneumonia in persons of poor constitution or debilitated by serious illness. Just as in the case of gangrene of limbs, a portion of lung dies and putrefies, giving rise to a most offensive smell, as the dead and broken-down lung tissue is spat up. The prospect of recovery is very small, even when the portion of lung involved is very limited.

BRONCHIECTASIS is a condition which may come on in persons who have long suffered from bronchitis or from chronic pneumonia. The proper lung substance undergoes a certain amount of shrinkage, while at the same time the bronchial tubes become here and there distended into large cavities. These cavities are lined by mucous membrane, which continues to form a secretion, and this secretion, as it does not find a ready outlet by the bronchial tubes, undergoes putrid changes. The person therefore spits up from time to time a copious amount of foul-smelling expectoration, and the air of the room in which he lies is rendered offensive

by his breath. The condition is not immediately dangerous to life, although it gradually produces deterioration of the general health, and its symptoms are those of an aggravated form of chronic bronchitis. The treatment is that of chronic bronchitis, and in addition the smell of the breath is kept in check by inhalations of creosote, or by vaporising creosote and other aromatic substances in steam, near the person's bed. Secretion tends to collect in the bronchiectatic cavities especially during the night, and the patient usually finds that he can get rid of this secretion by adopting a special posture while he coughs, lying on one or other side with the head over the edge of the bed. An operation similar to that for phthisical cavities is sometimes performed to relieve this condition.

CONGESTION OF THE LUNGS is a term which is used in two quite different senses. The term is used to mean acute inflammation of the lung in its early stages. When the patient recovers after a few days, instead of passing through the complete course of an attack of pneumonia, the illness is often described as an attack of acute congestion.

In strict medical language, the term is used to mean quite a different condition of a more chronic nature, viz. passive or mechanical congestion of the blood-vessels in the lungs due to some defect in the pumping action of the heart. Passive congestion arises under two sets of conditions. A very serious form, known as 'hypostatic congestion', arises when the heart is failing, towards the end of severe and long-continued fevers, such as typhoid fever; after severe surgical operations; and in old people who for any reason, such as the occurrence of a broken leg, are confined for some weeks to bed. It occurs in the back parts of the lungs, in consequence of the feeble heart being unable to drive out of them the blood which gravitates into these dependent parts. Inflammation is very apt to arise in these congested parts, and 'hypostatic pneumonia' often ends the life of old or feeble persons confined to bed. The other form of passive congestion is due, not so much to weakness in the pumping action of the heart, as to some obstruction which hinders the escape of blood from the lungs into the left auricle of the heart. Narrowing of the opening which leads from the left auricle to the left ventricle (mitral stenosis) is the chief cause of this, and, though the condition is by no means so serious as the 'hypostatic' form of congestion, it predisposes the persons affected by this form of heart disease to sharp attacks of blood-spitting on exertion, to frequent bronchitis, and to pneumonia. The treatment, in both cases, must be directed towards stimulating the heart and increasing the force of its beats.

ŒDEMA OF THE LUNGS is a condition in which these organs become dropsical. It occurs both when congestion is present as the result of heart failure, and also, during Bright's disease, following dropsy in other parts of the body. It gives symptoms of its onset in constant rattling noises proceeding from the lungs and air passages of the affected person, whose face becomes gradually more livid, and who experiences great difficulty in breathing. The œdema may be accompanied by the collection of fluid in the pleural cavities (hydrothorax), and, if the condition be not speedily relieved, the person dies, literally drowned in the fluids of his own body.

COLLAPSE OF THE LUNG occurs under several conditions. The lungs are so resilient in consequence of the elastic fibres with which they are everywhere interspersed that, if air be admitted to the pleural cavities, the lungs immediately collapse to a third of their natural bulk. Accordingly, if one side of the chest be wounded and air be admitted (pneumothorax), the lung collapses, though, after the wound is healed, the air is absorbed from the pleural cavity and the lung quickly regains its size. Also when fluid is effused into the pleural cavity, the lung is compressed and collapses, and if the fluid be not absorbed or drawn off, within some weeks, the collapse is apt to be permanent through the formation of adhesions round the lung. Again, if anything blocks a bronchial tube, the part of the lung to which it leads collapses, since these tubes do not communicate with one another. Thus, in children suffering from bronchitis or pneumonia areas of the lung may collapse through a plug of mucus sticking in a bronchus, which

the child is not sufficiently strong to free by coughing. A similar result is brought about by foreign bodies drawn into the air passages. Collapse of both lungs is necessarily fatal, as breathing then comes to a complete standstill, since the movements of the chest become ineffectual to draw air into these organs. Temporary collapse of one lung is a not uncommon accident following a tear of the lung substance produced by violent coughing or by a violent muscular strain. It is followed by a sensation of sudden shortness of breath. It also occurs when the chest is opened on one side to drain away a collection of pus, or where a large amount of fluid exists in one pleural cavity. The second lung, being healthy, is sufficient to overtake the needs of respiration, expanding as a rule somewhat in the process. The lungs of an infant at birth are collapsed in the sense that they have never been expanded, and any signs of expansion in the lungs of a dead infant form a sure token that it has been born alive. (*See* LUNGS.)

TUMORS OF THE LUNG.—Since the beginning of the twentieth century cancer of the lung has become increasingly frequent, though it is not so common as cancer in other sites. Tumors may arise in the mediastinum or in connection with the pleura. Hydatid cysts are found from time to time in the lungs.

WOUNDS OF THE LUNG are serious both by reason of the damage they may do to this organ and by admitting air into the pleural cavity, so that the lung collapses. The lung may be wounded by the end of a fractured rib, or by some sharp body pushed between the ribs, and it may also be torn as the result of disease; for example, a consumptive and excavated lung may be perforated during a fit of coughing. If by any cause a free opening is made between the pleural cavity and air passages, immediate difficulty of breathing, due to collapse of the lung, ensues. Generally, however, the person recovers from the immediate symptoms, and, if the perforation be caused by a wound from without, the wound may heal without leaving any permanent damage. Frequently in such cases blood is effused into the pleural cavity (hæmothorax). This is gradually absorbed, leaving usually some thickening of the pleural membrane and adhesions between the lung and chest wall. Such a wound is liable at the time of infliction to become infected by organisms, and empyema may then result with a tedious illness.

Wounds of the lung are chiefly dangerous on account of the risk of wounding large blood-vessels. Spitting of blood in any quantity after a wound of the chest has been received is a sign that the lung has been injured. A stab or bullet wound, which does not injure any large vessel, may traverse the lung without any serious consequences, but if one of the main veins or arteries be torn, death is likely to ensue.

LUPULIN (*see* HOPS).

LUPUS (*lupus*, a wolf) is a term used to designate a group of skin diseases of destructive and intractable character. There are two chief types of the disease, *Lupus vulgaris*, which is certainly due to the tubercle bacillus; and *Lupus erythematosus*, which some authorities consider also to be of tuberculous nature, though by most it is regarded as a type of inflammation by itself, which occurs in persons of feeble constitution and is often associated with digestive derangements.

LUPUS VULGARIS begins most commonly before the age of twenty, and, not infrequently, persists all through life, healing in one place to break out a short distance off. It causes great mutilation, both on account of the widespread destruction of the features which it attacks, and of the unsightly scars it leaves behind. The nose, cheeks, brow, and sides of the neck are most frequently attacked, though the hands and the mucous membrane inside the nose and mouth are also common seats of the malady. The first sign of the disease is a small, soft nodule of yellowish transparent appearance, on this account often called an 'apple-jelly' nodule. No pain or itching accompanies the disease, but the skin gradually becomes thickened and discoloured, other nodules appear, and finally ulcers or small abscesses form. The disease progresses very slowly, but, after it has been in existence some years, the deformity produced may be very great. The nose may be partly or wholly eaten

away, even the bones being absorbed, the lower eye-lids, if attacked, become drawn down, showing the red inner surface, and the skin, which is in places red and ulcerated, in places stretched and scarred, gives to the countenance a horrible appearance. The condition is of little infective power, and, though the victims of lupus often die of consumption in the end, they may on the other hand pass through a long life without any other organ than the skin becoming affected by tuberculosis.

Treatment.—Attention to the general health is of the greatest importance. Early cases are treated by destruction of the nodules by the cautery, by caustics, or, best of all, by complete removal of the affected piece of skin. When the condition has spread widely, the disease may be checked by various strong ointments, plasters, and caustics, but the deformity produced by scarring admits of little amelioration. Recently, however, the methods of treatment by concentrated sunlight or concentrated light from an electric arc-lamp, by exposure to the X-rays and by radium, have proved so successful in many cases to which they have been applied that the terrible disfigurement to which the disease used to give rise is now much less frequently seen. (*See* LIGHT TREATMENT.)

LUPUS ERYTHEMATOSUS consists of rounded red and slightly raised patches, which are distributed most commonly on the nose and cheeks. These patches, by fusing together at their edges, give a characteristic butterfly-like appearance to the reddened nose and cheeks. There is no tendency to the formation of ulcers, as in lupus vulgaris, and deformity in consequence does not result, though the patches of red alternating with white and atrophied skin render the complexion very unsightly.

Treatment.—Any tendency to tuberculosis should be treated. Loss of general vitality is often due to dyspepsia, or may be associated with a septic condition of the teeth, or in the nose, throat, or other part of the body. Any such condition must be treated. Quinine or salol is often useful. Locally, calamine lotion with 2 per cent of ichthyol, or collodion containing oxidised pyrogallic acid, is often applied to the red patches. Another method of treatment consists in freezing the patches for a short time by application of carbonic acid snow The disease is a very chronic one and apt to recur in cold weather.

LUXATION (*luxus*, a dislocation) is another word for dislocation. (*See* DISLOCATIONS.)

LYCANTHROPY is the term applied to the delusion entertained by an insane person that he or she is a wolf.

LYCOPODIUM is a fine, yellow powder, which consists of the spores of the club-moss, *Lycopodium clavatum*. It is used as a powder in which to roll pills, and also is a good dusting-powder for moist skin surfaces, such as the skin of infants.

LYING-IN (*see* LABOUR).

LYMPH (*lympha*, water) means properly the fluid which circulates in the lymphatic vessels of the body. It is a colourless fluid, like blood-plasma in composition, only rather more watery. It contains salts similar to those of blood-plasma, and the same proteins, though in smaller amount, viz. fibrinogen, serum albumin, and serum globulin. It also contains colourless lymph corpuscles, derived from the glands, similar to some of the white blood corpuscles. In certain of the lymphatic vessels, the lymph contains after meals a great amount of fat, in the form of a fine milky emulsion. These are the vessels which absorb fat from the food passing down the intestine, and convey it to the thoracic duct; they are called 'lacteals' on account of the milky appearance of their contents.

The lymph is derived in the first place from the blood, of which the watery constituents exude through the walls of the capillaries into the tissues, conveying material for the nourishment of the tissues and absorbing waste products. This is the result partly of the high blood-pressure within the capillaries, and partly, no doubt, is owing to the vital action of the cells which compose the walls of these minute vessels.

The various gaps and chinks in the tissues communicate with lymph capil-

laries, which have a structure very similar to that of the capillaries of the blood-vessel system, being composed of delicate flat cells joined edge to edge.

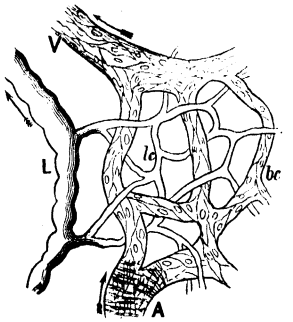


FIG. 313.—Diagram of the relation of the blood and lymph streams among the tissues. *A*, Small artery; *bc*, blood capillaries; *lc*, lymph capillaries; *V*, vein; *L*, lymphatic vessel; the arrows show the direction of the streams. (Turner's *Anatomy*.)

These unite to form fine vessels, resembling minute veins in structure, to which the name of 'lymphatics' or 'absorbents' is generally applied. These ramify all through the body, passing here and there through lymphatic glands, and ultimately discharge their contents into the blood circulation once more, by opening into the jugular

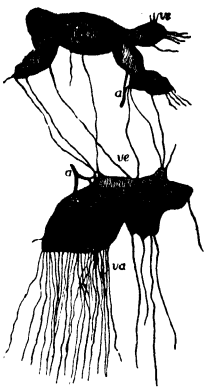


FIG. 314.—Cluster of lymphatic glands from the groin, through which the lymphatic vessels of the thigh are shown to pass. *va*, Afferent vessels; *ve*, efferent vessels; *a*, *a*, small arteries. Two-thirds natural size. (Turner's *Anatomy*.)

veins in the root of the neck. Other lymph vessels commence in great numbers as minute openings on the surface of the pleuræ and peritoneum, and act as drains for these otherwise closed cavities. When fluid is effused into these cavities, as in the occurrence of dropsy, pleurisy, etc., its absorption takes place through the lymphatic vessels. The course of these vessels is described under GLANDS.

The circulation of the lymph is effected in some of the lower animals by 'lymph-hearts', which pump the lymph, just as the heart belonging to the blood-vessels keeps the blood in circulation. In man and most of the higher animals there is no heart for the lymph, which circulates partly by reason of the pressure at which it is driven through the walls of the blood capillaries, but mainly in consequence of accidental forces. The lymph capillaries and vessels are copiously provided with valves, which prevent any back

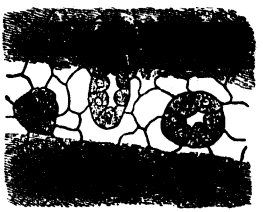


FIG. 315.—The cells lining the peritoneal membrane. Three 'stomata' which open into lymph vessels are shown. (Turner's *Anatomy*.)

flow of lymph, and every time these vessels are squeezed, as by the contraction of a muscle, or movement of a limb, the lymph moves on a little, leaving room for the exudation of fresh lymph.

From this fact one can perceive the immense importance of regular exercise in maintaining the free circulation of lymph.

Lymph, like blood, possesses in virtue of the fibrinogen which it contains the power of clotting, forming, when it does so, a faintly yellow or colourless coagulum. This can be seen in the case of small wounds after the blood has ceased to flow.

The term 'lymph' is also applied to the serous fluid contained in the vesicles which develop as the result of vaccination, and used for the purpose of vaccinating other individuals. (*See* VACCINATION.)

The term 'lymph' is also loosely applied to the layers and flakes of fibrin which are derived from the lymph and

are found on the pleura and other serous membranes as the result of inflammation.

LYMPHADENITIS (*lympha*, lymph ; ἀδήν, a gland) means inflammation of lymphatic glands. (*See* GLANDS, DISEASES OF.)

LYMPHADENOMA, or LYMPHOMA (*lympha*, lymph ; ἀδήν, a gland ; *-oma*, termination meaning tumor), is another name for Hodgkin's disease.

LYMPHÆMIA, and LYMPHOCYTHEMIA, are other names for lymphatic leukæmia (*see* LEUCOCYTHÆMIA).

LYMPHANGIECTASIS means an abnormal dilatation of the lymph vessels, as in filariasis.

LYMPHANGITIS (*lympha*, lymph ; ἀγγεῖον, a vessel) means an inflammation situated in the lymphatic vessels.

LYMPHATICS is the term generally applied to the vessels which convey the lymph. (For an account of their arrangement see GLANDS.)

LYMPHATISM is a condition found occasionally after death in pale, weak, or rickety children, who have died suddenly from some apparently trivial cause. The most noteworthy change is great enlargement of the thymus and of the lymphatic glands throughout the interior of the body. Such children tend to die as the result of slight operations and take anæsthetics badly.

LYMPHOCYTE (lymph, and κύτος, cell) is a variety of white blood corpuscle produced in the lymphoid tissues and lymphatic glands of the body. It contains a simple rounded nucleus surrounded by protoplasm generally described as non-granular. Two varieties of lymphocyte are described, small lymphocytes and large lymphocytes, and together they form over 20 per cent of the white corpuscles of the blood. Their numbers are increased in tuberculosis and certain other diseases, the condition known as 'lymphocytosis'.

LYMPHŒDEMA means dropsical swelling of a part or organ because of obstruction to the lymph-vessels draining it.

LYMPHOGRANULOMA INGUINALE, PORADENITIS VENEREA, LYMPHOPATHIA VENEREUM, is a venereal disease in which the chief characteristic is enlargement of glands in the groin, the infecting agent being a filter-passer.

LYMPHOMA (*lympha*, lymph ; *-oma*, termination meaning tumor) is another name for lymphadenoma, or Hodgkin's disease.

LYSIS (λύσις, relief from sickness) means the gradual ending of a fever, and is opposed to 'crisis', which signifies the sudden ending of diseases. (*See* CRISIS.)

LYSOFORM is a liquid soap containing formalin, by virtue of which it possesses a strong antiseptic power.

LYSOL is a brown, clear, oily fluid, of antiseptic properties, made from coal-tar by dissolving in fat and extraction with alcohol or by combining cresol with soap. When mixed with water it forms a clear soapy fluid which is useful in 1 per cent strength for cleansing the skin, and for acting as an antiseptic and deodorant. It is used to a great extent in the same way as carbolic acid, and it does not exert upon the skin so irritating and roughening an effect as the latter.

LYSOL POISONING.—Since lysol is very generally used for disinfecting and cleansing purposes, it has come to be one of the commonest substances by which poisonous effects are produced. Its action as a poison is due to the cresol and similar substances that it contains. It is not a very deadly poison, and as much as 4 fluid ounces has been taken without producing permanently serious consequences. Immediate treatment is, however, of great importance.

Symptoms.—There is a sense of burning about the mouth and throat, of which the mucous membrane shows a white and swollen appearance. If the lysol is not speedily removed, unconsciousness and stupor gradually come on and death may occur within 24 hours. Septic pneumonia is also very liable to supervene, and to produce death at a later period.

Treatment.—Large quantities of tepid water and salt may be given at

once to dilute the lysol and produce vomiting. If Epsom salts or Glauber's salt is available, this should be given in large quantities, dissolved in water, because it acts as a direct antidote to the poison. The stomach may also be washed out with a solution of one of these salts. Subsequently, olive oil or milk and cream may be given to soothe the irritation, and the patient, on account of difficulty in swallowing, must be fed on fluid food for several days.

LYSOZYME is the name given to a bactericidal substance present in tears (secreted by the lacrimal glands).

LYSSA (λύσσα, frenzy) is another term for rabies or hydrophobia.

M & B 693 (*see* SULPHAPYRIDINE).

MACBURNEY'S POINT is an area of small size on the front of the abdomen, at which the tenderness experienced in appendicitis is felt with special keenness. It is situated between the navel and the prominent anterior superior spine of the iliac bone, about 2½ inches distant from the latter.

MACERATION (*maceratio*) is a term applied to the softening of a solid by soaking in fluid.

MACROCYTE (μακρός, large; κύτος, cell) is the term applied to an unusually large red blood corpuscle especially characteristic of the blood in pernicious anæmia.

MACROGLOSSIA means an abnormally large tongue.

MACULES (*macula*, a spot) are spots or stained areas of brown or purplish-brown colour in the skin. They may be due to old hæmorrhages, sunburn, disease of internal organs, pregnancy, previous eruptions, such as those of eczema, psoriasis, acne, or syphilis, and to burns.

MADURA FOOT is the name given to a disease found in India in which the foot becomes swollen and its bones and other tissues riddled by sinuses caused by the presence of a fungus.

MAGISTRAL (*magister*, master) is a term applied to denote medicines prepared in accordance with a physician's prescription.

MAGNESIUM is a light white metal which burns readily in the air with a brilliant white flame, and the production of a fine white powder. It is used for photographic purposes in the form of ribbon or powder, but the metal itself is not used in medicine. The salts of magnesium used as drugs are the oxide of magnesium, generally known as 'magnesia', and the carbonate of magnesium, both of which have an antacid action; also the sulphate of magnesium generally known as 'Epsom salts', and the citrate of magnesium, both of which act as purgatives.

Uses.—Light and heavy magnesia, as also the light and heavy carbonates of magnesia, are used to correct over-acidity of the stomach, causing sick-headache or dyspepsia. They are also used as feeble laxatives. 'Fluid Magnesia' is prepared by mixing sulphate of magnesium and carbonate of soda with water and passing a stream of carbonic acid gas through the mixture. In doses of one or two tablespoonfuls for an adult, or half to one teaspoonful for a young child, it is a very useful and mild purgative. Magnesia should not be used constantly as a purgative, because it is said to lead to the production of concretions in the large intestine.

Magnesium sulphate is by far the most commonly used saline purge. (*See* EPSOM SALTS.)

Citrate of magnesium and mixture of magnesium hydroxide (cream of magnesia) also form good saline purgatives.

MAGNETISM (*see* ELECTRICITY IN MEDICINE).

MAIDISM (*mais*, maize), or PELLAGRA, is the name of a disease supposed to be produced by a diet consisting chiefly of Indian corn. (*See* PELLAGRA.)

MALACIA (μαλακία) is a term applied to softening of a part or tissue in disease, *e.g.* osteomalacia or softening of the bones.

MALAISE (*French word*) means a vague feeling of feverishness, listlessness, and languor, which often precedes the onset of serious acute diseases, or accompanies passing derangements, such as dyspepsia, chills, and colds.

MALARIA (Ital. *mala aria*, bad air), also known as AGUE, PALUDISM, JUNGLE FEVER, MARSH FEVER, PERIODIC FEVER, is a disease caused by the presence of certain parasites in the blood. It consists at first of a series of febrile attacks, which may come on every day, every second day, or every third day; later it assumes a chronic form, in which a bad state of health known as chronic malaria or malarial cachexia is developed, and there is a tendency towards frequent relapses.

History.—The history of this disease, and of the discoveries which have been made regarding it, forms one of the most interesting chapters in medicine. These discoveries have been of immense value to practical medicine, by placing in our

hands the means of combating malaria and rendering many previously deadly localities much more healthy. The careful study of the methods by which this disease is propagated also gave a great impetus to discovery of the channels by which other infectious diseases, especially those of tropical climates, are spread. Further, the results which have been achieved with regard to malaria form a striking example of the chain of inductive reasoning and painstaking experiment upon which all scientific research hangs.

The disease has been known from the earliest times, and not only is it described by many of the medical writers of antiquity, but numerous references to it exist in general literature, such as the works of Horace. From these it appears that its connection with swampy ground was even in ancient times quite well recognised.

The first important advance was made in 1640, when the Countess of Cinchon, wife of the Viceroy of Peru, brought home to Europe the bark by which the South American Indians had learned to treat the disease successfully. From this bark, named after her 'Cinchona bark', and also known as Jesuit's bark, since the secret had been learned by priests from the Indians, quinine is derived. By this drug, a means of treating the paroxysms of fever, as well as a slight aid in warding off the disease, was obtained. From the fact that quinine is an antiseptic, it was assumed that the disease must be due to some poison circulating in the blood which the quinine could destroy.

Not till 1880 was the next great step taken when Laveran, a French military surgeon, discovered the presence of minute parasites in the corpuscles of blood drawn from malarious persons and examined under the microscope. He described more than one form of the parasites, and subsequent observers demonstrated that the parasites go through a process of development, leading up to the production of spores, which are formed all through the blood of the affected person at one time, and from which a new set of parasites develops. Other observers were successful in finding similar parasites in the blood of lower animals, particularly of birds.

It has long been noticed, even by West African natives, that gnats, or, as they are called in the tropics, mosquitoes, seem to flourish together with malaria, and several scientists endeavoured to establish a connection between the two. This was successfully proved by Manson in 1894, through bringing from Italy live mosquitoes which had been allowed to suck blood from malarious persons in that country, and allowing the insects to bite healthy people in London, who had no other possible connection with the disease. The experiment was successful, and those persons who had offered themselves for the experiment proved conclusively that malaria is carried by mosquitoes. Other persons have proved the converse of this proposition, and have shown, by living for some months in a malarious district, such as the Campagna at Rome, that infection does not take place provided mosquitoes be kept off by gauze and other means.

From the examination of the blood in malarious persons, Manson reasoned that the parasites go through a stage of their development in the bodies of the gnats, passing, in the tissues of those insects, through a sexual stage, in which male and female forms unite in the production of masses of new parasites. The arduous work of demonstrating this was undertaken by Ross, then a military surgeon in India. The difficulty of this work is understood when one considers that the dissection of a great number of mosquitoes, and their examination under the microscope, were necessary before Ross was able in 1898 to confirm the truth of Manson's theory, by demonstrating the genus Anopheles as the insect in which the development of the malaria parasite takes place. Other observers, particularly in Italy, have confirmed his observations, and traced out in detail the changes which the parasites undergo while in the mosquito.

Causes.—As shown by the above discoveries, the presence of persons infected by the malarial parasite and the access of the Anopheles mosquito to these and to healthy persons form two of the conditions producing infection of fresh cases. But there are various factors which aid or retard the development of the parasite and of the mosquito. The disease is known all round

the world, but is chiefly found in tropical climates, spreading here and there into temperate regions, where it occurs in summer and autumn, if the other conditions are suitable. The presence of swamps, pools of surface water, rank vegetation, and a poorly fed population are also important factors. Its chief seats are the Mediterranean shores and tropical Africa, the East Indies, South China, and Central America. The disease is often curiously limited, sparing a high-standing and well-drained piece of ground in the midst of an infested jungle, or, on the other hand, being confined to some densely wooded swamp in the midst of perfectly healthy plains. It spreads gradually also from one district to another, probably in consequence of some slight change in moisture, temperature, or population.

The parasites of malaria are three in number, corresponding to the tertian fever, the quartan fever, and the æstivo-autumnal fever or subtertian or malignant tertian malaria. The parasites are protozoa, belonging to the order *Sporozoa*, and to the genus *Plasmodium*. The specific names for benign tertian, quartan, and malignant malaria are respectively *Plasmodium vivax*, *P. malariæ*, and *P. falciparum*. As has been stated, the malarial parasite passes one phase of its life-cycle in man (the asexual phase) and the other in the stomach and tissues of the mosquito (the sexual phase). After sexual union of male and female forms in the mosquito's stomach, the resulting offspring —the asexual sporozoites—eventually find their way into the mosquito's salivary gland. When the infected female mosquito bites a human being these filamentous sporozoites enter human red blood corpuscles, there to grow into 'ring forms', which themselves enlarge each to the capacity of the red corpuscle. The large trophozoite thus formed finally splits into numerous small parasites now called merozoites. These burst out of the red blood corpuscle into the blood stream and then attack other red corpuscles, the whole asexual cycle repeating itself once more. The paroxysm of malarial fever coincides with the bursting of the red blood corpuscles and the setting free of the merozoites into the blood-stream. Sexual forms—male and female gametocytes—also develop in the blood, but they undergo no further change until a mosquito bite sucks them into the mosquito's stomach.

Symptoms.—For a day or two before the actual fever sets in, there may be headache, vague pains about the body and limbs, chilliness, and slight rises of temperature. When the parasites have multiplied up to the stage already mentioned, the attack suddenly comes on.

The acute malarial attack has, in general, three stages, though in occasional cases one of the stages may be excessively marked or may be wanting. These are the cold stage, the hot stage, and the sweating stage.

The cold stage begins with a feeling of chilliness even in the hottest weather. This increases till the person has to betake himself to bed and heap himself with clothes, face and nails being blue with cold, and the whole body shaken with shivering. Nevertheless, if the temperature be taken with a thermometer, it is found to be considerably raised. This stage lasts an hour or less.

The hot stage comes on as the temperature of the body rises, beginning with hot flushes, which lengthen till the body feels burning hot, the temperature rising to 105° or 106° Fahr. There are also headache, dizziness, sickness, pains throughout the body, and sometimes even delirium. This stage may last several hours.

The sweating stage comes on after the fever reaches its height, as the temperature begins to fall. Profuse perspiration breaks out, the person begins to feel decidedly better, and the headache and pains at the same time pass off. Finally, after two or three hours the patient feels quite well, though much weakened, and remains so till the next attack begins.

If the parasite present be that of *quartan fever*, there is an intermission of two days before the next attack, that is to say, if the first attack be on the 1st day of the month the succeeding ones are on the 4th, 7th, and so on. If the parasite be that of *tertian fever*, the attacks are on the 1st, 3rd, 5th, and so on; while in the severe *æstivo-autumnal fever*, each attack may last considerably over a day, so that there may not be time for one to pass off completely

before the next begins. The patient then is in a continued state of fever, known as *subtertian fever*. A person may get a double or treble infection of the malarial parasites, and then the fever may also occur every day, although from the fact that the temperature on one set of days rises higher than it does on the set of alternate days, or from the time of the attacks being different, the attack commencing, for example, on the 1st, 3rd, 5th, etc., at 1 P.M., and on the 2nd, 4th, 6th, etc., at 5 P.M., it is clear that the person is affected by two agues running side by side. When the fever occurs every day, whatever be the cause, it is sometimes called a *quotidian fever*.

As a rule people after passing through an ague feel completely recovered till the next attack is due, but now and then the attack may develop seriously. For example, the temperature may go on rising till death occurs before the sweating stage sets in. Insensibility may set in and the person die owing to blockage of the small vessels in the brain by immense numbers of the parasites. Severe vomiting or diarrhœa may also endanger the patient's life, or he may become very much collapsed during the sweating stage.

If treatment be adopted between two attacks, the succeeding attack or the next after that is generally checked. Even when no treatment takes place, after a few weeks of the attacks, these gradually get less and less marked and finally disappear, a 'rally' taking place. The parasites become so diminished that they are unable to cause fever, but they are not entirely destroyed in the blood, and so the affected person is subject after some weeks or months to a 'relapse', when the attacks of ague are repeated as in the first seizure. These rallies and relapses may go on for several years, especially if the person leads an exposed, laborious, or poorly fed life, and anything which depresses the vitality, such as a chill, is apt to lead to a fresh relapse. On the other hand, under efficient treatment complete recovery may occur.

If the disease become chronic as above, various symptoms set in. The person becomes very anæmic in consequence of the large number of blood corpuscles destroyed by the parasites in each paroxysm of fever. A feeble state of health, accompanied by bodily wasting and yellow discoloration of the skin, ensues, the liver enlarges by a process of cirrhosis, and the spleen becomes so very large and soft that slight injuries to the abdomen are dangerous on account of risk of rupturing this organ. Dysentery and abscess of the liver are other serious complications which now and then occur.

Treatment. — The successful treatment of malaria has become much more perfect within the last few years since the true nature of the disease has become fully known, although the use of quinine as a remedy has been known for nearly three centuries. The treatment falls into two important sections, preventive and curative.

PREVENTIVE TREATMENT may be directed either against the parasites or against the mosquitoes which convey them. Quinine taken daily in a malarious district is looked upon as a useful prophylactic. But it does not prevent infection, though it prolongs the incubation period and 'tends to prevent clinical relapse in latent infections'.

It is still more important to attack the mosquitoes in their developing stage. The eggs are laid on or near pools of stagnant water in which the larvæ and pupæ swim just below the surface, breathing through a tube which projects above the surface of the water. These larvæ may be destroyed by pouring on the surface of these pools some fluid through which the breathing tube of the larva cannot be protruded. Crude petroleum and a special oil known as 'malariol' are used for this purpose, and when poured upon pools the oil spreads out instantly into a film which will remain intact for several days if not destroyed by rain or wind. Further, all small pools in gardens should be filled up, tubs, flower-pots, cisterns, and other collections of water emptied regularly at least once a week, and in public works, such as railways, it should be made illegal, as is the rule in Italy, to leave holes and ditches where water can collect. These means may be taken not only over whole districts or towns by municipal authorities, but, if consistently adopted by private individuals in their gardens, may suffice,

along with other means, to protect single houses and their inmates even in malarious districts. Anopheline breeding grounds can be sprayed with Paris green. Fish which feed on the larvæ can be introduced into ponds and lakes.

Wire-gauze screens to all the windows of a house, or muslin mosquito netting over the beds, form an efficient protection, and it should be remembered that not only should mosquitoes be kept away from healthy people by these means, but that it is even more important that the insects should not gain access to those suffering from the disease, by whose blood they become infected and made carriers of malaria to the healthy.

Various means of driving away mosquitoes, such as dense smoke and moving punkahs, are also used, but are not sufficiently effective by themselves.

CURATIVE TREATMENT depends chiefly upon quinine, given in the form of quinine sulphate, bisulphate, and hydrochloride. For intravenous and intramuscular administration the bihydrochloride is used. If quinine is in short supply (as in the war of 1939– after Japan had seized the East Indies), mepacrine (' atebrin ') is an efficient substitute, having a direct action on the malarial parasite. Pamaquin (' plasmoquine ') is another synthetic drug used in malaria. It is of no value in the acute attack, but has the virtue of destroying the sexual forms of the parasite.

In chronic malaria, quinine is not of so much use as good food, removal to a temperate climate, and other measures directed towards improving the general health. Tonics containing arsenic and iron are of great benefit, and the various complications which arise are treated as in other conditions. (*See also* BLACKWATER FEVER.)

MALE FERN (*see* FERN).

MALFORMATION (*see* DEFORMITIES).

MALIGNANT (*malignus*, of an evil nature) is a term applied in several ways to serious disorders. Tumors are called malignant when they grow rapidly, tend to infiltrate surrounding healthy tissues, and to spread to distant parts of the body, leading eventually to death. (*See* CANCER AND SARCOMA.) The term is also applied to types of disease which are much more serious than the usual form, such as malignant scarlatina, malignant smallpox, etc., the disease in these cases generally resulting in death. Malignant pustule is another name for anthrax. (*See* ANTHRAX.)

MALINGERING (Fr. *malingre*, sickly) is a term applied to the feigning of illness. In the great majority of cases a person who feigns illness has a certain amount of disability, but exaggerates his illness or discomfort for some ulterior motive.

MALLEOLUS (*malleolus*, a little hammer) is the term applied to either of the two bony prominences at the ankle. (*See* LEG.)

MALT is a substance derived from barley by allowing a certain amount of growth to take place in the moistened grain, which is then dried and crushed. It contains an albuminoid ferment named ' diastase ', together with a large amount of malt-sugar and dextrin, the latter constituents being still further developed from the starch of the barley by the action of the ferment, when the malt is allowed to digest in water at a temperature approaching 104° Fahr. Similarly, the ferment will convert into sugar a large amount of the starch in flour mixed with malt, and so perform the functions of the saliva and pancreatic juice.

For these reasons malt is mixed with various proportions of flour to form the popular foods for children.

MALTA FEVER, also known as MEDITERRANEAN FEVER, ROCK FEVER, NEAPOLITAN FEVER, LEVANT FEVER and UNDULANT FEVER, is a long-continued fever which occurs on the shores and islands of the Mediterranean principally, but is found also in many other countries. Elsewhere in Europe, in the U.S.A., and S. Africa undulant fever, the result of drinking cow's milk infected with *Brucella abortus*, is common.

Causes.—The disease chiefly affects young men, and is as common among the rich as among the poor, coming on usually during the summer months.

The direct cause is the *Brucella melitensis*, which is constantly found in the organs of those who die of the fever, and the principal means by which it spreads is in the milk from infected goats. Since this fact became known the disease has greatly decreased. Incubation period is about 14 days.

Symptoms.—For the first week or so, the person has headache, sickness, loss of appetite, constipation, and a feeling of tenderness over the liver and spleen, which are both enlarged. There is generally cough also, and the person perspires freely. Later, fever comes on and may resemble either that of typhoid or that of malaria in type, and it may be very difficult to distinguish a case of Malta fever, especially from typhoid. Malta fever lasts a very long time, its average duration being about three months, during which time the fever continues, the sweating is very profuse, the person gets extremely thin and weak, and rheumatic affections in the joints appear. The convalescence is equally tedious, but death very seldom occurs, only about one case in fifty being fatal.

Treatment.—The disease has practically been abolished from Malta by ceasing to use goats' milk. Treatment is directed towards relieving the sleeplessness, pain in the joints, and other symptoms. The strength must also be supported by careful dieting, and, during convalescence, removal to a cool climate quickens recovery. The sulphonamide drugs have been successfully used in the treatment of undulant fever due to infection with *Brucella abortus*.

It can be prevented by boiling goat's milk, and by boiling or pasteurising cow's milk in the case of infection with *Brucella abortus*.

MAMMARY GLAND (*mamma*, the breast) (*see* BREAST).

MAMMILLA is the Latin term for the nipple.

MANDELIC ACID is a non-toxic keto acid with formula $C_6H_5.CH(OH)COOH$ much used in treatment of infections of the urinary tract, especially those due to the bacillus coli and the *Streptococcus fæcalis* or *Enterococcus*. It is administered in doses of 45 grains several times daily, combined with bicarbonate of soda, and at the same time chloride or benzoate of ammonium is administered to make the urine acid.

MANDIBLE (*mandibulum*) is the name applied to the bone of the lower jaw.

MANDL'S SOLUTION consists of iodine 6 grains, potassium iodide 20 grains, oil of peppermint 5 minims, and glycerin 1 ounce. It is much used as a throat paint.

MANGANESE is a metal of which oxides are found abundantly in nature. Permanganate of potassium forms a well-known disinfectant. (*See* PERMANGANATE OF POTASSIUM.)

MANIA (*μανία*, fury) is a form of mental disorder characterised by great excitement. (*See* INSANITY.)

MANIC-DEPRESSIVE INSANITY, or CYCLOTHYMIA, is a form of madness characterised by alternate attacks of mania and depression.

MANOMETER (*μανός*, slack; *μέτρον*, measure) is an instrument for measuring the pressure or tension of liquids or gases. (*See* BLOOD-PRESSURE.)

MANTOUX TEST, also known as MENDEL'S TEST, is a test for tuberculosis. It consists in injecting into the superficial layers of the skin (*i.e.* intradermally) a very small quantity of 'old tuberculin'. A positive reaction of the skin—swelling and redness—shows that the person so reacting has been infected with the tubercle bacillus. But it does not mean that such a person is suffering from active tuberculosis.

MANUBRIUM is the uppermost part of the breast-bone.

MANZULLO'S TELLURITE TEST consists in applying to the throat of someone suspected of having diphtheria a 2 per cent potassium tellurite solution. If diphtheria bacilli are present the solution blackens. But some other germs also reduce the tellurite solution. As a negative test it has some use, because if no reduction occurs it is highly improbable that the patient has diphtheria.

MAPHARSEN, or MAPHARSIDE, or ARSENOXIDE are terms for the organic arsenic preparation chemically described as the hydrochloride of meta-amino-parahydroxyphenylarsine oxide.

This is now (1943) being widely used in the treatment of syphilis in preference to arsphenamine and neo-arsphenamine on account of its lower toxicity and higher efficacy.

MARASMUS (*μαραίνω*, I waste away) means progressive wasting, especially in young children when there is no ascertainable cause. It is generally associated with defective feeding. (*See* ATROPHY *and* INFANT FEEDING.)

MARGARINE (*see* DIET).

MARIHUANA is another term for CANNABIS INDICA, or hemp, or hashish.

MARROW means the softer substance enclosed in the interior of bones. It is of two kinds—*yellow marrow*, which occupies the large tubular space in the shaft of a long bone, such as a limb bone, and *red marrow*, which fills up the smaller spaces in the interior of the smaller long bones, such as the ribs, and of the short bones. There is no essential difference between the two, though yellow marrow owes its colour to the large amount of fat contained in it, while red marrow is of a highly cellular structure. The marrow is the site of formation of red blood corpuscles, platelets, and granular white blood cells.

MARSH FEVER (*see* MALARIA).

MARSHMALLOW ROOT is the root of *Althaea officinalis*, which has long been credited as a valuable domestic medicine. Extracts made from it have a soothing influence upon mucous membranes with which they come in contact, as well as exerting a diuretic action. It is used chiefly as an ingredient of lozenges for cases of sore throat.

MASSAGE, or RUBBING, is a method of treatment in which the operator uses his hands, or occasionally other appliances, to rub, knead, or press the skin and deeper tissues of the person under treatment. It is often combined with various 'passive' movements, in which the masseur moves the limbs in various ways, the person treated making no effort, or with 'active' movements, which are performed with the combined assistance of masseur and patient. Massage is also very frequently combined with baths and gymnastics in order to strengthen various muscles. The beneficial effects of massage are exerted in different ways. Applied gently, it has a soothing action upon the nerves of sensation, and, applied more vigorously, certain methods have the effect of quickening the circulation of lymph and blood, and so leading to the rapid absorption of waste products in the muscles, and of the results of disease in various organs. Other forms of massage cause muscular contractions, and so provide exercise for the muscles in cases where movements of the whole body are not desired.

Varieties.—STROKING or '*effleurage*' consists of gentle pressure with the hand moved in one direction. It soothes the nerves of the part treated and empties the main lymph-vessels and veins, thus increasing the circulation locally. It is carried out either with the flat of the hand or with the edges of thumb and first finger widely separated.

KNEADING or '*pétrissage*' is the most commonly employed form, and consists of squeezing, kneading, rolling, or rubbing movements coupled with a considerable amount of pressure, effected, it may be, with the fingers or knuckles, but generally with the pulp or the ball of the thumb. It has a still greater effect than stroking in moving on the lymph and blood circulation of deep-seated parts, and so leading to the absorption of inflammatory thickenings in and around joints, tendon-sheaths, and muscles. The masseur in this method, as it were, tries to dispel inflammatory deposits by his own endeavours, though he knows that it is rather by the vital activity which he merely assists that the effect is gradually produced. (*See* LYMPH.)

STABILE MOVEMENTS include such applications as the following. *Pressing* may be done with the finger-tips or with the knuckles, and it is usually combined with rubbing. *Tapping* is done with the points of the fingers from the wrist, and has, when applied gently, a soothing effect. *Thrusting*, which consists in poking up the deeper parts with the points of the fingers, and *hacking*, in which the muscles are struck with the inner edge of the hand, the arms moving from the elbows, are employed to cause muscular contractions.

VIBRATORY MOVEMENTS are made

either by tapping (as above) or by special pads, to which a very rapid oscillation is communicated from an electric motor. This form of massage has been much used lately in order to exert a soothing influence, for example in cases of headache.

PASSIVE MOVEMENTS are made chiefly for their effect upon the joints. The synovial fluid is increased if scanty, and tends to be absorbed if excessive, while adhesions, which limit the motions of the joint or render these painful, are broken down by passive movements of a more forcible type. This type of massage is the form chiefly employed in the treatment of stiff joints by bone-setters.

ACTIVE MOVEMENTS of a carefully regulated type, in which the person's will is concentrated upon the movement made, are specially useful for developing the muscles brought into play thereby. The amount of muscular force required is graduated and increased by the masseur resisting the movements with varying degrees of force.

Uses.—Massage can only be employed to full advantage by persons having a fair knowledge of anatomy and physiology, but a small degree of instruction and practice will render any person able to treat a given case under skilled supervision. The types of case in which massage is useful are extremely various. Neuralgia, sciatica, and muscular rheumatism are among the painful conditions in which some relief is generally obtained. In neurasthenia, muscular wasting, and paralysis due to nerve conditions, such as lead-poisoning, peripheral neuritis, crutch palsy, Bell's paralysis, and infantile paralysis, the muscles affected may be kept in a state of good nutrition till the nerve weakness has disappeared, and so recovery may be materially hastened. In various other nervous conditions, such as hysteria, St. Vitus's dance, loss of sensation and writer's cramp, massage often proves of great benefit. Several types of joint disease, such as chronic rheumatism and stiffness due to previous slight injuries, such as sprains, are specially amenable to treatment by passive movements combined with deep rubbing, but any such interference with joints which have been recently the seat of tuberculous disease is very dangerous, as by these means the disease may be more widely spread. In several general conditions, such as corpulence and constipation associated with a flabby state of body, massage may be of great usefulness.

Massage is often combined with electrical applications. For example, high-frequency and static electricity are often used along with gentle massage to obtain a soothing effect. The interrupted galvanic, sinusoidal, and faradic currents are frequently useful combined with more forcible massage to stimulate muscular contraction in various cases of paralysis.

MASTITIS (*μαστός*, the breast) is a term applied to inflammation of the breast, usually of a chronic type. (*See* BREAST, DISEASES OF.)

MASTOID PROCESS (*μαστοειδής*, like a breast) is the large process of the temporal bone of the skull which can be felt immediately behind the ear. It contains numerous cavities, one of which, the 'mastoid antrum', communicates with the middle ear, and is very liable to suppurate when the middle ear is diseased. (*See* EAR, DISEASES OF.)

MATCH-WORKERS' DISEASE (*see* PHOSPHORUS).

MATERIA MEDICA is that branch of medical study which deals with the sources, preparations, and uses of drugs.

MATERNITY and CHILD WELFARE.—The high rate of infantile mortality which used to prevail in the larger towns drew attention to the great loss of infant life, which was produced partly by ignorance on the part of the mothers and partly by poverty. A movement was accordingly begun early in the present century in some of the larger cities to provide trained women as health visitors for giving advice to working-class women in the proper methods of rearing their children. This was at first a voluntary effort conducted by philanthropic agencies, but it was soon taken up by county councils and sanitary authorities throughout the country. The necessary information as to the existence of newly born infants

MATERNITY AND CHILD WELFARE

was provided by the Notification of Births which was demanded by Acts passed in 1907 and 1915. Women health visitors were appointed to visit the homes where such newly born infants were found, and shortly afterwards INFANT CONSULTATION CENTRES and Clinics were established by various sanitary authorities and voluntary agencies.

At first the movement for child welfare was limited to infants from birth to 1 year of age, but shortly afterwards the necessity for supervising the health of children until they came under school discipline at 5 years was recognised. Still later it became evident that it was desirable to watch over the health of the expectant mother and to provide skilled attendance prior to and during confinement. This led accordingly to the establishment of MATERNITY AND CHILD WELFARE CENTRES and Clinics by many sanitary authorities. The schemes which have now been devised for combating infantile mortality are very wide. They include better housing, paid and voluntary health visitors, consultation centres for mothers, infant milk depots, the provision of cheap meals for expectant and nursing mothers, and hospital accommodation for necessitous expectant mothers before and during confinement. The provision of Child Welfare Centres to which parents may bring their infants at stated times produces valuable results, both by advice to the mothers and by keeping records of increase in weight and other important facts regarding the infants, and also by interesting and stimulating the mothers to greater efforts. The Centre also provides opportunities for giving instruction in health, cookery, sewing, etc., to the mothers, and for distributing food and clothing as may be necessary. Antenatal Clinics, which provide education and assistance for the expectant mother, are usually conducted in connection with Maternity Hospitals and form an important section of this work.

HEALTH VISITORS are concerned with everything in the household that tends to secure and maintain health for the young children. The health visitor, who is often a certificated nurse, deals with the minor ailments of infancy and indicates when treatment by a doctor is necessary. During epidemics part of her duty is to keep the Public Health Authority advised in regard to the progress of infection. As a rule one whole-time health visitor is provided for each 400 births taking place in any locality. By a Memorandum issued by the Ministry of Health in 1922, a woman appointed as health visitor must have one of the following qualifications; (1) a Certificate prescribed by the Board of Education, or (2) a training as a nurse in a general hospital or children's hospital, together with a Certificate from the Central Midwives Board, or a qualification as a Sanitary Inspector, or a Certificate from one of the bodies approved by the Ministry of Health.

ANTENATAL CLINICS are considered to be of great value, because the fatality among the unborn from still-birth, abortion, etc., is higher than the mortality of infants during the first year of life; it is generally believed, further, that by the medical attention provided at such clinics about half of these antenatal deaths could be prevented, and the number of infants born prematurely and of feeble constitution could be much reduced. Health visitors are supposed to follow up cases seen at antenatal clinics and to ensure that the medical instructions given at the Clinic are carried out, and proper steps taken to prepare for the confinement. Under the National Insurance Act in Great Britain, both Maternity benefit and Sickness benefit for 4 weeks after confinement are paid to lying-in women in order to aid their safety and comfort.

INFANT CONSULTATION CLINICS are conducted usually by local sanitary authorities, and, in cases where it is desirable, mothers are urged to bring infants to these clinics regularly. Many of the disabling illnesses of early childhood are thus prevented, and the attendance should continue as required during the first five years of the child's life.

DAY NURSERIES, or crèches, are provided in many places in connection with these clinics, at which children can be left when the mothers are out at work.

Most local authorities have schemes for supplying special foods or nutritious diet to mothers of children who after medical examination at the Clinic are found to require such assistance. SPECIAL TREATMENT CLINICS are also

provided in many places for the examination and treatment of teeth, eyes, ears, nose, throat, and skin of children. Also there is at present a movement for the treatment of cases in which children are crippled as the result of early disease. Further, in connection with the clinics many local authorities possess convalescent homes, or arrange with voluntary agencies for admission to their convalescent homes of children who are in need of special care and open-air regime. Indirectly connected with these clinics in many places there have also been established play centres and kindergartens for young children.

Under certain specified conditions the Ministry of Health gives grants to local authorities in aid of maternity and child welfare work, intended to cover the salaries and expenses of health visitors and nurses, to provide midwives or doctors for necessitous women in confinement, to defray the expenses of Centres for women and children, and to provide hospital treatment in special cases of confinement and for infants requiring hospital treatment. Grants are also paid to voluntary agencies for similar purposes.

MATTER (*see* Pus).

MATTOID (*mattus*, drunken) is a term applied to a person who, though passing as sane, is eccentric or mentally unbalanced in some particular direction.

MAW-WORMS is another name for round-worms. (*See* Parasites.)

MAXILLA (*maxilla*, a jaw) is the name applied in human anatomy to the upper and lower jaw-bones, which bear the teeth.

MEASLES, also known as Morbilli or Rubeola, is an acute infectious disease occurring mostly in children. It appears to have been known from an early period in the history of medicine, mention being made of it in the writings of Rhazes and others of the Arabian physicians in the tenth century. For long, however, its specific nature was not recognised, and it was held to be a variety of smallpox. Measles and scarlet fever were long confounded with each other; and in the account given by Sydenham of epidemics of measles in London in 1670 and 1674, it is evident that even that accurate observer had not as yet clearly perceived their pathological distinction, although it would seem to have been made a century earlier by Ingrassias, a physician of Palermo. It is only within a comparatively recent period that measles has come to be universally regarded as a distinct and independent malady. The disease known as German measles, or rötheln, is still slighter than measles, though the former is probably often mistaken for true measles. Since November 1939 measles has been compulsorily notifiable in England and Wales.

Causes.—Measles is a disease of the earlier years of childhood. Like most other infectious maladies, it is admittedly rare, though not unknown, in nurslings or infants under six months old. It is comparatively seldom met in adults, but this is largely due to the fact that most persons have undergone an attack in early life, or have been repeatedly exposed to the infection of measles and so have probably acquired a certain amount of immunity, for, among communities where measles is not prevalent, the old suffer equally with the young, when infection is once introduced. Some countries enjoy long immunity from outbreaks of measles, but it has been frequently found that in such cases the disease, when introduced, spreads with great rapidity and virulence. This was shown in two instances in recent times—namely, in the epidemic in the Faroe Islands in 1846, where, within six months after the arrival of a single case of measles, more than three-fourths of the entire population were attacked and many perished; and the similarly produced and still more destructive outbreak in Fiji in 1875, in which it was estimated that about one-fourth of the inhabitants were cut off by the disease within three months. In such cases it is generally held that epidemics arising on what may be termed a virgin soil are apt to possess a special severity.

In many lands, such as the United Kingdom and the United States, measles is rarely absent, especially from large towns, where sporadic cases are found in greater or less number at all seasons. But every two years, especially from

December to February, epidemics arise and spread among the children who are not protected by a recent attack. One attack of measles does not give complete immunity from future attacks, though there is a certain amount of protection, and second attacks are rare.

There are few diseases so infectious as measles, and its rapid spread in epidemics is no doubt due to the fact that infection is most potent in the earlier stages, even in the first three days, before its real nature has been shown by the appearance of the rash. Hence the difficulty of timely isolation and the readiness with which the disease is spread, which is mostly by infected droplets from the nose and throat coughed or sneezed into the air. (*See* INFECTION.) Another fact, which sometimes assists the spread of measles, is that the temperature often falls to normal on the second day and the child appears to be much better, so that it is again allowed to mix with its play-fellows, owing to the mistaken idea that it is suffering merely from a cold, till the rash appears on the fourth day and shows the real nature of the malady. It is possible also that infection may be carried from one place to another by clothing, etc., although the tenacity and activity of the infective agent is in this respect much less marked than in the cases of scarlatina and smallpox. It is not in all probability the case that measles can be carried from one child to another by a third and unaffected person.

It is believed that the infecting agent is a filterable virus.

Symptoms.—Like the other eruptive fevers (exanthemata), to which class of diseases measles belongs, its progress is marked by several stages more or less sharply defined.

After the infection has been received into the system, a period of incubation or latency precedes the development of the disease, during which scarcely any disturbance of the health is perceptible. This period appears to vary in duration, but it may be stated as generally lasting for from ten to fourteen days, when it is followed by the invasion of the symptoms specially characteristic of measles. These consist in the somewhat sudden onset of acute catarrh of the mucous membranes. Sneezing, accompanied with a watery discharge, sometimes bleeding, from the nose, redness and watering of the eyes, cough of a short, frequent, and noisy character, with little or no expectoration, hoarseness of the voice, and occasionally sickness and diarrhœa, are the chief local symptoms of this stage. But along with these there is well-marked febrile disturbance, the temperature being elevated (102°–104° Fahr.) and the pulse rapid, while headache, thirst, and restlessness are usually present to a greater or less degree. In some instances, however, these initial symptoms are so slight that they almost escape notice, and the child is allowed to associate with others at a time when, as will be afterwards seen, the contagion of the disease is most active. In rare cases, especially in young children, convulsions usher in, or occur in the course of, this stage of invasion, which lasts as a rule for three or four days, the febrile symptoms, however, showing a characteristic tendency to pass away temporarily (remission) on the second and sometimes also on the third day. About the fourth day after the invasion, some times later, rarely earlier, the characteristic eruption appears on the skin, being first noticed on the brow, cheeks, chin, also behind the ears, and on the neck. It consists of small spots of a dusky red or crimson colour, slightly elevated above the surface, at first isolated, but tending to become grouped together into patches of irregular, occasionally crescentic, outline, with portions of skin free from the eruption intervening. The face acquires a swollen and bloated appearance, which, taken along with the catarrh of the nostrils and eyes, is almost characteristic, and renders the diagnosis at this stage a matter of no difficulty. Even before it appears on the skin, the rash is sometimes visible within the mouth, as bluish-white spots on the mucous membrane, known as 'Koplik's spots'. The eruption spreads downwards over the body and limbs, which are soon thickly studded with the red spots or patches. Sometimes these become confluent over a considerable surface, giving rise to a larger area of uniform redness. The rash continues to come out for two or three days, and then begins to fade in the order in which it first showed

itself, namely, from above downwards. By the end of about a week after its first appearance, scarcely any trace of the eruption remains beyond a faint staining of the skin. Occasionally during convalescence slight peeling of the epidermis takes place, but much less frequently and distinctly than is the case in scarlet fever. At the commencement of the eruptive stage, the fever, catarrh, and other constitutional disturbance, which were present from the beginning, become aggravated, the temperature often rising to 105° or more, and there are headache, thirst, furred tongue, and soreness of the panied with intense catarrh of the respiratory or gastro-intestinal mucous membrane. Such cases, always of serious import, are happily rare, occurring mostly in circumstances of bad hygiene, both as regards the individual and his surroundings. On the other hand, cases of measles are often met of so mild a form throughout that the patient can scarcely be persuaded to submit to treatment.

Measles as a disease derives its chief importance in the view of medical men from the risk, by no means slight, of certain complications which are apt to arise during its course, more especially

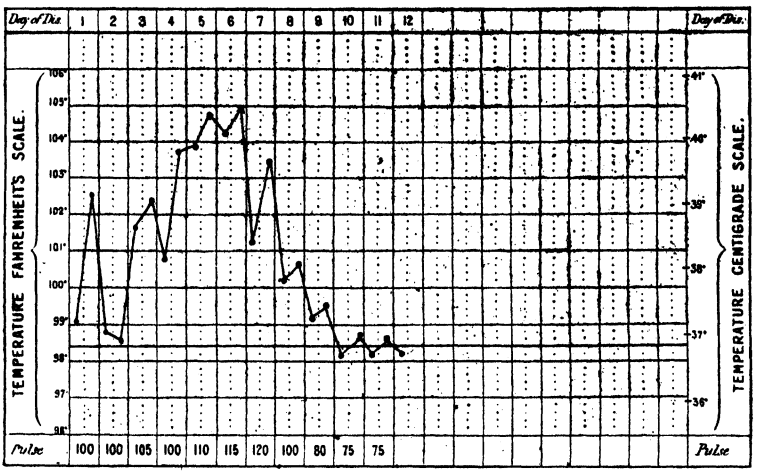


FIG. 316.—Typical temperature chart from a case of measles. The fall of temperature which often occurs on the second day is shown.

throat, upon which red patches similar to those on the surface of the body may be observed. The patient is also usually much depressed. These symptoms usually decline as soon as the rash has attained its maximum, and often there occurs a sudden and extensive fall of temperature, indicating that the crisis of the disease has been reached. In favourable cases, convalescence proceeds rapidly, the patient feeling perfectly well even before the rash has faded from the skin.

Measles may, however, occur in a very severe or malignant form, in which the symptoms throughout are of urgent character, the rash but feebly developed and of dark-purple hue, while there is great prostration of strength, accom- inflammatory affections of the respiratory organs. These are most liable to occur in the colder seasons of the year and in very young and delicate children. It has been already stated that irritation of the respiratory passages is one of the symptoms characteristic of measles, but that this subsides with the decline of the eruption. Not infrequently, however, these symptoms, instead of abating, become aggravated, and bronchitis of the capillary form (*see* BRONCHITIS), or pneumonia, generally of the diffuse or lobular variety (*see* PNEUMONIA), imparts to the case a gravity which it did not originally possess. By far the greater proportion of the mortality in measles is due to its complications, of which those just mentioned are the

most common, but which also include inflammatory affections of the larynx, and also diarrhœa assuming a dysenteric character. Or there may remain, as direct results of the disease, chronic ophthalmia, discharge from the ears with deafness, or occasionally a form of gangrene affecting the tissues of the mouth or cheeks and other parts of the body, leading to disfigurement and even endangering life.

Apart, however, from those immediate risks, it deserves to be borne in mind that in measles there appears to be a tendency in many cases for the disease to leave behind a weakened and vulnerable condition of the general health, which may render children, previously robust, delicate and liable to chest complaints and enlargement of glands. Measles is in many instances the precursor of some of those tuberculous affections to which the period of childhood and youth is liable.

Treatment.—The treatment of measles embraces the preventive measures to be adopted in the case of an outbreak by the isolation of the sick at as early a period as possible. In families with little house accommodation this measure is frequently ineffectual, for the reason already mentioned regarding the communicable period of the disease, nevertheless, where practicable, it ought to be tried, at all events in the case of children under the age of five years. Those *unaffected children, who have not previously had measles*, should on the occurrence of a case in a school class, be excluded from school from the 9th to the 14th day thereafter. If they have been infected, they will show the signs of the disease in this time. The same rule may be applied to children living at home but attending day schools and in whose family measles has broken out.

Injections of 'immune globulin' obtained from placental tissue, or of immune serum from the blood of those convalescent from the disease, may prevent or modify an attack of measles in a child who has been exposed to infection.

As regards special treatment, in an ordinary case of measles little is required beyond what is necessary in febrile conditions generally. Severe attacks, or attacks in weakly children, may be treated by the injection of serum obtained from those convalescent from the disease. Confinement to bed in a darkened room, into which, however, air is freely admitted in such a way as to avoid draughts; light, nourishing diet (soups, milk, puddings, etc.), and mild diaphoretics, such as Mindererus spirit and ipecacuanha (*see* DIAPHORETICS), are all that is necessary in the febrile stage. When the catarrhal symptoms are very severe, the hot bath or warm packing to the body generally, or to the chest and throat, affords relief, and a hot bath, to which one or two tablespoonfuls of mustard are added, may, with advantage, be administered, if the eruption be feebly developed or tend to recede too soon, and especially if convulsions should set in. The serious chest complications of measles are to be dealt with by those measures applicable for the relief of pneumonia or bronchitis. (*See* BRONCHITIS *and* PNEUMONIA.) The inhalation of vapour, and the administration of sal volatile and other preparations of ammonia, are specially useful. Inflammation of the eyes is best soothed by washing several times daily with weak boric acid lotion, and thereafter smearing a little boric ointment on the edge of each lower lid. Ear complications, if they come on, usually appear with a discharge as the child is getting better. (*See* EAR, DISEASES OF.) Diarrhœa is treated by the usual remedies, including carefully administered doses of Dover's powder, chalk mixture, etc. (*See* DIARRHŒA.) During convalescence, the patient must be guarded from exposure to cold, and, for a time after recovery, the state of the health ought to be watched with the view of averting the evils, both local and constitutional, which are very liable to follow this disease.

MEASURES (*see* WEIGHTS AND MEASURES).

MEAT (*see* NITROGENOUS FOODS).

MEATUS (*meatus*, passage) is a term applied to any passage or opening, *e.g.* external auditory meatus, the passage from the surface to the drum of the ear.

MECHOLYL, or ACETYL-BETA-METHYLCHOLINE, is a drug which stimu-

lates the parasympathetic nerves, and is used as a miotic, being thus employed in the treatment of glaucoma.

MECKEL'S DIVERTICULUM is a hollow process sometimes found attached to the small intestine. It is placed on the small intestine about 3 or 4 feet away from its junction with the large intestine, is several inches long, and ends blindly.

MECONIUM (*μηκώνιον*, poppy-juice) means the brown semi-fluid material which collects in the bowels of a child prior to birth, and which should be discharged either at the time of birth or shortly afterwards. It consists partly of bile secreted by the liver before birth, partly of debris from the mucous membrane of the intestines.

MEDIASTINUM (*medius*, middle) is the name given to the space in the chest which lies between the two lungs. It contains the heart and great vessels, the gullet, the lower part of the windpipe, the thoracic duct, the phrenic nerves, as well as numerous structures of less importance.

MEDINAL is a name applied to the sodium salt of barbituric acid used as a hypnotic in doses of 5 to 15 grains.

MEDITERRANEAN FEVER (*see* MALTA FEVER).

MEDULLA (*medŭlla*) is another word for marrow. The term is usually restricted to the marrow of bones, or to designate a part of the brain, though the spinal cord is also sometimes known as the spinal medulla, or spinal marrow.

MEDULLA OBLONGATA (*medulla*, marrow; *oblongus*, long), or BULB, is the hindmost part of the brain and is continued into the spinal cord. In it are situated several of the nerve-centres which are most essential to life, such as those governing breathing, the action of the heart, swallowing, etc. (*See* BRAIN.)

MEGA- and MEGALO- (*μέγας*, great) are prefixes denoting largeness.

MEGALOMANIA (*μέγας*, great; *μανία*, madness) is the term applied to a delusion of grandeur or an insane belief in a person's own extreme greatness, goodness, or power.

MEGRIM (Fr. *migraine*, corrupted from *ἡμικρανία*, pain on half of the head). (*See* HEADACHE.)

MEIBOMIAN GLANDS are the minute glands situated in the eyelids, in connection with which styes and cysts frequently arise. (*See* EYE, DISEASES OF.)

MELÆNA (*μελαίνω*, I blacken) means a condition of the stools in which dark, tarry masses are passed from the bowel. It is due to bleeding from the stomach or from the higher part of the bowel, the blood undergoing chemical changes under the action of the secretions, and being finally converted in large part into sulphide of iron.

MELANCHOLIA (*μέλας*, black; *χολή*, bile) is a form of insanity characterised by great mental and physical depression. (*See* INSANITY *and* MANIC-DEPRESSIVE INSANITY.)

MELANOTIC (*μέλας*, black) is a term applied to certain tumors, dark in colour, and usually malignant in nature, in whose substance black pigment is deposited.

MELORHEOSTOSIS is an abnormal condition of bone in which pathological hardening and denseness extend in a linear direction through one of the long bones of a limb, causing deformity and limitation of movement of the limb.

MEMBRANES (*see* BRAIN, CROUP, DIPHTHERIA, *and* LABOUR).

MEMORY (*see* FORGETFULNESS).

MENARCHE (*μήν*, month; *ἀρχή*, beginning) is the term applied to the beginning of the menstrual function.

MENDELISM is the term applied to a law enunciated by G. J. Mendel that the offspring is not intermediate in type between its parents, but that the type of one or other parent is predominant. Characteristics are classed as either dominant or recessive. The offspring of the first generation tend to inherit the dominant characteristics, while the recessive characteristics remain latent and appear in some of the offspring of the second generation. If individuals possessing recessive characters unite, recessive characters then become dominant characters in succeeding generations. The law may be expressed by the

following formula n(DD + 2 DR + RR), in which DD represents dominant offspring, RR recessive offspring, and DR offspring with mixed characters.

MÉNIÈRE'S DISEASE is a condition in which giddiness, headache, deafness, and ringing in the ears are associated in sudden attacks and usually caused by hæmorrhage into the internal ear. (*See* EAR, DISEASES OF.)

MENINGES (μῆνιγξ, a membrane) are the membranes surrounding the brain and spinal cord. (*See* BRAIN.) The membranes include the 'dura mater', a tough, fibrous membrane closely applied to the inside of the skull; the 'arachnoid mater', a more delicate membrane, enveloping the brain but separated from its irregular surface by spaces containing fluid; and the 'pia mater', a delicate network of fibres containing blood-vessels and uniting the arachnoid mater to the brain. The two latter are generally regarded as one membrane, the 'pia-arachnoid'. These membranes bear the blood-vessels which nourish the surface of the brain and the interior of the skull. Meningeal hæmorrhage from these vessels forms one of the chief dangers arising from fracture of the skull.

MENINGISM is the name applied to a condition with symptoms closely resembling those of meningitis, but due simply to a feverish state.

MENINGITIS (from μῆνιγξ, a membrane) is a term applied to inflammation affecting the membranes of the brain (cerebral meningitis), or spinal cord (spinal meningitis), or both. Either the dura or the pia-arachnoid may be inflamed. In the former case the condition is known as pachymeningitis; in the latter, leptomeningitis. Pachymeningitis is the less common of the two, is often local and secondary to disease of the bone (*e.g.* tuberculous or syphilitic), and may be cranial or spinal. Leptomeningitis is the more common, is usually extensive in distribution, greatly alters the composition of the cerebrospinal fluid, and may be primary or secondary to infection elsewhere in the body.

Meningitis may be classified according to the infecting organism as pneumococcal, pyogenic, tuberculous, syphilitic, meningococcal. The all-important evidence is gained by lumbar puncture and examination of the CEREBROSPINAL FLUID (*q.v.*). In meningitis the pressure of this fluid is increased, changes in its appearance and constituents occur, and the infecting agent can usually be isolated from it. In meningitis the protein and the number of cells increase and the glucose decreases. A decrease in the amount of chlorides of the cerebrospinal fluid is characteristic of tuberculous meningitis. Increase in the number of cells may make the normally clear cerebrospinal fluid opalescent, as in tuberculous meningitis, or turbid, as in pneumococcal and pyogenic meningitis. Clinically, the symptoms are due to irritation of the meninges and rise in the intracranial pressure: headache, vomiting, photophobia, rigidity of the neck, Kernig's sign (*q.v.*), convulsions, paralyses, coma.

(1) PNEUMOCOCCAL MENINGITIS is usually secondary to infection with the pneumococcus elsewhere — for example, empyema or otitis media. This formerly fatal condition is now in many cases successfully treated by the sulphonamide drugs, especially sulphapyridine.

(2) PYOGENIC MENINGITIS is due to secondary infection with staphylococci, streptococci, *H. influenzæ*, gonococci, anthrax bacilli—especially the first two. The introduction of the sulphonamide drugs has altered the previously fatal prognosis of these cases. Sodium sulphapyridine intravenously in some cases and sulphadiazine by mouth in others have, for example, cured cases of meningitis due to *H. influenzæ*.

(3) TUBERCULOUS MENINGITIS is an inflammation of the membranes caused by the tubercle bacillus. The disease is most common in children under the age of ten years, but is by no means confined to that period of life, and may affect adults. The scrofulous or tuberculous constitution is an important factor in the disease. The determining factor, however, is exposure to infection with the bovine or the human tubercle bacillus. In numerous cases, it is manifestly connected with bad hygienic conditions, with insufficient or improper feeding, or is a consequence

of some disease of childhood, particularly measles or whooping-cough. When it occurs in adults it is usually secondary to some chronic manifestation of tuberculosis in another part of the body, especially in the lungs.

Symptoms.—Tuberculous meningitis is usually described as passing through three stages; but its earlier manifestations are often vague.

The *premonitory symptoms* of tuberculous meningitis are mostly such as relate to the general nutrition. The patient, if a child, becomes listless and easily fatigued, loses appetite, and is restless at night. There is headache after exertion, and the temper often undergoes a marked change, the child becoming unusually peevish and irritable. These symptoms may persist during many weeks; but, on the other hand, such premonitory indications may be entirely wanting, and the disease be developed to all appearance quite suddenly.

The onset of the *first stage*, or *stage of excitement*, is in most instances marked by the occurrence of vomiting, often severe, but sometimes only slight, and there is, in general, obstinate constipation. In some cases, the first symptoms are convulsions, which, however, may in this early stage subside, and remain absent, or reappear at a later period. Headache is one of the most constant of the earlier symptoms, and is generally intense and accompanied by sharper paroxysms, which cause the patient to scream with a peculiar and characteristic cry. There are great intolerance of light and sound and general nervous sensitiveness. The neck shows rigidity so that the head cannot be so readily bent forwards as usual, and similar rigidity in the lower limbs is almost invariably present. The latter symptom forms an important sign (Kernig's Sign) of the disease. If the knee is raised from the bed, stiffness and pain are experienced in the muscles behind the thigh when the attempt is made to straighten the leg at the knee-joint, whereas in the healthy child the whole lower limb can be readily flexed on the abdomen with the knee straight. Fever is present to a greater or less extent, the temperature ranging from 100° to 103° Fahr.; yet the pulse is not quickened in proportion, being on the contrary rather slow, but exhibiting a tendency to irregularity, and liable to become rapid on slight exertion. This slowness of the pulse is of great importance in distinguishing the disease from others which resemble it, and in which the heart beats more rapidly in proportion to the temperature. Symptoms of this character, constituting the stage of excitement, continue for a period varying from one to two weeks, when they are succeeded by the stage of depression.

In the *second stage*, or *stage of depression*, there is a marked change in the symptoms, which is apt to lead to the belief that a favourable turn has taken place. The patient becomes quieter and inclines to sleep, but it will be found on careful watching that this quietness is but a condition of apathy or partial stupor into which the child has sunk. The vomiting has now ceased, and there is less fever; the pulse is slower, and shows a still greater tendency to irregularity than before, while the breathing is of markedly unequal character, being rapid and shallow at one time, and long drawn out and sinking away at another. There is manifestly little suffering, although the peculiar cry may still be uttered, and the patient lies prostrate, occasionally rolling the head uneasily upon the pillow, or picking at the bedclothes or at his face with his fingers. He does not ask for food, but readily swallows what is offered. The eyes present important alterations, the pupils being dilated or unequal, and scarcely responding to light. There may be double vision, or partial or complete blindness. Squinting is common in this stage, and there may also be drooping of an eyelid, due to paralysis of the part, and one or more limbs may be likewise paralysed.

To this succeeds the *third stage* or *stage of paralysis*, in which certain of the former symptoms recur, while others become intensified. There is generally a return of the fever, the temperature rising sometimes to a very high degree. The pulse becomes feeble, rapid, and exceedingly irregular, as is also the case with the breathing. Coma is profound, but the patient may still be got to swallow nourishment, though not so readily as before. Convulsions are apt to occur, while paralysis, more or less extensive, affects portions of the body

or groups of muscles. The pupils are now widely dilated, and there is often complete blindness or deafness. In this condition the sufferer's strength undergoes rapid decline and the body becomes markedly emaciated. Death takes place suddenly in a fit, or, more generally, from exhaustion. Shortly before the fatal event it is not uncommon for the patient, who, it may be for some days previously, lay in a state of profound stupor, to wake up, ask for food, and talk to those around. But the hopes which may be thus raised are quickly dispelled by the setting in of the symptoms of rapid sinking.

The duration of a case of tuberculous meningitis varies, but, in general, death takes place within three weeks from the onset of the symptoms. The disease is almost invariably fatal, yet it must be admitted that cases presenting all the chief symptoms of tuberculous meningitis do occasionally recover, and, in the brain of those who die, traces of former and healed meningitis are sometimes found. But such cases are undoubtedly very rare. Indeed the condition revealed in the brain *post mortem* renders its fatal character in no way surprising. Tubercles (*see* CONSUMPTION) are deposited in the membranes of the brain, more particularly at its base and along its blood-vessels or in the space between the medulla and the cerebellum. The irritation set up in consequence of this is accompanied by effusion of fluid into the arachnoid membrane and ventricles within the brain, which, by its pressure, distends and compresses the brain substance.

Besides this condition of the brain, there exists, in most cases, deposition of tubercle elsewhere, as in the lungs and abdominal glands, and this may have given evidence of its presence even before the head symptoms appeared, particularly when the disease affects adults.

Treatment.—With respect to treatment, little can be stated of an encouraging nature. It is most important in families where the history indicates a tuberculous tendency, and particularly where meningitis has already occurred, that every effort should be used to fortify the system and avoid the causes that favour the development of the disease during early childhood. With this view, wholesome food, warm clothing, cleanliness, regularity, and the avoidance of over-exertion, physical and mental, are of the utmost consequence, and care should be taken to avoid tuberculous milk. (*See* MILK.)

Little can be done when the disease has set in. The severe headache may be relieved by the frequent use of cold water or ice applied to the head. The patient's strength must be maintained by light nourishment, and sedatives for the nervous system be employed. Convulsions are best treated by chloral or chloroform. Lumbar puncture is of value both as an aid to diagnosis, and in relieving headache and quieting or preventing convulsions by withdrawing excess cerebro-spinal fluid.

(4) SYPHILITIC MENINGITIS is usually chronic inflammation (but sometimes producing acute symptoms) occurring in most cases within the first four years of infection. It may spread from the pia-arachnoid into the brain—a meningo-encephalitis—or it may attack the dura mater and the overlying bone. The pressure of the cerebrospinal fluid is raised; the fluid itself is clear and contains an increased number of lymphocytes. Headache is a common symptom. Paralysis of cranial nerves (resulting, for example, in a squint) can occur as a result of strangulation of the nerve in inflamed meninges at the base of the brain. Hydrocephalus may arise suddenly, with headache, vomiting, sleepiness, mental changes, and congestion of the optic discs as symptoms and sign. Or syphilitic meningitis may come on acutely. The treatment is as for syphilis.

(5) MENINGOCOCCAL MENINGITIS, also known as EPIDEMIC CEREBROSPINAL MENINGITIS, CEREBROSPINAL FEVER, SPOTTED FEVER, MALIGNANT PURPURIC FEVER, and POST-BASIC MENINGITIS, is a dangerous epidemic condition characterised by painful contractions of the muscles of the neck, retraction of the head, and mental symptoms. It was first distinctly recognised in the year 1837, when it prevailed as an epidemic, chiefly among troops in the south-west of France. In 1846 it appeared in Ireland, especially in the workhouses of Belfast and Dublin. Since that time it has appeared repeatedly both in Europe and America, notably in a severe epidemic in the large towns of Scotland in

1907–1909, in a slighter form among the troops during the four-years war of 1914–1918, and a fair-sized epidemic in Great Britain in the winter of 1939–1940.

Causes.—When an outbreak takes place, it usually occurs about the months of February, March, and April, and affects a closed community, such as a school, garrison, camp, or prison. The direct cause is an organism, the *Diplococcus meningitidis intracellularis* or *meningococcus*, discovered by Weichselbaum, which is found in the exudation round the nervous system, also in the blood, and frequently in the nasal discharge. The organism is of four different types, a point of importance in connection with serum treatment of the disease. Some cases with closely similar symptoms are due to the *pneumococcus* or other bacteria. It is believed that the infection takes place through the nose and that a large number of persons who do not contract the disease harbour the meningococcus in the nasal discharge and form sources of infection to more susceptible people, especially children, by coughing, sneezing, etc.—they are known as 'carriers'. Factors favouring infection are a high carrier-rate, the virulence of the organism, a closed community (*e.g.* camp), naso-pharyngeal catarrh, bad ventilation, insufficient space between beds, introduction of susceptible persons into a closed community, season of the year (winter and spring). Young children are much more susceptible than adults.

Symptoms.—The onset is usually sudden, sometimes startlingly so. As a rule, vomiting, headache, and shivering first appear, followed in a few hours by stiffness of the neck. In children, convulsions are common. In a case of very sudden onset, the patient, while going about as usual, may fall down suddenly in a convulsion, or he may go to bed perfectly well and be found unconscious on the following morning. If the patient is not unconscious, headache and pain with stiffness in the back of the neck continue, squinting is often seen, the tongue is furred and dry, and there is a certain amount of rise of temperature (100° to 104°). The patient is irritable, the body tender to the touch, and the limbs stiff, so that bending up of the lower limbs on the abdomen with the knee straight becomes impossible (Kernig's Sign). The patient is often sleepless or delirious, and there is a great tendency for the symptoms to go and come. The red spots, from which the disease takes its name of 'spotted fever', appear over the surface of the trunk during the first week of the disease in greater or less numbers in about one quarter of the cases. Death occurs in a large number of the cases within a week of the onset, taking place very often suddenly from cardiac failure. After the first week, if life is prolonged, the disease usually abates gradually and in the course of some weeks the rigidity may have disappeared and the temperature may have become normal. On the other hand, the disease may pass into a chronic state with great wasting, and, if the patient be a young child, head retraction in these cases usually becomes very marked and the body is greatly bent backwards. The patient during the course of this chronic stage may become blind or deaf or may show very marked mental deterioration. Very often the child falls a victim to some complication, such as bronchopneumonia.

In those patients who die, it is common to find the surface of the brain and the spinal cord covered with thick pus and the blood-vessels markedly congested. If death has occurred at a very early period, nothing more may be visible than very intense congestion of the membranes on the surface of the brain. The interior of the brain shows more than the usual amount of fluid.

The mortality of this disease varies in different epidemics, in some being as high as 80 per cent of the cases affected, in others only about 20 per cent. Among the cases treated with serum the mortality appears to be consistently somewhere between 20 and 30 per cent only. At ages under twelve months and over forty years the mortality rate is still high, the effect of the sulphonamides — sulphapyridine, sulphathiazole, sulphadiazine, and sulphamethazine — being greatest between these ages. In one series treated by a sulphonamide drug there were only two deaths in 100 consecutive cases.

Treatment.—The risk of infection

is very slight except among persons living in barracks and under similar crowded conditions. In such cases isolation is very necessary. The diet should be light and nutritious. For insomnia, soporifics may be necessary, and for pains in the back and limbs the hot bath is very effective. The severe headache, which is an almost constant symptom, is relieved at once, though it may be only temporarily, by the operation of lumbar puncture, which is also of great importance in regard to diagnosis. It used to be the invariable practice to inject anti-meningococcal serum into the spinal theca after the withdrawal of cerebro-spinal fluid. This practice has now (1943) been abandoned by highly competent authorities, who prefer to use sulphonamides only.

In the epidemic during the winter of 1939–1940 good results were obtained by treating the disease with sulphapyridine and since then with sulphathiazole, sulphadiazine, and sulphamethazine.

MENISCUS (*μηνίσκος*, crescent), is the term applied to a crescentic fibro-cartilage in a joint such as the cartilages in the knee-joint.

MENOPAUSE (*μήν*, month; *παῦσις*, cessation) is the term applied to the cessation of menstruation at the end of reproductive life. Usually it occurs between the ages of 45 and 50, though in numerous cases it occurs before 45 or after 50. It rarely occurs before 40 unless as the result of disease. For the changes accompanying it see CLIMACTERIC.

MENORRHAGIA (*μηνές*, the menses; *ῥήγνυμι*, I burst forth) means an over-abundance of the menstrual discharge.

MENSTRUATION (*menstruus*, monthly) is a periodic change occurring in human beings and the higher apes, and consists chiefly in a flow of blood from the cavity of the womb, and is associated with various slight constitutional disturbances. It begins between the ages of thirteen and fifteen, as a rule, though its onset may be delayed till as late as twenty. It is said to appear earlier in warm countries and among certain races, for example, the Jews. Along with its first appearance the body develops greatly, while the mental change is even more striking. The duration of each menstrual period is very regular, varying in different persons from two to eight days. It recurs in the great majority of cases with extreme regularity, most commonly at intervals of twenty-eight days or thirty days, less frequently with intervals of twenty-one or twenty-seven days, ceasing only during pregnancy and lactation, till the age of forty-four or fifty arrives, when it stops altogether, as a rule ceasing early if it has begun early, and *vice versa*. The final stoppage is known as the menopause or the grand climacteric.

Menstruation depends upon a functioning ovary and this upon a healthy pituitary gland. The regular rhythm may depend upon a centre in the hypothalamus, which is in close connection with the pituitary. After menstruation the denuded uterine endometrium is regenerated under the influence of the follicular hormone, œstradiol. The epithelium of the endometrium proliferates, and about a fortnight after the beginning of menstruation great development of the endometrial glands takes place under the influence of progesterone, the hormone secreted by the corpus luteum. These changes are made for the reception of the fertilised ovum. In the absence of fertilisation the uterine endometrium breaks down in the subsequent menstrual discharge.

Disorders of menstruation.—In the majority of healthy women, menstruation proceeds regularly for thirty years or more, with the exceptions connected with childbirth. In many persons, as the result either of general or local conditions, the process may be absent, or excessive, or may be attended with great discomfort or pain. The term *amenorrhœa* is applied to cases in which menstruation is absent, *menorrhagia* and *metrorrhagia* to cases in which it is excessive, the former if the excess occurs at the regular periods, the latter if it is irregular, while *dysmenorrhœa* is the name given to cases in which the process is attended by pain.

AMENORRHŒA may be due to general or to local causes. Among the former, anæmia, with the various conditions that lead to it, ranks perhaps first in importance in young women. Bad

feeding, over-hard work, want of fresh air, and all causes which depress the system and cause loss of flesh tend to cause diminution and finally stoppage of the menses. In a similar manner, serious diseases, such as Bright's disease, consumption, malaria, aggravated dyspepsia, which weaken the constitution, lead to this result. In all these cases, stoppage of the menstrual loss of blood is salutary, because it prevents a needless extra drain upon the system. Various influences which act through the nervous system, such as a sudden fright, great grief, and exposure to cold like that of an unaccustomed bath just before a period is due, may also cause stoppage for several months. Among the local causes of amenorrhœa, pregnancy, of course, stands first. Failure of menstruation to appear at all in a young woman may be due to slow or imperfect development of the ovaries or womb; and in occasional cases, though menstruation does take place regularly, the menstrual fluid does not escape but is retained and accumulates within the womb, in consequence of some structural defect.

The treatment in all cases consists in removal of the cause and attention to the general health, remedies for the condition of bloodlessness if present (*see* ANÆMIA), and in the cause last mentioned some operative interference.

MENORRHAGIA.—Excessive menstruation may to a certain extent be due to the same general conditions which produce amenorrhœa, the same diseases, such as Bright's disease or consumption, causing stoppage or excess in different persons, according to their personal peculiarities. Thus, in some persons an excessive discharge is brought about by these conditions, and the bad effects of the general disease are much increased by the added drain upon the system, due to loss of blood. In heart disease, the womb may share in the general internal congestion, and the menses in consequence are increased. In some persons, menstruation at its first appearance is excessive, and even dangerous amounts of blood are lost; while it is so frequently the case as to be almost the general rule that at the time when the menstrual periods are about to stop they become irregular in time and often excessive in amount. But it is most often a local condition that produces menorrhagia, and in this case, as a rule, not only is the periodic loss increased but there is bleeding at irregular times (metrorrhagia). Polypus, fibroid, and other tumors, displacements of the womb, and particularly some inflammation consequent upon childbirth or miscarriage, are the most common causes of this type. In the treatment, rest and various internal remedies which check hæmorrhage, together with careful attention to the general health between the periods, are essential. As a rule, some local measures intended to check the bleeding or to remove its cause, such as insertion of radium, are necessary. (*See* UTERUS, DISEASES OF.)

DYSMENORRHŒA may vary from mere discomfort to agonising colic, accompanied by prostration and vomiting. Anæmia is sometimes a cause of painful menstruation as well as of stoppage of this function. Gout and rheumatism are also fairly frequent causes, and it is well that remedies for these should be tried in dysmenorrhœa which appears without obvious reason, before recourse is had to more serious measures. Chills and exhaustion may produce pain for a single period in persons usually natural. Occasionally pain, especially when it precedes the menstrual period, is due to irritation in the ovary; and in this case it is generally accompanied by pain in one groin, and often by hysterical manifestations. For this type of pain, careful regulation of the bowels, regular exercise, and the application of counter irritation to the lower part of the abdomen form the course of treatment generally carried out. In some cases the administration of ovarian or other glandular extract is attended with benefit.

Inflammation of various internal organs, *e.g.* of the womb itself, the ovaries, or the Fallopian tubes, is one of the commonest causes of dysmenorrhœa which comes on for the first time late in life, especially when the trouble follows the birth of a child. In this case the pain exists more or less at all times, but is aggravated at the periods. It is relieved by various local means directed towards checking the inflammation present.

Many cases of dysmenorrhœa appear with the beginning of menstrual life,

and accompany every period. Some of these are of an obstructive type, due to spasm of the neck of the womb, in consequence of which a severe uterine colic is set up. In many cases, the spasm appears to be one manifestation of a nervous temperament. In other cases the pain appears to be due to difficulty in the separation of the surface layer of mucous membrane, which comes away in healthy menstruation in fragments with the blood.' In these cases, the lining of the uterus, after great difficulty, is finally expelled in the form of a complete membranous cast of the interior, and the pain then abates. In other cases, the spasm may be due in part to defective development of the womb, producing either great narrowness of its mouth or causing it to be bent upon itself, and occasionally these cases are benefited or cured by an operation designed to stretch the neck of the womb, or otherwise relieve the defect. For the temporary relief of dysmenorrhœa, rest in bed, or, at all events, in the recumbent position, hot compresses to the lower part of the abdomen, and antipyrine or phenacetin internally, are the remedies which prove most useful.

MENTAL DEFECTIVENESS.—Mental defect, as opposed to insanity, is a primary condition in which certain persons never develop to the average standard of intelligence, while insanity means an occurrence of mental disease appearing in persons previously healthy. The question of mental defect has in recent years attracted a great deal of attention, because it is realised that much incapacity for work, with suffering and hardship, both as regards mental defectives and their relatives, as well as a large amount of crime, is due to failure to recognise this condition at an early stage of life. If recognised in childhood as mentally defective, these persons may often be educated in special schools for simple employments and kept under observation and training with regard to moral and social qualities. Legislation has in recent years been introduced in most countries for dealing with this problem, and numerous institutions and colonies have sprung up where these people can be kept and given useful forms of work under supervision. An idea may be obtained of the prevalence of serious mental defect among the general community from the fact that in the year, 1936 in Scotland there were 4414 certified mental defectives out of a population of 4,971,200. This, allowing for the fact that many mental defectives live uncertified in their own families, means that considerably over 1 in every 1000 of the population is incapacitated by mental defect.

Mental defect is of several types and of all grades from complete idiocy up to that of the high-grade mental defective, who is merely unable to understand and transact complicated business. Idiocy has been defined as mental deficiency or extreme stupidity depending upon malnutrition or disease of the nerve centres occurring either before birth or before the evolution of the mental faculties in childhood. *Idiots* are generally unable to guard themselves against common physical dangers, and are often very dirty in their habits. Imbecility is a slightly milder stage of the same defect and *imbeciles* are incapable of managing themselves or their affairs. Feeblemindedness is a term which covers the less marked cases of defect, to which the name *amentia* is also applied. The term *moron* is also applied to the highest grade of mentally defective person who is able to transact work requiring reason and judgement, but is in social matters dependent upon the help or guidance of other people. A special class of *moral imbeciles* is also recognised, consisting of persons who from an early age display mental defect with vicious or criminal propensities, and on whom punishment has little or no effect.

Causes.—The term mental deficiency is largely a relative one, and the mental defective must be compared with persons of his own race, age, and opportunities; for example, the average negro has the mental endowment of a child of nine or ten years as compared with the average white person living in towns, but he is not, therefore, to be regarded as a mental defective. Again, mental defect is not so evident in persons living in country districts, where employment suitable for mental defectives can be obtained, as it is among persons in towns, where the struggle for existence

is more intense. Less importance than previously is now attached to heredity as a cause, although mentally defective children sometimes occur in a family of which other members show insanity, epilepsy, alcoholism, etc., especially when the parents are nearly related to one another. The descendants of various mental defectives have been traced and it has been found that among the descendants of a union between two mental defectives a very high proportion of feeble-minded persons occurs. Several varieties of type are recognised. The great majority of cases fall into the group of *simple primary amentia*, for which no further cause is evident than the hereditary consideration mentioned above. In these cases, the children show too little of the normal automatic movements of healthy infancy, and speech and walking fail to develop at the proper age, between one and two years. Many such children show peculiarity in gestures and behaviour even in early life, and are very late in gaining control over the bladder and bowels, if they do so at all. A large proportion of such children also take epileptic attacks. Along with mental defect these children generally show much physical weakness, and they are more liable to die from slight disorders or injuries than are ordinary persons. Such children, even when the defect is not great, are difficult to teach, because they are unable to concentrate their attention on one subject for long. They are lacking in perseverance. Some are morbidly shy and self-conscious, or deficient in self-control so that they are constantly laughing, crying, and getting into unreasonable fits of passion. When these children go to school, the defect is soon noticed by comparison with other children of their own age, and in most large towns special schools are provided for mentally defective children, where they are taught by specially trained teachers and an attempt is made to fit them for taking up simple forms of employment. While these children are generally benefited by contact with older persons who make allowances for them, their condition is usually made much worse by the teasing which they are apt to undergo at the hands of other children or fellow-workers.

MENTAL DEFECTIVENESS

Other types of mental defect are those associated with *microcephalus*, in which the head is unusually small and the whole nervous system defective in development. Another type is that of *Mongolian imbecility*, in which there is some arrest or perversion of development prior to birth. These children usually come at the end of large families. Still other cases are associated with gross disease of the nervous system in early life, such as *hydrocephalus*, *hæmorrhage* on the surface of the brain at birth, *congenital syphilis* or disease of other organs, such as thyroid defect, which occurs in *cretins*. Children may also be mentally defective in cases where they have been deprived of some important sense, such as in blindness or deafness, but such mental defect is curable by special instruction.

Diagnosis.—The symptoms by which the presence of mental defect is recognised in infants and young children are bodily as well as mental. At a later stage of life the degree of mental defect can be assessed by comparing the mental powers of the person in question with the capabilities of normal children of different ages.

Some children present from birth abnormalities of bodily structure which are commonly associated with mental defect. Thus, the conditions of microcephalism, mongolism, cretinism, chronic hydrocephalus, and various forms of paralysis can be recognised, and these are known to be commonly associated with mental defect. Other less marked bodily malformations may be found when careful search is made, such as unusual height of the palate, defects of the ear, defective formation of the head or spine, such as spina bifida, and congenital malformations of the heart. Any of these defects may be met in children of ordinary intelligence, but they are more common in the mentally defective, and, if noticed, should direct attention to the child's mental condition.

The occurrence in infants of convulsions is often associated with mental defect either as a cause of or produced by brain defect. Abnormal gestures and actions, such as constant crying, rolling of the eyes, or simply want of animation when the nurse or mother

fondles a child and, at a later stage, unmeaning laughter and grimaces, dirty habits, disgusting ways of eating, or dribbling of saliva from the mouth, are all signs of defective mentality.

Other significant signs are found in slowness of development as compared with other children. Thus the infant may be too long in learning to hold up its head, to use its hands for grasping objects, to stand, and to notice bright or attractive objects placed before it. Difficulty in learning to suck, backwardness in speaking, and delay in learning cleanly habits are all significant.

At a later age, in order to find out the degree of mental defect in a child or adult, a simple form of examination is set, questions being asked which have been found capable of being answered by a normal child at a given age. Various scales are employed, the best known being the Stanford revision of the Binet-Simon tests. Examples of these are given below. If the mentally defective person can only pass the test which a child of three would answer, his 'mental age' is said to be that of three years. If he can pass the test of a normal child of six, nine, etc., his 'mental age' is said to be six years, nine years, etc. The following are three examples—

Year 3. A normal child of three should be able to do the following: (1) To point correctly to his nose, eyes, mouth, hair, etc., when asked to do so. (2) To name familiar objects like key, penny, knife, watch, pencil, etc., when shown to him. (3) To name three simple objects in a picture shown him. (4) To say whether he is boy or girl. (5) To tell his last name. (6) To repeat three numbers, *e.g.* 6, 4, 1 when named to him.

Year 6. A normal child of six should be able to do the following: (1) Point to right hand, left ear, etc., as named. (2) When shown a picture of a figure from which parts have been left out, to name the missing parts. (3) To give an explicit reply to simple questions such as 'What should you do if you find that the house is on fire?' (4) To count objects up to 13. (5) To name correctly coins shown him. (6) To repeat correctly a simple sentence of 12 or 15 words

Year 9. A normal child of nine should be able to do the following: (1) To give the correct day, month, and year. (2) To arrange a series of weights in proper order. (3) To subtract two numbers from other two. (4) To repeat backwards four stated figures, *e.g.* 6528. (5) To make a simple sentence containing three stated words. (6) To name the month coming before a stated month.

It must always be remembered that comparison with a normal child is only a rough index of the mental age of the defective person, who has reached a greater number of years and who has, therefore, had special experience along certain lines which the normal child has not yet had time to gain.

Treatment.—In the great majority of cases, mental defect is incurable and children who are mentally weak will remain so throughout life. Nevertheless, most mentally defective children, unless the defect is very great, are capable of improvement under suitable treatment and may actually be able in later life to earn a satisfactory living at some simple automatic employment which a normally minded person would find depressing or even intolerable because of its monotony. Attention to the general health is of great importance, and when special conditions such as cretinism, syphilis, deafness, etc., are found, these should receive appropriate treatment. Young children who are found to possess insufficient concentration for book work should be instructed in amusing kindergarten occupations, and bad and dirty habits should be gradually corrected. The child should be encouraged to do as much as he can for himself, and particular care should be exercised to promote self-control and to cultivate moral character.

If home conditions are satisfactory, the home is far the best place for a mentally defective child, and, if his home is unsatisfactory, it is better to board him out under family conditions rather than to send him to an institution. At a later stage of childhood, however, the mental defective both becomes a drag upon normal children and is apt to be discouraged by ineffective competition with them, as well as by teasing to which they are very liable

to subject him. He is then more happily placed with children about his own level of intelligence either in a special school or in an institution. At such a school or institution the attempt should be made to prepare him about the age of sixteen for taking up some simple form of productive work, if he is at all capable of such training. If he proves incapable of this, it is better for society that he should be maintained in some institution for the remainder of his life.

MENTAL DISEASES (*see* INSANITY).

MENTHOL is a white crystalline substance deposited from oil of peppermint when it is cooled. It comes principally from Japan, being derived from several species of *Mentha*. It dissolves freely in alcohol, ether, chloroform, and olive oil, and also to a slight extent in water, to which it gives a strong odour and taste of peppermint. Mixed with a little oil of peppermint, it can be moulded into cones, sticks, or pencils, which are very widely used. When menthol is rubbed up with thymol, carbolic acid, chloral, or camphor, the two solids form a clear oily liquid, which can be painted on the skin, exerting the effects of both drugs.

Action.—Applied to the skin, menthol has weak antiseptic properties, and it acts upon the sensory nerves something like aconite, causing first a hot, tingling sensation, followed quickly by a cool, numb feeling. When applied to inflamed mucous membranes, such as those of the nose and throat, menthol relieves irritability, diminishes congestion, and checks excessive secretion. Menthol has the merit of being non-poisonous.

Uses.—In neuralgia, cones and sticks of menthol are widely used to rub over the affected part. In toothache, cotton-wool dipped in one of the oily fluids above named and placed in the cavity of the carious tooth quickly relieves the pain. In many itchy conditions of the skin a strong solution of menthol in olive oil (1 part in 10) relieves the sense of irritation at once. Menthol plaster is useful in gout, rheumatism, and neuralgia, and so are mixtures with chloral or camphor painted over the painful parts. For inflamed conditions of the nose and throat, the oily compounds of menthol are diluted with parolene and sprayed on the part affected, or in the case of the throat various lozenges and pastilles containing menthol are sucked. In bronchitis menthol crystals thrown upon hot water, from which the vapour is inhaled, give much relief.

MEPACRINE HYDROCHLORIDE is the official *British Pharmacopœia* term for the proprietary anti-malarial remedy ATEBRIN (*q.v.*).

MERCUROCHROME is an organic salt of mercury of dark red colour when dissolved in water, with weak antiseptic action, used as an urinary antiseptic.

MERCURY, also known as QUICKSILVER or HYDRARGYRUM, is a heavy fluid metal. In medicine the metal is used in a state of fine subdivision in the form of an ointment, a plaster, grey powder, and blue pill. Mercury itself is, however, an inert substance, and its effect upon the body is probably the result of the action of the secretions upon it, which convert it into some of its powerful salts.

Action.—The salts of mercury fall into two groups: the mercuric salts, which are very soluble and powerful in action; and the mercurous salts, which are less soluble and act more slowly and mildly. The mercuric salts are all highly poisonous both to man and to bacterial life, so that they are strongly antiseptic. In strong solutions, several act as caustics, and in weaker solutions they are irritants. Taken internally, the first effect of the mercuric, and to a less degree of the mercurous, salts, is by their irritating action to set up copious purging. They are also credited, particularly perchloride of mercury and blue pill, with the power of increasing the flow of bile, and for this reason are much used as purgatives. They are absorbed into the body in the form of a compound, either with albumin, or with the chlorides of the blood and lymph, and in certain diseased conditions exert a powerful effect upon the health. Particularly is this the case in the early stages of syphilis.

Uses.—Externally the great use of the mercuric salts is as disinfectants and antiseptics. The uses of the perchloride of mercury are given under these headings. The ammoniated mercury oint-

ment, or white precipitate ointment, is much used to apply to the contagious eczematous condition which appears on the head and face of children, known as impetigo. The yellow oxide of mercury ointment is very widely used for an application to the eyelids when a mild antiseptic ointment is required. Internally, mercurial salts are frequently used as purges, and for persons who cannot take castor oil calomel forms one of the most convenient drugs, producing much the same effect as the oil, if 3 or 4 grains be given to an adult. Blue pill and grey powder are used in the same way, and in about the same dose. All of these are best taken at night, and followed by a saline draught in the morning.

In syphilis, mercurial preparations are very extensively used, and must be taken by the subjects of this disease over many months in order to render a cure likely. The methods by which it is given are various. Mercury ointment is sometimes ordered to be rubbed into the armpits or abdomen daily, and a flannel shirt or binder, being worn next the skin, aids this process. This method is specially used in the case of infants. Or emulsions of mercury and of subchloride of mercury made up with oil are injected periodically into the substance of a muscle, whence they are slowly absorbed. Grey powder and perchloride of mercury are also frequently given in small doses twice or thrice daily. Oxycyanide of mercury is sometimes used by intravenous or intramuscular injection.

MERCURY POISONING is of two kinds: (1) acute mercury poisoning, due to swallowing one of the soluble mercury salts, generally perchloride of mercury; and (2) chronic mercury poisoning, produced either by continuing repeated medicinal doses of mercurials for too long a time, or by handling the metal or inhaling its fumes, as happens sometimes among looking-glass and barometer makers.

ACUTE POISONING. — **Symptoms.** —There is burning pain, first in the mouth, then in the stomach, followed by diarrhœa and vomiting. The lips and mouth are generally burned white, and a metallic taste is left in the mouth. Great collapse soon comes on, and the person may die in a few hours. If death does not take place at an early stage, the kidneys are liable to remain seriously damaged by the drug.

Treatment.—Any albuminous fluid forms an antidote to corrosive sublimate, with which it forms an insoluble and harmless compound. One or more raw eggs shaken up with water, and given as quickly as possible, flour and water, or milk, suffice for this purpose, and an emetic may then be given. Drinks of milk and lime-water may afterwards be administered from time to time, to soothe the injured surfaces.

CHRONIC POISONING. — **Symptoms.**—When too much mercury is being taken into the system in small doses, the first signs are an excessive discharge of saliva into the mouth, and tenderness about the teeth when the mouth is tightly shut. Next, the odour of the breath becomes bad, the gums tender, spongy, and ready to bleed at the slightest touch, and the tongue swollen. Finally, the teeth become loose and drop out, the jaw-bone may become diseased, the person becomes generally weak and bloodless, and may indeed die. Persons who work with metallic mercury may develop these symptoms to some extent, and in addition they become affected by trembling and palsy in various parts of the body.

Treatment consists in stoppage of the mercury if it is being administered as medicine, and change of employment if the symptoms be due to work. Potassium iodide is often given, in addition to the good food and tonics which are necessary.

MERSALYL, or SALYRGAN, is a complex synthetic mercurial compound, used in the treatment of œdema and dropsy due to heart disease.

MERTHIOLATE is the proprietary term for a mercurial germicide said to be highly effective in sterilizing tissue surfaces. Its chemical description is sodium ethylmercurithiosalicylate.

MERYCISM is another name for rumination, in which the contents of a meal are returned to the mouth some time after they have been swallowed and are once again chewed.

MESENCEPHALON is the term applied to the mid-brain connecting

the cerebral hemispheres with the pons and cerebellum.

MESENTERY (*μέσον*, middle; *ἔντερον*, the intestine) is the name given to the double layer of peritoneal membrane which supports the small intestine. It is of a fan shape, and its shorter edge is attached to the back wall of the abdomen for a distance of about 6 inches, while the small intestine lies within its longer edge, for a length of over 20 feet. The terms meso-colon, meso-rectum, etc., are applied to similar folds of peritoneum that support parts of the colon, rectum, etc.

MESMERISM (*see* HYPNOTISM).

MESOCOLON (*μέσος*, middle; *κόλον*, colon) is the name of the double fold of peritoneum by which the large intestine is suspended from the back wall of the abdomen.

METABOLISM (*μεταβολή*, change) means tissue change and includes all the physical and chemical processes by which the living body is maintained, and also those by which the energy is made available for various forms of work. The constructive, chemical and physical processes by which food materials are adapted for the use of the body are collectively known as anabolism. The destructive processes by which energy is produced with the breaking down of tissues into waste products is known as catabolism. *Basal metabolism* is the term applied to the energy changes necessary for essential processes such as the beating of the heart, respiration, and maintenance of body warmth. This can be estimated, when a person is placed in a state of complete rest, by measuring the amounts of oxygen and carbon dioxide exchanged during breathing under certain standard conditions. (*See* CALORIE.)

METACARPAL (*μετά*, beyond; *καρπός*, wrist) bones are the long bones, five in number, which occupy the hand between the carpal bones at the wrist and the phalanges of the fingers. The large rounded 'knuckles' at the root of the fingers are formed by the heads of these bones.

METAPLASIA (*μεταπλάσσω*, I mould anew) is the term applied to a change of one kind of tissue into another.

METASTASIS (*μετάστασις*, a change of place) and METASTATIC are terms applied to the process by which malignant disease spreads to distant parts of the body, and also to the secondary tumors resulting from this process. For example, a cancer of the breast may produce metastatic growths in the glands of the armpit, cancer of the stomach may be followed by metastases in the liver.

METATARSAL (*μετά*, beyond; *ταρσός*, instep) bones are the five bones in the foot which correspond to the metacarpal bones in the hand, lying between the tarsal bones, at the ankle, and the toes.

METATARSALGIA (*μετά*, beyond; *ταρσός*, instep; *ἄλγος*, pain) is the name applied to pain of a gouty or rheumatic nature affecting, as it often does, the metatarsal region of the foot. It also occurs in flat-foot.

METEORISM (*μετεωρίζω*, I raise up) means the distension of the abdomen by gas produced in the intestines. (*See* FLATULENCE.)

METHÆMOGLOBIN is a modification of the pigment of the blood which is found in the blood and sometimes in the urine after taking large doses of certain drugs, such as acetanilid, and also in some diseases.

METHYL is the name of an organic radical whose chemical formula is CH_3, and which forms the centre of a wide group of substances known as the methyl group. For example, methyl alcohol is obtained as a by-product in the manufacture of beet-sugar, or by distillation of wood; methyl salicylate is the active constituent in oil of wintergreen; methyl hydride is better known as marsh-gas.

Methyl alcohol, or wood spirit, is distilled from wood and is thus a cheap form of alcohol. It has actions similar to those of ethyl alcohol. It has a specially pronounced action on the nervous system, and in large doses is apt to cause neuritis, especially of the optic nerves, causing blindness, partial or complete.

METHYL TESTOSTERONE.—A derivative of the testicular hormone, testosterone (*q.v.*), which is active when taken by mouth. About three to four

times as big a dose is needed to produce the same effect as an injection of testosterone propionate.

METHYLTHIONIN CHLORIDE, or METHYLENE BLUE, is a dark powder forming a deep blue solution, used for various tests.

METRAZOL (*see* CARDIAZOL).

METRITIS (*μήτρα*, the womb) means inflammation of the womb.

METROPATHIA HÆMORRHAGICA, or ESSENTIAL UTERINE HÆMORRHAGE, is the term given to a diseased state characterised by hæmorrhage from the uterus, cysts in the ovaries, and thickening of the uterine mucosa.

METRORRHAGIA (*μήτρα*, the womb; *ῥήγνυμι*, I burst forth) means bleeding from the womb otherwise than at the proper period.

MICROBE (*see* BACTERIA).

MICROCEPHALY (*μικρός*, small; *κεφαλή*, head) is a term applied to abnormal smallness of the head. (*See* MENTAL DEFECTIVENESS.)

MICROCYTE (*μικρός*, small; *κύτος* cell) means a small red blood corpuscle.

MICRO-ORGANISM (*see* BACTERIA).

MICTURITION (*micturio*, I make water) means the act of passing water.

MIDWIFERY (*see* LABOUR).

MIGRAINE (a corruption of *ἡμικρανία*, pain on half the head) is a special type of headache. (*See* HEADACHE.)

MIL is a contraction for millilitre, equal to one cubic centimetre of fluid.

MILIARY (*milium*, a millet seed) is a term, expressive of size, applied to various disease products which are about the largeness of millet seeds, *e.g.* miliary aneurysms, miliary tuberculosis.

MILIUM is the term applied to a small, whitish nodule in the skin, especially of the face. (*See* ACNE.)

MILK is the natural food of all animals belonging to the class of mammalia for a considerable period following their birth. It is practically the only form of animal food in which protein, fat, carbohydrate, and salt are all represented in sufficient amount, and it therefore contains all the constituents of a standard diet. Milk is important in human nutrition because it contains

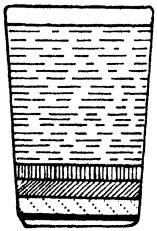


FIG. 317.—FRESH MILK

Fuel Value per lb. (roughly ½ pint) = 315 calories.

	Per cent.
Water	87·0
Protein	3·3
Fat	4·0
Carbohydrate	5·0
Ash	0·7

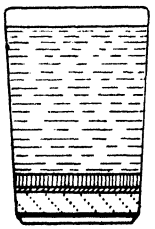


FIG. 318.—SKIM MILK

Fuel Value per lb. (roughly ½ pint) = 165 calories

	Per cent.
Water	90·5
Protein	3·4
Fat	0·3
Carbohydrate	5·1
Ash	0·7

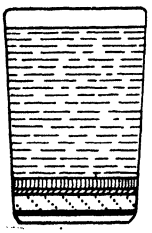


FIG. 319.—BUTTERMILK

Fuel Value per lb. (roughly ½ pint) = 160 calories

	Per cent.
Water	91·0
Protein	3·0
Fat	0·5
Carbohydrate	4·8
Ash	0·7

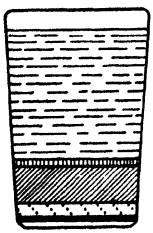


FIG. 320—CREAM

Fuel Value per lb. (roughly 1 pint) = 881 calories.

	Per cent.
Water	74·0
Protein	2·5
Fat	18·5
Carbohydrate	4·5
Ash	0·5

first-class animal protein of high biological value, because it is exceptionally rich in calcium, and because it is a good source of vitamin A (in summer months), vitamin B1, riboflavin, vitamin C. Raw milk yields 66 calories per 100

grammes, in which are present (in grammes) 87·6 of water, 3·3 of protein, 3·6 of fat, 4·7 of carbohydrate, and 0·120 of calcium. In pasteurisation about 10 per cent of the vitamin B1 is lost and about 20 per cent of the vitamin C; in sterilisation of milk the corresponding figures are 30 and 50 per cent. Heat has no effect on the vitamin A or D content of milk, or on the riboflavin content.

The milk of different cows varies especially in the amount of fat and of the fat-soluble vitamins A and D, but the mixed milk of a herd should reach a certain standard. It should contain over 12 per cent of solids, as shown in Fig. 317. A pint of milk provides about 400 calories of energy value. The percentage of cream by volume should be not less than 10 per cent. The amount of cream contained in milk can readily be discovered by allowing the milk to stand overnight in a cylindrical graduated vessel, when the cream rises to the top, and its volume can be measured off.

The ready digestibility of milk, especially when mixed with lime water, or when two or three grains of citrate of soda have been added for each ounce of milk in order to soften the curd, makes it a specially suitable food for children, invalids, and persons suffering from fever; its blandness and the completeness with which it is absorbed and assimilated adapt it admirably for the general staple of nourishment in Bright's disease; and its high nutritive value compared with its cost renders it a valuable article of diet for the healthy. As a complete diet for an adult doing hard work, about nine pints of milk would be required daily; but for a person confined to bed and restricted in the matter of food, three pints daily afford sufficient nourishment for two or three weeks.

Preparation of Milk.—Milk may be prepared for food in various ways. *Boiling* destroys the bacteria, and especially any tubercle bacilli which the milk may contain. It also partly destroys vitamins C and B1, as does *pasteurisation*. *Curdling* of milk is effected by adding rennet, which carries out the initial stage of digestion and thus renders milk more suitable for persons who could not otherwise tolerate it. *Souring* of milk is practised in many countries before milk is considered suitable for food; it is carried out by adding certain organisms such as the lactic acid bacillus, the Bulgarian bacillus, etc., and setting the milk in a warm place for several hours (*see* LACTIC ACID BACILLI). *Sterilisation*, which prevents fermentation and decomposition, is usually carried out by raising the milk to boiling temperature (100° Centigrade) for fifteen minutes and then hermetically sealing. *Condensed, unsweetened milk* — usually known as *evaporated milk*—is concentrated *in vacuo* at low temperature; the milk is then placed in tins, which are sealed, and is sterilised by heat at a temperature of 240° F. This destroys some 60 per cent of the vitamin C and 30-50 per cent of the vitamin B1. Sweetened condensed milk is not exposed to such a high temperature. The sugar, which prevents the growth of micro-organisms, is added before the condensing and finally reaches a concentration of about 40 per cent. In a good, well prepared sweetened condensed milk, only 15 per cent of vitamin C and 5-10 per cent of vitamin B1 may be lost. The sweetened form is apt to lead in children to fermentation, flatulence, and diarrhœa. *Dried milk* is prepared by evaporating all the fluid so that the milk is reduced to the form of powder. In *spray-drying* a very fine spray of milk is forced into a heated chamber, where drying is almost instantaneous. Milk powder thus prepared is nearly completely soluble in water. During the drying process about 20 per cent of the vitamin C and 10 per cent of the vitamin B1 are lost. There is about a 5 per cent decrease in the biological value of the milk proteins (casein, lactalbumin, lactoglobulin). The calcium is unaffected. *Roller-dried milk* is prepared by spreading a thin film of milk over steam-heated revolving metal cylinders; the powder is removed by a stationary scraper. Roller-dried milk is less soluble in water than spray-dried milk; and in its preparation the loss of vitamins C and B1 is higher and there is slightly greater deterioraton of protein. *Peptonised milk* is prepared by treating fresh milk with peptonising powder, and although the milk is rendered less palatable by this means, it is easily

digested and is readily tolerated in weak conditions of the stomach and intestines. (*See* PEPTONISED FOODS.) *Humanised milk* is cows' milk treated in such a way as to render it closely similar to human milk. It is prepared as follows: A pint of milk is allowed to stand in a cool place for three hours and the cream which has risen to the top separated by skimming. The skimmed milk is then divided into two equal parts, rennet is added to one part, and the curd when formed is strained off, leaving the whey. The whey is brought to the boil in order to destroy the rennet remaining in it and is then added to the other half of the skimmed milk, to which the cream is also returned. Milk sugar (3 drams) and a tablespoonful of lime water are then added to the mixture, which is finally pasteurised for twenty minutes.

Pure milk suitable for children is sold under an order of the Ministry of Health which came into force in 1923, and is milk derived under clean conditions from cows which are specially inspected and tested periodically by tuberculin in order to ensure that they are free from tuberculosis. Pasteurised milk may be sold having a similar freedom from the risk of tuberculosis. The grades of milk which are now officially recognised (since June 1936) are:

1. *Tuberculin Tested Milk.*—This is milk from cows which have passed a veterinary examination and a tuberculin test; it is bottled on the farm or elsewhere; and it may be raw or pasteurised. Every animal in the herd from which this milk comes must pass a veterinary examination at intervals of not more than six months, and must also pass a tuberculin test at intervals of not less than two and not more than six months; any animal which reacts to the tuberculin test must immediately be removed from the herd. Milk must be bottled at the farm or at some other licensed bottling establishment, and the cap must bear the address of the bottling establishment and the words '*Tuberculin Tested Milk*'. If it is bottled on the farm it may be described on the bottle caps or cartons as '*Tuberculin Tested Milk (Certified)*'. This milk must further satisfy a methylene blue reduction test and must not contain any coliform bacillus.

2. *Accredited Milk.*—This is raw milk from cows which have passed a veterinary examination; it is bottled on the farm or elsewhere. Every cow in the herd from which the milk comes must pass at intervals of three months an examination by a veterinary surgeon nominated by the local authority; the herd must not at any time include an animal which has reacted to the tuberculin test. The cap of the bottle must bear the address of the bottling establishment and the words '*Accredited Milk*'. It must satisfy the same bacteriological tests as raw tuberculin tested milk.

3. *Pasteurised Milk.*—This is milk which has been retained at a temperature of 145°-150° F. for at least thirty minutes. Every receptacle must be labelled '*Pasteurised Milk*'. It must not contain more than 100,000 bacteria per millilitre. Tuberculin tested milk may if desired be pasteurised, and it is then described as '*Tuberculin Tested Milk (Pasteurised)*'; a sample of this milk must not contain more than 30,000 bacteria per millilitre.

In Scotland (from 1st October 1936) other names are used as follow; 'Certified' for *Tuberculin-Tested (Certified)*; 'Tuberculin-Tested' as in England; 'Standard' for *Accredited*; and 'Pasteurised' and 'Tuberculin-Tested (Pasteurised)' as in England. (*See also* ADULTERATION OF FOOD, DIET, INFANT FEEDING, NITROGENOUS FOODS.)

MILK, DISEASES DUE TO.—Milk has a remarkable power of absorbing gases and vapours to which it is exposed so that it becomes readily tainted. Milk is also liable to be infected by dirt, or from water, or from the hands of milkers suffering from disease, and in these circumstances epidemics of enteric fever, scarlet fever, and diphtheria are frequently traceable to the milk supply. Efficient protection against these diseases is obtained by boiling or pasteurising the household supply of milk. Summer diarrhœa in children is usually due to milk containing large quantities of bacteria. Tuberculosis may be communicated by the milk from disease affecting the cow itself. This risk is avoided by using milk from tuberculin-tested cows or by boiling or pasteurisation.

MILK-FEVER is a term applied to a slight feverish attack which may appear about the third day after childbirth, in consequence of tenseness in the breasts, constipation, or other trivial cause, and which quickly passes off again.

MILK TEETH are the temporary teeth of children. For the time of their appearance see TEETH.

MIND DISORDERS (*see* INSANITY).

MINDERERUS SPIRIT is an old name for *liquor ammonii acetatis*, a solution of ammonium acetate, which acts as a diuretic, and is much used in domestic medicine. It is a harmless substance, and acts as an antacid and diuretic, and helps to reduce feverishness. The usual dose of Mindererus spirit is a dessert-spoonful or more, for colds and slight feverish conditions.

MIOTIC means (*a*) causing the pupil of the eye to contract; (*b*) any agent which causes the pupil to contract; (*c*) of the pupil, in the state of being contracted.

MISCARRIAGE, or ABORTION (from *aborior*, I perish), means the premature separation and expulsion of the contents of the pregnant uterus. When occurring before the eighth lunar month of gestation, *abortion* is the term ordinarily employed, but subsequent to this period it is designated *premature labour*. The present notice includes both these terms. As an accident of pregnancy, abortion is far from uncommon, although its relative frequency, as compared with that of completed gestation, has been very differently estimated by accoucheurs. It is more liable to occur in the earlier than in the later months of pregnancy, and it would also appear to occur more readily at the periods corresponding to those of the menstrual discharge.

Causes.—Abortion may be induced by numerous causes, both of a local and general nature. Malformations of the pelvis, accidental injuries, and the diseases and displacements to which the uterus is liable, on the one hand, and, on the other, various morbid conditions of the ovum or placenta leading to the death of the fœtus, are among the direct local causes of abortion. The general causes embrace certain states of the system which are apt to exercise a more or less direct influence upon the progress of utero-gestation. A deteriorated condition of health, whether hereditary or as the result of habits of life, certainly predisposes to the occurrence of abortion. Syphilis is known to be a frequent cause of the death of the fœtus and of diseases of the placenta. Many diseases arising in the course of pregnancy act as direct exciting causes of abortion, more particularly the eruptive fevers and acute inflammatory affections. Prolonged irritation in other organs may, by reflex action, excite the uterus to expel its contents. Strong impressions made upon the nervous system, as by sudden shocks and mental emotions, occasionally have a similar effect. Further, certain medicinal substances are commonly believed to be capable of exciting uterine action, but the effects, as regards at least early pregnancy, are very uncertain, while the strong purgative medicines sometimes employed with the view of procuring abortion have no effect whatever upon the uterus, and can only act remotely and indirectly, if they act at all, by irritating the alimentary canal. In cases of asphyxia, abortion has been observed to take place, and experimental evidence shows that anything interfering with the normal oxygenation of the blood may cause the uterus to contract and expel its contents. Many cases of abortion occur without apparent cause, but in such instances the probability is that some morbid condition of the interior of the uterus exists, and the same may be said of many of those cases where the disposition to abort has become habitual. In such cases syphilitic disease is a very common cause. The tendency, however, to the recurrence of abortion in persons who have previously miscarried is well known, and should ever be borne in mind with the view of avoiding any cause likely to lead to a repetition of the accident. Abortion resembles ordinary labour in its general phenomena, excepting that, in the former, hæmorrhage, often to a large extent, forms one of the leading symptoms.

Treatment.—The treatment of abortion embraces the means to be used by rest, astringents, and sedatives, to prevent the occurrence when it merely

threatens ; or when, on the contrary, it is inevitable, to accomplish as speedily as possible the complete removal of the entire contents of the uterus. The artificial induction of premature labour is occasionally resorted to by accoucheurs in conditions involving the safety of the mother or of the child.

MITHRIDATISM is a term applied to immunity against the effects of poisons produced by administration of gradually increasing doses of the poison itself. The process is named after Mithridates, King of Pontus, who rendered himself immune against poisoning by this means.

MITRAL STENOSIS is the term applied to the narrowing of the opening between the left auricle and left ventricle as a result of rigidity of and adhesion between the cusps of the mitral valve, due, almost invariably, to the infection of rheumatic fever.

MITRAL VALVE, so called from its resemblance to a bishop's mitre, is the valve which guards the opening between the auricle and ventricle on the left side of the heart. (*See* HEART.)

MOGIGRAPHIA (*μόγις*, with difficulty ; *γράφω*, I write) is a term sometimes applied to writer's cramp. (*See* CRAMP.)

MOLAR TEETH (*molaris*, a millstone) are the last three teeth on each side of the jaw. (*See* TEETH.)

MOLE is a term used in two quite different senses. In the first place, a mole on the skin is a darkly pigmented spot, usually raised above the surrounding surface, rough, and covered with hair. These moles are of developmental origin, and malignant growths may spring from them late in life. Secondly, the term mole, or molar pregnancy, is applied to cases in which, following upon conception, a degenerative mass forms in the womb, the embryo dying in the process.

MOLLITIES OSSIUM (*mollities*, softness ; *ossium*, of the bones) is another name for osteomalacia.

MOLLUSCUM CONTAGIOSUM is the name given to a rare disease in which small tumors, seldom larger than peas, develop on the surface of the skin. It appears to be of a contagious nature, and is believed by some to be derived from birds, some species of which suffer from a similar condition.

MOLLUSCUM FIBROSUM, or VON RECKLINGHAUSEN'S DISEASE, is the term applied to the condition in which numerous soft nodules of fibrous tissue —believed to arise from nerve fibres— appear on the skin.

MONGOLISM means the condition of being a mongol, which in medical science is the term for describing a certain type of idiot. The idiot has Mongolian-like eyes, a snub nose, high cheek-bones, a large tongue, a small round skull, and short, thick hands and feet. Mongols are amiable creatures and often the last in a large family or born of elderly parents.

MONK'S-HOOD (*see* ACONITE).

MONOMANIA (*μόνος*, single ; *μανία*, madness) means a kind of partial insanity, in which the affected person has a delusion upon one subject, though he can converse rationally, and is a responsible individual, upon other matters.

MONOPLEGIA (*μόνος*, single ; *πληγή*, stroke) means paralysis of a single limb or part. (*See* PARALYSIS.)

MONOSACCHARIDE is the term applied to a sugar having six carbon atoms in the molecule. It includes glucose, galactose, levulose, etc.

MORBID (*morbus*, disease) means 'diseased'.

MORBIFIC (*morbus*, disease ; *facio*, I make) means 'disease-producing'. For example, the comma bacillus may be called the morbific agent in cholera.

MORBILLI (a diminutive of *morbus*, a disease) is another name for measles.

MORBUS, the Latin word for disease, is used in such terms as cholera morbus, morbus coxæ (hip-joint disease).

MORON (*μωρός*, stupid) is a term applied to a feeble-minded person whose defect is relatively slight and whose 'mental age' is somewhere between eight and twelve years. (*See* MENTAL DEFECTIVENESS.)

MORO'S TEST (*see* TUBERCULIN).

MORPHINE (*Μορφεύς*, the god of sleep), or MORPHIA, is the name of the chief alkaloid upon which the action of opium depends. (*See* OPIUM.)

MORTALITY (*see* DEATH, CAUSES OF, *and* INFANTILE MORTALITY).

MORTIFICATION (*mors*, death; *facio*, I make) is another name for gangrene. (*See* GANGRENE.)

MOTOR is a term applied to those nerves and tracts of fibres in the brain and cord by which impulses are sent to the muscles, thus causing movements. (*See* SPINAL CORD.)

MOUNTAIN-SICKNESS is the name given to the group of symptoms which appear when people reach great heights, either in climbing mountains or in aeroplanes. Some persons suffer at lower altitudes than others, but prolonged residence at a high level does not seem to prevent mountain-sickness when the person climbs higher. Persons who live habitually at a high altitude develop an increased proportion of red corpuscles in the blood and thus obtain a greater amount of oxygen from the rarefied air, and lose the tendency to mountain-sickness. Exhaustion, want of food, and exposure to cold bring it on sooner, but every one seems to begin to suffer when a height over 16,000 feet is reached. Want of oxygen, in consequence of the rareness of the atmosphere, is supposed generally to be the cause. Weakness, difficulty of breathing, palpitation of the heart, giddiness, sickness, vomiting, and finally unconsciousness, are the main symptoms, but these rapidly pass off, causing no permanent damage, when the person again reaches a lower level.

MOUTH is the cavity into which the food is first received, and where it is prepared by chewing and admixture with saliva for the early stages of digestion in the stomach. The mouth opens through the 'fauces', a narrow passage between the tonsils, into the pharynx or throat. The chief contents of the mouth are the edges of the jawbones bearing the teeth, and the tongue. The cavity is bounded above by the hard and soft palates, while beneath the tongue a layer of muscles, salivary glands, and other soft structures form the 'floor' of the mouth. (*See also* TEETH *and* TONGUE.)

MOUTH, DISEASES OF.—The state of the mucous membrane lining the mouth as regards pallor, pigmentation, and other conditions gives a general idea of the extent to which other mucous membranes in the interior of the body are affected in anæmia, Addison's disease, jaundice, etc. As the tongue consists essentially of a pointed mass of muscle wrapped round with mucous membrane, its condition as to shape and size gives valuable information regarding the general muscular state in debility, nervous diseases, and the like; while the mucous membrane covering it shows many marked changes in various diseases of the alimentary system and general maladies. Further, on account of the exposed position of the mouth, of the tendency for its diseases to involve the face in some way, and of the interference with the acts of eating and speaking, which painful conditions of the mouth produce, disturbances of this region demand speedy attention.

Conditions of the tongue.—The *muscular condition* of the tongue is naturally such that the organ when at rest touches the lower set of teeth all round, and is slightly arched upwards. It should present a smooth surface, with a groove up the middle, and a sharp, even edge. Further, it is completely under control of the will, and can be moved in any direction. Now and then the tongue is too large for the mouth, rendering speech indistinct and even interfering with swallowing, or being so bulky that it is constantly protruded from the mouth. Such a condition is either congenital or may result from inflammation. Tongue-tie is a congenital condition in which the band beneath the middle of the tongue uniting it to the floor of the mouth is either so short, or attached so far forwards, that the tongue cannot be fully protruded from the mouth, and cannot move with the freedom required for speech. This condition may be responsible for childish defects of speech but is much rarer than is popularly supposed. A flabby condition of the tongue, in which the organ is large, pale, and distinctly indented by the teeth along its edge, affords a sign of general debility in the muscular system and a need for tonic treatment. Tremulousness of the tongue when it is protruded is a sign of various nervous diseases, but by far its commonest cause

is excessive indulgence in alcohol, of which it may form the only sign that cannot be concealed. After an apoplectic attack which has involved the nerve centre controlling one side of the tongue, this organ is protruded in a one-sided manner, pointing towards that side of the body which is paralysed, and the rapidity with which the person recovers the power to put the tongue out straight is a good criterion of his general progress towards recovery. Another important localising sign in certain diseases of the brain and of the facial nerve is loss of the sense of taste on one side of the tongue.

A still more easily noticed sign is the presence or absence of *fur* on the tongue. This consists of a thickening of the superficial layers of the mucous membrane, due partly to increased growth, as the result of fever and other conditions; partly to diminished use of the tongue, whose surface should constantly be rubbed down against the teeth and food. The fur is sometimes white, sometimes brown, or even black, from drying and the accumulation on it of materials derived from the food. It should be remembered that milk whitens the tongue and makes it look as if 'furred'. Fevers of all sorts are associated with a furred tongue, and in typhoid fever perhaps, most of all, the fur accumulates till the tongue is covered with a thick mass, brown in the centre and yellow towards the edges, where the red mucous membrane is exposed. In scarlet fever there is often seen what is called a 'strawberry tongue', the general surface being covered with a white fur, through which project the red and inflamed points of the larger papillæ with which the tongue is studded. Constipation and obstruction of the bowels are associated, as a rule, with a thick, white or brownish, fissured fur upon the tongue, and in trivial cases of indigestion the presence of such a fur is often made the occasion for administering a laxative. Gastritis, particularly when due to excess in alcohol, is prone to cause a thin white fur; and the tremulous tongue coated in the mornings with fur, which wears off as the day advances, is one of the surest signs of habitual drinking. It is a noteworthy fact, however, that two of the most serious diseases of the stomach, viz. cancer and gastric ulcer, are usually associated with a remarkably clean tongue. All inflammatory affections of the throat, such as tonsillitis, are apt to be accompanied by a thick, moist fur upon the tongue, very much resembling a layer of thick cream. In rheumatic fever a uniform yellowish fur often gives an appearance known as 'blanket tongue'. One half of the tongue may show a fur, while the rest of the surface is clean, and this is generally caused by neuralgia or by the presence of a bad tooth upon the furred side.

In some severe cases the tongue may, instead of showing a fur, present a dry, red, *raw appearance*. An inflamed tongue ('beet tongue') is one of the characteristics of pellagra, a disease due principally to deficiency of nicotinic acid in the diet. A magenta-coloured tongue is said to be caused by deficiency of riboflavin in the diet.

Feeble children and persons brought very low by illness frequently develop small raised *white patches*, called 'thrush', upon the mucous membrane of the mouth and tongue. These are caused by the growth in its surface layer of a parasitic mould known as 'oïdium albicans'. Thrush is not of itself a serious condition, being easily removed by frequent application of borax-honey, or of glycerin of boric acid, to the affected spots. Nevertheless, the presence of this affection indicates grave constitutional weakness.

A chronic condition, in which the tongue becomes studded with thickened, smooth, white patches, often separated by *deep fissures*, is known as 'leucoplakia'. It develops gradually as the result of some long-standing irritation or inflammation of the tongue, and is a permanent condition, which does not usually give much trouble beyond interfering somewhat with the distinctness of the speech, and the fact that the condition may, late in life, pass into one of malignant tumor.

A slighter condition, in which the tongue shows white patches interspersed with sharply marked red, bare areas, is known as 'geographical tongue' or eczema of the tongue. It is a mild and usually transitory form of inflammation in which the surface layer of the mucous membrane on the tongue

peels off, and it is usually associated with digestive disorders and a certain amount of general debility.

Ulcers on the tongue are common, but they generally remain of small size, and they do not differ from ulcers on other parts of the mouth, either in their cause or in their course. (*See below.*)

INFLAMMATIONS OF THE MOUTH arise from the same causes as inflammation elsewhere, but among the special causes may be noted a jagged or painful tooth, an ill-fitting plate, the cutting of teeth in children, alcohol, tobacco-smoking, digestive disturbance, and, in the special form of inflammation known as thrush (above mentioned), a parasitic mould. General ill-health plays a very important part in the case both of children and of adults. Whatever be the cause, the mucous membrane becomes red, swollen, and tender, while small ulcers may in some cases develop here and there. Generally, the avoidance of highly spiced food, of alcohol, and of tobacco is sufficient to cure the condition, which may be soothed, while it lasts, by smearing on glycerin of boric acid, or honey of borax.

The chronic inflammation of the gums (gingivitis) which arises in connection with unclean teeth, concealed inflammation within the sockets of the teeth, and the serious condition of pyorrhœa alveolaris, are forms of inflammation in the mouth which are treated under TEETH, DISEASES OF.

ULCERS OF THE MOUTH are usually of small size, and arise from a variety of causes. It is not at all uncommon in feeble, badly fed children for one or two ulcers to develop on the inside of the cheeks, on the gums, or on the tongue, causing pain in eating, profuse discharge of saliva, and great fœtor of the breath. These ulcers generally heal when the child is well fed and a mouth-wash of chlorate of potash is frequently used, but they may pass on to the serious condition of cancrum oris. (*See* CANCRUM ORIS.) Single small ulcers arise in otherwise healthy people from the irritation of a jagged tooth, a small wound, or even apparently as the result of dyspepsia. These may be very troublesome, and being generally situated in the groove between lip and gum, or on the tip and edge of the tongue, they are prevented from healing by the movement of the parts, and may become very troublesome for weeks or even months. A small ulcer is frequently developed beneath the tongue during the course of whooping-cough, as the result of friction against the lower teeth in coughing, and is prevented from healing by the same cause. The digestion must receive careful attention, the mouth must be kept clean by antiseptic washes and regular brushing of the teeth, and the little ulcer may be touched with a strong astringent such as tincture of iodine or nitrate of silver every few days, and, in the interval, protected by occasional application of borax-honey or glycerin of boric acid. Large ulcers may also be of tuberculous or syphilitic origin, the latter being a frequent cause.

BAD TEETH form one of the commonest sources of complaint regarding the mouth. (*See* TEETH, DISEASES OF.)

GUMBOIL is a very common minor disease. (*See* GUMBOIL.)

SALIVARY CALCULUS is a condition which sometimes occurs and may give rise to a good deal of trouble. (*See* CONCRETIONS.) The stone, if it lodges in one of the salivary ducts, may ulcerate out on the face, and then causes a fistula, from which saliva constantly trickles over the cheek. A fistula may be produced also by wounds of the cheek, involving the duct of the parotid gland. These fistulæ are cured by a slight operation, which reopens a passage to the mouth and closes that upon the cheek.

RANULA is a clear, cyst-like swelling, appearing beneath the tongue in connection with the salivary glands in this region. It is a cyst full of saliva, and is treated by several minor surgical procedures, its obliteration being a simple matter.

MUMPS is an acute infective inflammation of the salivary glands. (*See* MUMPS.)

TUMORS occur on the lips, on the alveolus bearing the teeth, arising either from the gums or bone, and most commonly on the tongue. Those which develop in the gum or bone beneath it go by the general name of 'epulis', whatever be their nature. Occasionally these are malignant, more often they

are simple fibroid tumors, produced frequently by the irritation of decaying teeth. On extraction of the associated tooth or teeth and removal of the epulis it seldom gives more trouble. Growths upon the lips and tongue may be simple warts, or cysts may occasionally be found, but the commonest tumor of these parts is cancer. It seldom appears before the age of forty, and seems in many cases to arise as the result of long-standing irritation by a jagged tooth, smoking, or a chronic ulcer. The glands on the front and sides of the neck in such cases become early the seat of secondary malignant growths; and as the foul state of the interior of the mouth, after such a tumor ulcerates, causes much interference with the general health, the duration of life is not long, being placed by authorities upon the subject at little over a year after the tumor first appears. By modern surgical treatment, which aims at very free removal of the diseased part of the tongue and glands, life is prolonged, particularly in cases subjected to early operation, considerably beyond this period. The result of removal causes little or no disfigurement, and even when the whole tongue is removed the power of speech is often but little impaired.

MOVABLE KIDNEY (*see* KIDNEY, DISEASES OF).

MUCILAGE is prepared from acacia or tragacanth gum, and is used as an ingredient of mixtures containing solid particles in order to keep the latter from settling, also as a demulcent. (*See* DEMULCENTS.)

MUCOCELE is an abnormally dilated cavity in the body due to the accumulation of mucus: such a 'cyst' may therefore form anywhere where there is mucous membrane.

MUCOMEMBRANOUS COLIC is the term applied to a disorder in which constipation, abdominal pain, and the passage of mucus or casts of mucus in the stools occurs in highly-strung or neurotic people, especially women. The spasm of the colon causing these symptoms may be allergic in origin.

MUCOUS MEMBRANE is the general name given to the membrane which lines many of the hollow organs of the body. These membranes vary widely in structure in different sites, but all have the common character of being lubricated by mucus, derived in some cases from isolated cells on the surface of the membrane, but more generally

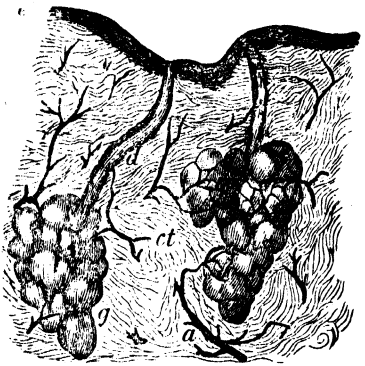


FIG. 321.—Section through the mucous membrane of the throat, showing two of the mucous secreting glands. *e*, Epithelium of the surface; *d*, connective tissue beneath it; *g*, gland; *d*, its duct opening on the surface; *a*, artery ending in a capillary network round the gland. Magnified 40 times. (Turner's *Anatomy*.)

from definite glands placed beneath the membrane, and opening here and there through it by ducts. The air passages, the alimentary canal and the ducts of glands which open into it, and also the urinary passages, are all lined by mucous membranes.

In structure a mucous membrane

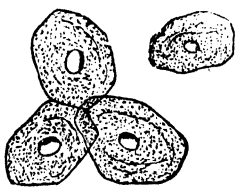


FIG. 322.—Scaly epithelium from the roof of the mouth. (Turner's *Anatomy*.)

consists of a basis of fibrous tissue resembling the true skin, though looser and lighter in texture, in which the blood-vessels, nerves, and mucous glands lie. This is covered on its surface by a layer of epithelium resembling the cuticle covering the skin, though the cells are in all cases of a more soft and succulent nature than those on the outer surface of the body.

It is in the character and properties of these cells that the various mucous membranes chiefly differ. In the air

FIG. 323.—Columnar epithelium. *A*, Side view of a group of cells; *B*, surface view of the ends of a group of cells; *C*, a columnar cell from the mucous membrane of the small intestine. (Turner's *Anatomy*.)

passages they are, almost everywhere except over the vocal cords, of a pillar-like shape, and provided with thread-like processes, being known as 'ciliated' cells. On the vocal cords the cells, which are exposed to constant friction, resemble those of the skin. In the alimentary system generally, they are of a simple pillar-like or 'columnar' type, placed side by side, though in the

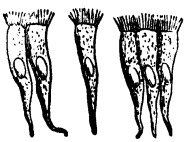


FIG. 324.—Ciliated epithelial cells from the air passages. (Turner's *Anatomy*.)

mouth and gullet, where the food causes much friction, the surface, like that of the vocal cords, closely resembles the cuticle of the skin. In the urinary passages again the cells are 'ciliated', except in the bladder, where they approach in type to that of the skin epithelium.

Lying close beneath the epithelium there is, in most mucous membranes, a thin layer of involuntary muscle fibres, and to this, coupled with the extremely loose attachment of mucous membranes to the organs which they line, is due the great pliability and elasticity of these membranes.

MUCOUS PATCH is the name given to the syphilitic eruption as it affects mucous membranes. These patches are seen especially about the lips, mouth, and throat, and consist of slightly raised areas, reddish at the edge, and covered by a velvety whitish layer. They are very infectious. (*See* SYPHILIS.)

MUCUS (*mucus*, the discharge from the nose) is the general name for the slimy secretion derived from mucous membranes. It is mainly composed of a substance called mucin, which varies according to the particular mucous membrane from which it is derived, and it contains other substances, such as cells cast off from the surface of the membrane, ferments, and dust particles. From whatever source derived, mucin has the following characters. It is viscid, clear, and tenacious; when dissolved in water it can be precipitated by addition of acetic acid; and when not in solution already, it is dissolved by weak alkalies, such as lime-water.

Under normal conditions the surface of a mucous membrane is lubricated by only a small quantity of mucus; the appearance of large quantities is a sign of inflammation.

MULL is the name of a thin, soft muslin used in surgery. Plaster mull is the name given to a sheet of mull coated with gutta-percha and usually containing some drug or antiseptic for the treatment of skin disease.

MULTIGRAVIDA is a woman who has been pregnant more than once.

MULTIPARA (*multus*, many, and *paro*, I bear) is a term applied to a woman who has borne several children.

MULTIPLE NEURITIS (*see* NEURITIS).

MUMPS, also known as PAROTITIS, CYNANCHE PAROTIDEA, and popularly as 'THE BRANKS', is an infectious disease characterised by inflammatory swelling of the parotid and other salivary glands, frequently occurring as an epidemic, and affecting mostly young persons.

Causes.—Mumps is highly infectious from person to person, though it seldom affects adults or those who have had the disease already. It appears to be infectious even for a week or two after the swelling of the glands has subsided. It occurs at all seasons of the year, and especially in schools, barracks, and similar institutions. The cause is thought to be infection with a filter-passer.

Symptoms.—There is a long incuba-

tion period of two to three weeks, after infection, before the glands begin to swell. The first signs are fatigue, slight feverishness, and sore throat, which may precede the swelling by a day or two. The gland first affected is generally the parotid, situated in front of and below the ear, and along with the swelling there is often some face-ache and considerable rise of temperature (to 101° or even 104° Fahr.). The swelling usually spreads to the submaxillary and sublingual glands lying beneath the jaw, and to the glands on the side opposite that first affected. There is hardly ever any redness or tendency to suppuration in the swollen parts, though interference with the acts of chewing and swallowing may occasion a good deal of trouble; and the swelling is tender to touch. After continuing four or five days the swelling abates, the temperature having generally already fallen. During the period of convalescence there occasionally occurs some tenderness and swelling of the testicles in the male, or of the ovaries and breasts in the female, and it is said that in some cases atrophy of these organs follows upon this inflammation, this being one of the few untoward effects which may result from mumps. Inflammation of the pancreas, accompanied by tenderness in the upper part of the abdomen and digestive disturbances, sometimes occurs, and is believed to be occasionally a cause of diabetes. Meningitis is also an occasional complication. The various complications are found much more frequently when the disease affects adults than when it occurs in childhood.

Treatment.—During the two or three days that the fever lasts, the patient should remain in bed, and he should be confined to one room, or at all events should avoid other children for about three weeks, in order to prevent the spread of infection. Soft food, mild aperients, and the protection of the inflamed parts by a strip of flannel or by cotton-wool and a handkerchief are all the treatment usually required. If there be much face-ache, it is relieved by warm opium fomentations. After the attack subsides, tonics are called for.

It is important that, if a child has been exposed to the infection of mumps, he should be kept from school, and from mixing with healthy children, till three or preferably four weeks have elapsed. (*See* INFECTION.)

MURIATIC ACID (*muria*, brine) is an old name for hydrochloric acid.

MURMUR is the name given to an uneven, rustling sound heard by auscultation over the heart and various blood-vessels in abnormal conditions. For example, murmurs heard when the stethoscope is applied over the heart are highly characteristic of valvular disease of this organ.

MUSCÆ VOLITANTES (*musca*, a fly; *volitans*, floating about) is a term signifying the floating specks which become visible when the eye looks steadily at a white ground in bright light. These specks are present in most eyes and can be seen at any time, but they become especially noticeable when the general health is depressed, and sometimes cause great annoyance through the fear that they may be the sign of some eye disease. They are due to the presence of filaments and cells in the vitreous humour of the eye, which, though transparent, are rather denser than the rest of the humour, and sufficiently opaque to cast a shadow upon the retina. These shadows are referred outwards as floating objects in the field of vision.

MUSCARINE is the poisonous principle found in some toadstools. (*See* FUNGUS-POISONING.)

MUSCLE (*musculus*, a muscle), popularly known as FLESH, is the tissue by which, in virtue of its power of contraction, movements are made in the higher animals. Muscular tissue is divided, according to its function, into two great groups, *voluntary muscle* and *involuntary muscle*, of which the former is under control of the will, while the latter discharges its functions independently. The term 'striped' muscle is often given to voluntary muscle, because under the microscope all the voluntary muscles show a striped appearance, while involuntary muscle is, in the main, 'unstriped' or 'plain'. There are exceptions to the latter statement, for the heart muscle, which is involuntary, is partially striped, while certain muscles of the throat, and two small muscles inside the ear, not controllable by willpower, are also striped.

MUSCLE

Structure of muscle.—VOLUNTARY MUSCLE is disposed in a regular method over the body, being mainly attached to the skeleton, and hence often called 'skeletal' muscle. There are certain definite muscles, and these vary as to shape only slightly in different persons, though in one person particular muscles may be developed to a much greater bulk than in others. Each muscle is enclosed in a sheath of fibrous tissue, known as "fascia' or 'epimysium', and, from this, partitions of fibrous tissue, known as 'perimysium', run into the substance of the muscle, dividing it up into small bundles. Each of these bundles, if carefully examined, will be found to consist in turn of a collection of 'fibres', which form the units of the muscle. Each fibre is about $\frac{1}{500}$ inch in thickness and about 1 inch long, though the dimensions vary a little in different muscles. If the fibre be cut across and examined under a high power of the microscope, it is seen to be further divided into 'fibrils', the cut ends of which are known as 'Cohnheim's areas'; but as all the fibrils of a fibre act in concert, this is a needless subdivision. Each fibre is enclosed in an elastic sheath of its own, which allows of its lengthening and shortening, and is known as the 'sarcolemma' (σάρξ, flesh; and λέμμα, a husk). Within the sarcolemma lie numerous nuclei belonging to the muscle fibre, which was originally developed from a simple cell. To the sarcolemma, at either end, is attached a minute bundle of connective tissue fibres which unites the muscle fibre to its neighbours, or to one of the connective tissue partitions in the muscle, and by means of these connections the fibre produces its effect upon contracting. The sarcolemma is pierced by a nerve fibre, which breaks up upon the surface of the muscle fibre into a complicated 'end-plate', and by this means each muscle fibre is brought under the guidance of the central nervous system, and the discharge of energy which produces muscular contraction is controlled. When the muscle fibre within the sarcolemma is examined by a high magnifying power, it is found to show alternate light and dark transverse stripes, with a fine dotted line, called Dobie's line or Krause's membrane, across the middle of each light stripe. These appearances are due to the fact that the fibre is composed of segments made up partly of fibrous connective material, partly of semi-fluid contractile tissue, in which

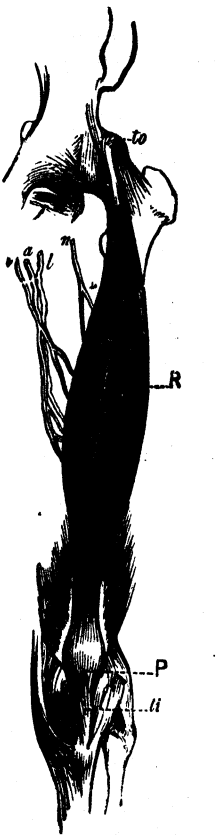


FIG. 325.—The rectus muscle on the front of the thigh showing the various parts of a muscle. *R*, The fleshy part or 'belly', composed of muscle fibres; *to*, *ti*, tendons of origin and insertion; *n*, nerve of supply; *a*, artery; *v*, vein; *l*, lymphatic vessel; *P*, patella or knee-cap. (Turner's *Anatomy*.)

visible changes take place as the fibre contracts.

Between the muscle fibres, which have, on account of their relative length and width, a pillar-like shape, run many capillary blood-vessels. They are so placed that the contractions of the muscle fibres empty them at once of blood, and thus the active muscle is ensured a specially good blood supply.

None of these vessels, however, pierce the sarcolemma surrounding the fibres, so that the blood does not come into direct contact with the muscular tissue, whose nourishment is carried on by the

FIG. 326.—A muscle fibre splitting up into fibrils. (Turner's *Anatomy*.)

lymph that exudes from the blood-vessels. The lymph circulation is also automatically varied, as required, by the muscular contractions. Between the muscle fibres, and enveloped in a sheath of connective tissue, lie here and there special structures known as 'muscle-spindles'. Each of these contains thin muscle fibres, numerous nuclei, and the endings of sensory nerves. They appear to be the sensory organs of the muscles. (*See* TOUCH.)

INVOLUNTARY MUSCLE includes, as already stated, the heart muscle and

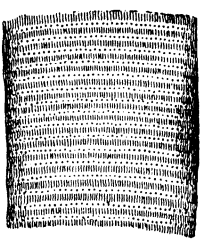


FIG. 327.—Portion of a muscle fibre showing the alternate dark and light stripes, with Dobie's line in the clear stripe. Magnified about 500 times.

unstriped muscle. The heart muscle stands in structure between striped and unstriped muscle. Each fibre is short, has a nucleus in its centre, communicates with its neighbours by short branches, shows a faintly striped appearance near its exterior, and is devoid of sarcolemma.

Plain or unstriped muscle is found in

the following positions: the inner and middle coats of the stomach and intestines; the ureters and urinary bladder; the windpipe and bronchial tubes; the ducts of glands; the gall-bladder; the uterus and Fallopian tubes; the middle coat of the blood- and lymph-vessels; the iris and ciliary muscle of the eye; the 'dartos' tunic of the scrotum; and in association with the various glands and hairs in the skin. The fibres are very much smaller than those of striped muscle, though they vary greatly in size. Each is pointed at the ends, has one or more oval nuclei in the centre, and a delicate sheath of sarcolemma enveloping it. The fibres are grouped in bundles, much as are the striped

FIG. 328.—Unstriped muscle. *A*, A bundle of fibres; *B*, a single fibre more highly magnified. (Turner's *Anatomy*.)

fibres, but they adhere to one another by cement material, not by the tendon bundles found in voluntary muscle.

Development of muscle.—All the muscles of the developing individual arise from the central layer (mesoblast) of the embryo, each fibre taking origin from a single cell. Later on in life, muscles have the power both of increasing in size, as the result of use, for example, in athletes, and also of healing, after parts of them have been destroyed by injury. This takes place partly by the growth and splitting of the original fibres to form new fibres, and partly from reserve cells, known as 'sarcoplasts', which lie in every muscle between the muscle fibres. An example of the great extent to which unstriped muscle can develop, to meet the demands made upon its power, is given

by the womb, whose muscular wall develops so much during pregnancy that the organ increases from the weight of 1 ounce to a weight of 1½ lb., decreasing again to its former small size in the course of a month after childbirth.

Physiology of Contraction.—A muscle is an elaborate chemico-physical system for producing heat and mechanical work. The total energy liberated by a contracting muscle can be exactly measured. From 25 per cent to 30 per cent of the total energy expended is used in mechanical work. A steam engine puts out between 7 per cent to 20 per cent of its energy in work. Muscle is therefore mechanically much more efficient. The heat of contracting muscle makes an important contribution to the maintenance of the heat of the body.

The energy of muscular contraction is derived from a complicated series of chemical reactions. Complex substances are broken down and built up again, supplying each other with energy for this purpose. The first reaction is the breakdown of adenyl-pyrophosphate into phosphoric acid and adenylic acid (derived from nucleic acid); this supplies the immediate energy for contraction. Next phosphocreatine breaks down into creatine and phosphoric acid, giving energy for the resynthesis of adenyl-pyrophosphate. Creatine is a normal nitrogenous constituent of muscle. Then glycogen through the intermediary stage of sugar bound to phosphate breaks down into lactic acid to supply energy for the resynthesis of phosphocreatine. Finally part of the lactic acid is oxidised to supply energy for building up the rest of the lactic acid into glycogen again. If there is not enough oxygen, lactic acid accumulates and fatigue results.

There are some points to be noticed in this modern version of muscular activity. First, muscle contraction and relaxation take place in the absence of oxygen—the anærobic phase. Secondly, oxygen comes into the picture in the phase of recovery, and by oxidising some of the lactic acid winds up the contractile mechanism once more. Thirdly, the energy of contraction does not come directly from the breakdown of glycogen.

The whole of the chemical changes are mediated by the action of several enzymes.

Involuntary muscle has several peculiarities of contraction. In the heart *rhythmicality* is an important feature, one beat appearing to be, in a sense, the cause of the next beat. *Tonus* is a character of all muscle, but particularly of unstriped muscle in some localities,

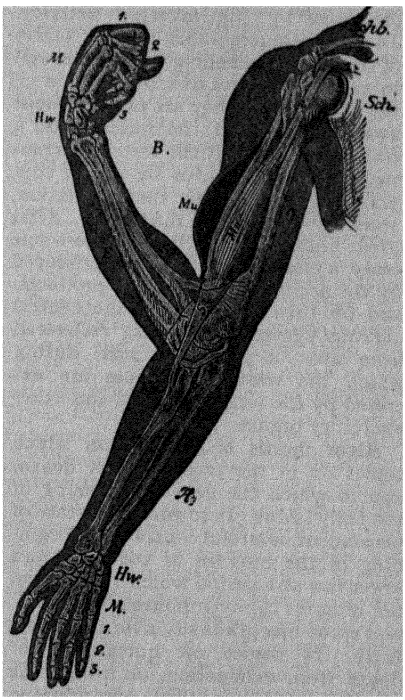


FIG. 329.—Human arm, showing the mode of action of a muscle. *A*, Forearm extended; *B*, forearm flexed; *O*, upper arm; *Sp*, radius; *E*, ulna; *Hw*, carpus; *M*, metacarpal bones; 1, 2, 3, phalanges; *Mu*, biceps muscle (the part shaded deep black shows the extent of the muscle when the lower arm is flexed); *SS*, tendons of the biceps; *Sch*, shoulder-blade (scapula); *Schb*, collar-bone (clavicle). (Schmeil's *Zoology*.)

as in the walls of arteries. Muscles are not held either slack or taut, but in a slightly stretched condition, so that when occasion arises they are ready for instant action, while the arteries owe their elasticity and strength mainly to this fact. The involuntary muscle, forming the middle coat of the bowels, gland-ducts, and other tubes, contracts in the so-called *vermicular movement*, or

' peristalsis ', which means that a ring of contraction passes slowly along the tube, at a rate of about 1 inch per second, the muscle relaxing as the ring of contraction passes on.

Fatigue of muscle comes on when a muscle is made to act for some time. It is due, not to wearing out of the muscle's power, but to the accumulation of waste products, especially sarcolactic acid, produced by the muscle's activity. These substances affect the end plates of the nerve controlling the muscle, and so prevent destructive over-action of the muscle. As they are rapidly swept away by the blood, the muscle, after a rest, particularly if the rest be accompanied by massage or by gentle contractions to quicken the circulation, recovers rapidly from the fatigue. After great muscular activity over the whole body, a more lasting fatigue is produced by the accumulation of these products, and by their action upon the central nervous system, this being recovered from after a prolonged rest, during which the waste substances are excreted by the lungs, kidneys, and other excretory organs.

Rigor mortis is a condition which comes on in the muscles after death, and to which the general stiffening of the body is due. It consists in a state of permanent, wasteful contraction, beginning in the muscles of the neck and lower jaw at a period which varies from ten minutes to seven hours after death, and spreading gradually over the whole body. It comes on quickest after death from exhaustion, or from some weakening disease; and, occasionally, after violent injuries causing death, it comes on instantaneously, so that the posture of the body is fixed in the attitude in which death occurs. The rigidity lasts usually from sixteen to twenty-four hours, but its duration is extremely variable, being longer, as a rule, when its onset has been slow. (*See* DEATH, SIGNS OF.)

Muscular system, popularly known as ' the flesh ', comprises all the voluntary muscles, and amounts in an average man of 154 lb. to about 62 lb., or over two-fifths of the whole body weight. The total number of the voluntary muscles, each of which is named, amounts to about 620, including the muscles of both sides. Each muscle constitutes a separate organ, controlled by a special nerve or nerves, which connect it with the spinal cord and brain, where, however, actions and combined movements are represented rather than individual muscles. (*See* BRAIN.) The fleshy part of the muscle is known as its ' belly ', and there is usually at either end a tendon, by which the muscle is ' inserted ' into bone or other structure, upon which it acts. One end is more fixed than the other, as a rule, the rigid end being known as the ' origin ' of the muscle, the more mobile end as its ' insertion '.

UPPER LIMB.—*Between the trunk and limb* run the following muscles: the trapezius, latissimus dorsi, large and small rhomboids, and levator of the angle of the scapula, behind; and the large and small pectoral, the subclavius, and serratus magnus muscles in front. *In the shoulder region* lie the deltoid, supraspinatus, infraspinatus, large and small teres, and the subscapular muscles. *In the upper arm* the coracobrachialis, biceps, and brachialis anticus occupy the front, while the triceps and anconeus fill up the back of the arm. *In the forearm* the muscles in front that bend the wrist and fingers, or turn the hand palm downwards, are the round pronator of the radius, the radial flexor of the wrist, the long palmar, the ulnar flexor of the wrist, the superficial and deep flexors of the fingers, the long flexor of the thumb, and the square pronator of the radius; while the muscles on the back of the forearm that extend the fingers and bend the wrist backwards, or turn the hand palm upwards, are the long supinator of the radius, longer and shorter radial extensors of the wrist, common extensor of the fingers, extensor of the little finger, ulnar extensor of the wrist, short supinator of the radius, the extensors of the metacarpal bone, of the first joint, and of the second joint of the thumb, and the extensor of the forefinger. *In the palm of the hand* there are four lumbrical muscles, the short palmar muscle, three muscles each for the thumb and little finger, which respectively abduct, oppose, and flex these digits, an adductor of the thumb, and, in the spaces between the metacarpal bones, seven interosseous muscles.

LOWER LIMB.—*Muscles of the hip* are

the ilio-psoas in front, and, behind, the three gluteus muscles forming the prominence of the buttock, with the pyriform, external and internal obturator, two gemelli, and quadratus femoris muscles under cover of the largest gluteal muscle, while to the outer side lies the tensor of the sheath of the thigh. *On the back of the thigh* lie the biceps, semitendinosus, and semimembranosus muscles, whose tendons, standing out prominently behind the knee, are known collectively as the 'hamstrings'. *In front of the thigh* are placed the sartorius, which is the longest, and the quadriceps extensor of the leg, which is the largest muscle of the body. *On the inner side of the thigh* lie the gracilis and pectineus muscles, with the long, the short, and the large adductors. *On the front of the leg* are placed the tibialis anticus, the special extensor of the great toe, the long extensor of the toes, and the peroneus tertius muscles. *On the outer side of the leg* are two muscles, the long and short peroneal muscles, whose tendons pass down behind the outer ankle to the foot. *On the back of the leg* are two groups of muscles. The superficial group of three muscles, consisting of the gastrocnemius, a double-bellied muscle, and the soleus, which is flat and projects slightly beneath the gastrocnemius, together with the small plantaris muscle, forms the 'calf' of the leg, and ends in the 'tendo Achillis' behind the heel. The deep group lies close upon the bones, and consists of the popliteus, long flexor of the toes, long flexor of the great toe, and tibialis posticus muscles, the tendons of the last three passing down behind the inner ankle. *In the foot* there is one muscle, the short extensor of the toes, upon the 'dorsum' or upper surface; while in the sole of the foot are four layers of small muscles, comprising the short flexor of the toes, and abductors of the great and little toes; the accessory flexor of the toes, and four lumbrical muscles; the short flexor of the great toe, oblique and transverse adductors of the great toe, and short flexor of the little toe; and in the fourth layer seven interosseous muscles, as in the hand.

FACE AND HEAD.—Attached to the auricle of the ear are three muscles of feeble power, which raise, draw back, and flatten the auricle. The eyelids, nose, and lips are provided with numerous flattened muscles, which dilate and draw together these openings, and which form the means by which varying facial expression is brought about. The actions of these muscles have been exhaustively studied and treated by Sir C. Bell in his *Anatomy and Philosophy of Expression*, and by C. Darwin in his *Expression of the Emotions in Man and Animals*. The movements of the eyeball are effected by six small muscles. (*See* EYE.) The movements of the lower jaw in chewing are controlled by four muscles on each side: the masseter muscle, which can be felt on the hinder part of the cheek as the jaws are closed; the temporal muscle, felt in the region of the temple; and the outer and inner pterygoid muscles, attached to the deep surface of the jaw-bone. Within the mouth, the tongue consists of certain intrinsic muscle bundles, together with four muscles on each side, which connect it with the lower jaw, hyoid bone, and base of the skull. The floor of the mouth is formed by four muscles, which pass from the hyoid bone in front of the neck up to the lower jaw and base of the skull. The throat or 'pharynx', which is open in front to the nose, the mouth, and the larynx, one beneath the other, is closed behind by three broad, flat muscles, the superior, middle, and inferior constrictors of the pharynx, and is swung from the base of the skull by the stylo-pharyngeus muscle on either side. The soft palate, which separates the hinder part of the cavities of nose and mouth from one another, consists of five muscles on each side covered by mucous membrane. The larynx is controlled by eleven small muscles, which open or close its opening, and render the vocal cords more or less tense in the production of the voice.

FRONT OF NECK.—The most prominent feature of the neck is the thick sterno-mastoid muscle, which on each side runs from behind the ear downwards and forwards to the breast-bone and collar-bone. Partly under cover of these and protecting the front of the larynx are four small muscles on each side, the sterno-hyoid, sterno-thyroid, thyro-hyoid, and omohyoid muscles. Deep in the neck, behind, and to

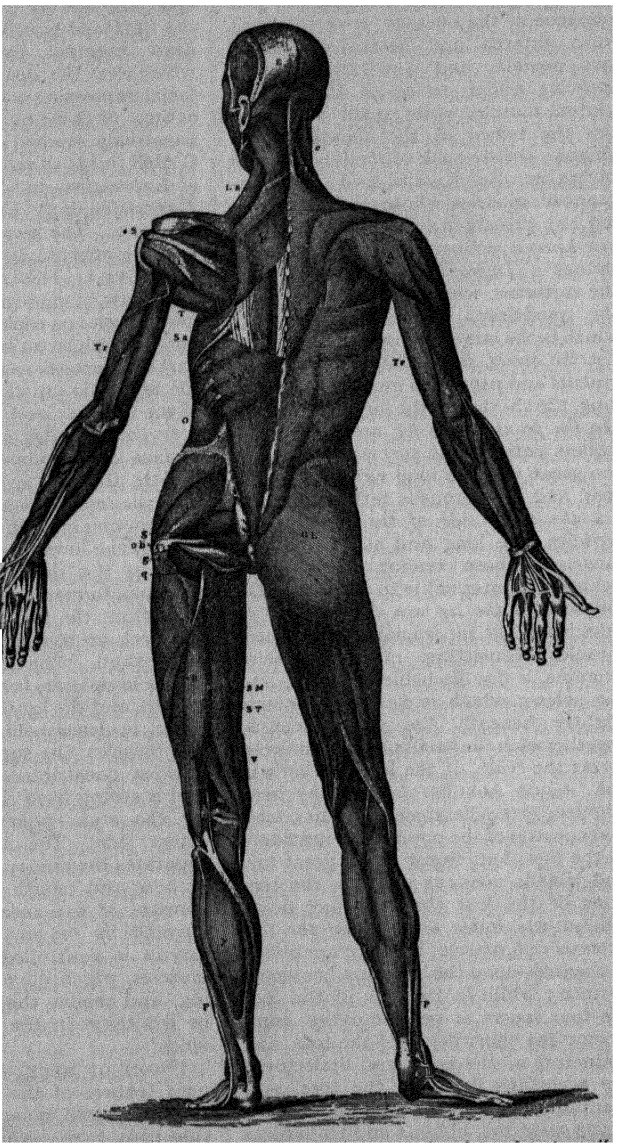


FIG. 330.—behind the body; the right-hand side showing the more superficial ones; the left showing those at a deeper level. *Head and neck*: *A*, temporal muscle; *E*, strong fascia covering cranium; *c*, *C*, trapezius; *Ls*, levator of the angle of the scapula; *S*, splenius; *P*, rhomboid muscles. *Upper limb*: Δ, deltoid; *sS*, supraspinous; *iS*, infraspinous muscles; *T*, larger rounded muscle: *t*, smaller rounded muscle; *Tr*, triceps. *Trunk*: *L*, latissimus of the back; *LD*, longissimus of the back; *S*, ilio-costal muscle; *Sa*, great serrated muscle; *Sp*, hinder serrated muscle; *O*, inner oblique muscle of abdomen. *Lower limb*: *GL*, largest gluteal muscle; *p*, pyriform muscle; *ob*, inner obturator with *g*, *g*, two gemellus muscles: *q*, square muscle of the thigh; *B*, biceps of the thigh; *SM*, semimembranous; *ST*, semitendinous muscles; *V*, inner vastus; Γ, Γ, two heads of the gastrocnemius; γ, soleus; *P*, *p*, peroneal muscles. (*Ency. Brit.*, 9th Edition, vol. i.)

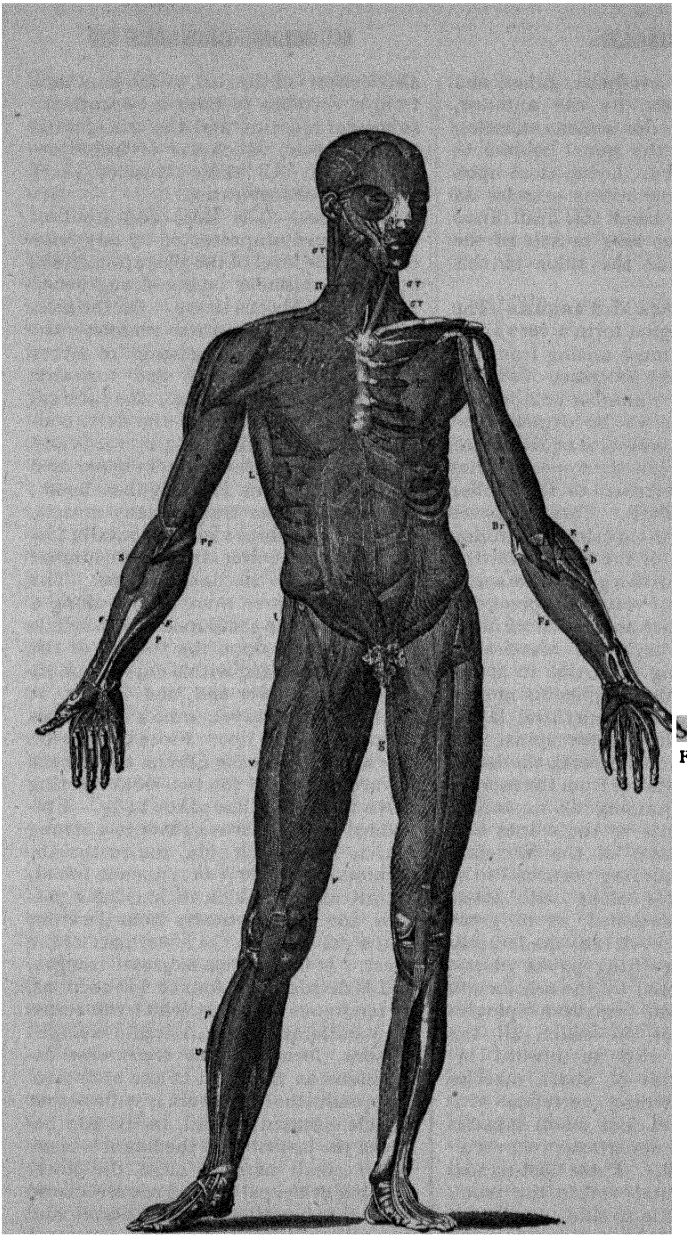


FIG. 331.—Muscles on the front of the body; the right-hand side showing the more superficial ones, the left showing those at a deeper level. *Head and neck*: Π, platysma; σT, sterno-mastoid. *Upper limb*: Δ, deltoid; *B*, biceps, with *b*, its tendon; *Br*, anterior brachial muscle; *Pr*, round pronator; *S*, long supinator; *s*, short supinator; *E*, extensors of the wrist; *FF*, flexors of the wrist; *P*, long palmar muscle; *Fs*, deep fascia of the forearm; *fP*, fascia covering the palm muscles. *Trunk*: *P*, greater pectoral; *p*, smaller pectoral; *L*, latissimus of the back; *S*, great serrated muscle; *O*, outer oblique muscle; *R*, straight muscle; and *T*, transverse muscle of the abdomen. *Lower limb*: *a*, *A*, adductors; *s*, sartorius; *t*, tensor of the fascia of the thigh; *g*, gracilis; *v*, *V*, outer and inner vastus; *p*, peroneal muscles; *U*, anterior tibial muscle. (*Ency. Brit.*, 9th Edition, vol. i.)

either side of the windpipe, gullet, and large blood-vessels, lie the anterior, middle, and posterior scalene muscles, which pass from the spinal column to the upper two ribs. Lying close upon the spine are three rectus muscles on each side, which bend the head upon the spine, and the long muscle of the neck, which bends the spine in this region.

BACK OF THE NECK AND TRUNK.—The muscles in this region form a very complicated system, most arising from the spines or transverse processes of several vertebræ or from a number of ribs, and running upwards to be attached to another series of vertebræ or ribs some distance above, while the upper muscles of the set are attached to the hinder portion of the skull. These muscles form a couple of strong columns running the whole length of the back from the loins to the head, with a groove between, in which the line of vertebral spines can be felt. The upper and lower serrated muscles of the back are muscles of respiration passing from ribs to spine, and, together with the splenius muscle in the neck, form a superficial layer. Beneath them the erector spinæ, the great muscle which supports the back, runs the whole distance from the sacrum to the skull, obtaining at numerous points attachments to the spines and transverse processes of the vertebræ and to the neighbouring portions of the ribs. This muscle, along with those about to be mentioned, is of great power, having, even in moderately strong persons, a lifting power of 200 to 400 lb. Covered by the erector are the complexus and transverso-spinales group of muscles, in which all the muscles ascend with an inward inclination; a series of short muscles connecting succeeding vertebræ with one another; and four small muscles passing from the uppermost two vertebræ to the skull. These last-named muscles incline and rotate the trunk and head from side to side.

CHEST.—The diaphragm is the chief muscle of this part of the body. (*See* DIAPHRAGM.) Next in importance come the outer and inner intercostal muscles, which form a double layer of oblique fibres filling up the gaps between the ribs, the fibres of the two muscles running in different directions. There are also levators of the ribs, which pass each from a vertebra to the rib beneath it; subcostal muscles, and the triangularis sterni muscle, which are of feeble development. All these muscles share in the act of inspiration.

ABDOMEN.—The sides and front of the abdomen, unprotected by any bone beneath the level of the ribs, are enclosed by thick muscular layers strengthened by sheets of fibrous tissue. On the sides of the abdomen are three muscles—the external oblique, consisting of fibres which run downwards and forwards from the lower eight ribs; the internal oblique, under cover of the first, consisting of fibres which run upwards and forwards from the haunch-bone, and fibrous layers in its neighbourhood; and thirdly, the transversalis muscle, of which the fibres run horizontally forward from the lower six ribs, the lumbar vertebræ, and the haunch-bone. The fibres of all three muscles end along a curved line, the semilunar line, which is plainly visible upon the surface of the abdomen, running with a curve from its upper to its lower end, and distant, at the level of the navel, some 4 or 5 inches from the middle line. From the curved line a sheet of dense fibrous tissue runs inwards, those of the two sides meeting down the middle line of the body. Embedded in this fibrous sheet is a strong muscle upon each side, the rectus abdominis, which is 3 or 4 inches broad, almost an inch thick in muscular persons, and runs vertically from the front of the pelvis up to the lower part of the chest. It is a muscle of great strength, and is divided into four or five sections, by tendinous intervals, which run across the muscle, and which, in well-developed persons, form distinct transverse depressions on the front of the abdomen. The quadratus lumborum is still another muscle situated behind, in the gap between the last rib and the haunch-bone. Other small muscles close the lower opening of the pelvis, and are associated with the functions of the bowel and genital organs.

MUSCLES, DISEASES OF.—The muscles are singularly free from liability to diseases which commonly affect other tissues, this being the result, probably, of their activity, good blood supply, and the changes constantly taking place in

them. Wasting of muscles sometimes occurs as a symptom of disease in other organs—for example, damage to the nervous system, as in infantile paralysis or in the disease known as progressive muscular atrophy. (*See* PARALYSIS.)

INFLAMMATION (myositis) of various types may occur. As the result of injury, an abscess may develop (*see* ABSCESS), though wounds affecting muscle generally heal well. Tuberculous inflammation in muscles is almost unknown. Syphilis is the disease which, perhaps more than any other, affects the muscular system, a growth due to this disease, known as a 'gumma', sometimes forming a hard, almost painless swelling in a muscle. Rheumatism is another type of chronic inflammation (*see* RHEUMATISM) to which muscles are very liable. Fibroid and even bony degeneration may occur in muscles which are the seat of long-continued irritation, or which receive a poor blood supply, the former, for example, taking place under certain conditions in the heart, the latter affecting the thigh muscles of those who ride much.

RUPTURE of a muscle may occur, without any external wound, as the result of a spasmodic effort. It may tear the muscle right across, as sometimes happens to the feeble plantaris muscle in running and leaping, or part of the muscle may be driven through its fibrous envelope, forming a 'hernia' of the muscle. The severe pain experienced in many cases of lumbago is due to tearing of one of the muscles in the back. These conditions give rise to considerable pain, but are relieved by rest and massage.

MYASTHENIA (*see* MYASTHENIA).

PAIN, quite apart from any inflammation or injury, may be experienced on exertion. This type of pain, known as 'myalgia', occurs especially in weakly persons, and is then relieved by rest and tonic treatment. It is also one of the common forms of rheumatism. In young children pains of an aching character are often experienced in the muscles, especially of the legs and back, and are known as 'growing pains'. These come on specially after exertion and are relieved by resting.

CRAMP is a well-known condition due to spasm. (*See* CRAMP.)

PARASITES sometimes lodge in the muscles, the most common being *Trichinella spiralis*, producing the disease known as trichinosis.

TUMORS are occasionally met with, the most common being fibroid, fatty and sarcomatous growths.

MYOPATHY is a term applied to a developmental defect in certain muscles. (*See* MYOPATHY.)

MUSHROOM POISONING (*see* FUNGUS POISONING).

MUSK (*moschus*) is the name given to a dried secretion obtained from genital glands of the musk deer. It is used particularly in hysterical conditions.

MUSTARD is a yellowish powder, consisting of the dried, ripe seeds of *Brassica nigra* and *Brassica alba* mixed together. The former contains an active principle called 'sinigrin', the latter contains one named 'sinalbin', while both contain a quantity of a ferment named 'myrosin', which in the presence of water converts the two active principles into the volatile oil to which the action of mustard is due. This oil is extremely irritating to skin and mucous surfaces with which it is brought in contact.

Uses.—Externally, mustard is used, made into a paste with water and spread upon brown or cartridge paper, or made up with linseed into a poultice, for its irritant action upon the skin, in cases of rheumatism, inflamed joints, neuralgia, and for application to the chest and abdomen when organs in these cavities are inflamed. These applications should not, as a rule, last longer than twenty minutes. Liniment or mustard is used for similar purposes. In a hot or cold bath one or two tablespoonfuls of mustard have an invigorating effect. For Mustard Pack see WET PACK. The effect of mustard, if too pronounced, may be relieved by applying olive oil.

Internally, mustard is used in small quantities as a stimulant to digestion, and in large quantities as an emetic, a tablespoonful of mustard powder being stirred up in a tumberful of cold water for the latter purpose.

MYALGIA (μῦς, a muscle; ἄλγος, pain) means pain in a muscle. (*See* LUMBAGO *and* RHEUMATISM.)

MYASTHENIA GRAVIS (*μῦs*, muscle; *ἀσθένεια*, weakness) is the name given to a serious disorder of rare occurrence, in which the chief symptoms are muscular weakness and a special tendency for fatigue to come on rapidly when efforts are made.

The cause of the disease is not accurately known, but the symptoms are due to deficiency in the muscles of acetylcholine which is necessary for muscular contraction. It affects, as a rule, persons in early adult life. Not only the voluntary muscles, but those connected with the acts of swallowing, breathing, etc., become infiltrated with small round cells and progressively weaker, though there is no very marked wasting. Rest and avoidance of undue exertion, so as carefully to husband the strength, are necessary, and injections of prostigmin at intervals enable the muscles to be used and in some cases have a curative effect. Good results are being reported in treatment by surgical removal of the thymus.

MYCOSIS (*μύκηs*, a fungus) is the general term applied to diseases due to the growth of fungi in the body. Among some of the simplest and commonest mycoses are ringworm, favus, and thrush. The Madura-foot of India, actinomycosis, and occasional cases of pneumonia and suppurative ear disease are also due to the growth of moulds in the bodily tissues.

MYDRIASIS (*μυδρίασις*) means a state of unusual dilatation of the pupil. Drugs which cause dilatation of the pupil, such as belladonna and cocaine, are known as ' mydriatics '.

MYELEMIA and MYELOCYTHÆMIA (*μυελόs*, marrow; *κύτοs*, cell; *αἷμα*, blood) are terms applied to leukæmia of the spleno-medullary variety. (*See* LEUCOCYTHÆMIA.)

MYELIN (*μυελόs*, marrow) is the name given to the white fat-like substance forming a sheath round medullated or myelinated nerve-fibres in the nerves and in the central nervous system.

MYELITIS (*μυελόs*, marrow) is a disease which, by inflammation, induces destructive changes in the spinal cord. In the *acute* variety the nerve elements in the affected part become disintegrated and softened, in the *chronic* form the change is slower, and the diseased area tends to become denser (sclerosed), the nerve-substance being replaced by connective tissue. In the variety known as *polio-myelitis* nerve-cells in the grey matter of the cord become destroyed, and the condition known as ' infantile paralysis ' is produced. (*See* PARALYSIS.)

Causes.—The chief causes of myelitis are injuries or diseases affecting the spinal column, extension of inflammation from the membranes of the cord to its substance (*see* MENINGITIS), exposure to cold and damp, and occasionally some pre-existing infection or inflammatory condition, such as a fever. Any debilitating cause or excess in mode of life will act in predisposing to this malady. The chronic form is most common in adults, while polio-myelitis, affecting the anterior horn of grey matter in the cord, is chiefly limited to young children.

Symptoms.—Myelitis may affect any portion of the spinal cord. Its most frequent site is in the lower part, and its existence there is marked by the sudden or gradual occurrence of weakness of motor power in the legs (which tends to pass into complete paralysis), impairment or loss of sensibility in the parts implicated, nutritive changes affecting the skin and giving rise to bed sores, together with bladder and bowel derangements. There is, in addition, if the disease affects the cord at a level above that from which the nerves of the lower limbs originate, a 'spastic', or jerky condition, in which, owing to the control of the higher centres in the brain being cut off, involuntary contractions of the muscles and movements of these limbs take place. In the acute form, in which there is at first pain in the region of the spine and much constitutional disturbance, death may take place rapidly from extension of the disease to those portions of the cord connected with the muscles of respiration and the heart, from an acute bed sore, which is very apt to form, or from some intercurrent disease. Recovery to a certain extent may, however, take place; or, again, the disease may pass

into the chronic form. In the latter, the progress is usually slow, the general health remaining tolerably good for a time, but gradually the strength fails, the patient becomes more helpless, and ultimately sinks exhausted, or is cut off by some complication.

Treatment.—The treatment for myelitis in its acute stage is similar to that for spinal meningitis. When the disease is chronic, the most that can be hoped for is the relief of symptoms. Good is sometimes derived from the employment of electricity, in maintaining the action of the muscles involved, and from the use of baths and douches to the spine. Above all, careful and regular attention to the functions of the bladder and bowels is essential, and also attention to the skin of the back, upon which bed sores are liable to form.

MYELOCYTE (*μυελός*, marrow; *κύτος*, cell) is the name given to one of the typical cells of red bone-marrow from which the granular white corpuscles of the blood are produced. They are found in the blood also in certain forms of leukæmia.

MYELOID (*μυελός*, marrow; *εἶδος*, form) is a term applied to sarcomatous tumors which contain cells similar to those of bone-marrow.

MYELOMA is the name of a tumor made up of bone-marrow cells and generally occurring in the marrow of more than one bone at the same time.

MYELOMALACIA is the term applied to morbid softening of the spinal cord, as a result of injury, pressure, inflammation, or arterial disease.

MYIASIS (*μυῖα*, a fly) is a term applied to any disease caused by maggots or flies.

MYOCARDITIS (*μῦς*, muscle; *καρδία*, the heart) means inflammation of the muscular wall of the heart. (*See* HEART DISEASES.)

MYOCARDIUM is the name applied to the muscular substance of the heart.

MYOMA (*μῦς*, muscle; *-oma*, meaning tumor) is the term applied to a tumor, almost invariably of a simple nature, which consists mainly of muscle fibres. These muscle tumors often occur in the uterus.

MYOPATHY (*μῦς*, muscle; *πάθος*, disease), also known as MUSCULAR DYSTROPHY or IDIOPATHIC MUSCULAR ATROPHY, is the term applied to a somewhat rare condition in which wasting takes place in certain muscles, with or without previous increase in bulk of these muscles, and apparently without any affection of the nervous system. The cause of the condition is still obscure, though the disease appears to run in families, being transmitted, like some other hereditary diseases, by the mothers. Generally the disease appears in early childhood, and it seldom affects persons over the age of twenty. The changes which are found after death show that a simple wasting away of the muscle fibres takes place, and that these are in some cases to a great extent replaced by fatty and fibrous tissue.

Symptoms.—There are three chief types of myopathy. The commonest, known as 'pseudo-hypertrophic paralysis', affects particularly the upper part of the lower limbs of children. The muscles of buttocks, thighs, and calves seem excessively well developed, but nevertheless the child is clumsy, weak on his legs, and has difficulty in picking himself up when he falls. In another form of the disease, which begins a little later, as a rule about the age of fourteen, the muscles of the upper arm are first affected, and those of the spine and lower limbs become weak later on. In a third type, which begins about this age, the muscles of the face, along with certain of the shoulder and upper arm muscles, show the first signs of wasting. All the forms have this in common, that the affected muscles grow weaker till their power to contract is quite lost. In the first form, the patients seldom reach the age of twenty, falling victims to some disease which, to ordinary persons, would not be serious. In the other forms the wasting, after progressing to a certain extent, often remains stationary for the rest of life.

Treatment.—The nutrition must be exceptionally well maintained, and various tonics are of use. Massage, electricity, and exercise short of fatigue are of the utmost importance, and above all, care must be taken that these invalids are not exposed unduly, as they succumb easily to chest affections.

MYOPIA (*μύωψ*, blinking; from *μύω*, I close; *ὤψ*, the eye), or SHORT-SIGHT, means a condition in which, owing to the lens of the eye being too highly convex or the ball of the eye too long, rays of light are brought to a focus before they reach the retina, and so form circles of diffused light upon it. It is the opposite of hypermetropia or long-sight. (*See* VISION, DISORDERS OF.)

MYOSIS (*μύω*, I close), or MIOSIS, means a narrowing of the pupil. Some persons, largely on account of having a small amount of pigment in the eye, possess naturally small pupils, but apart from this, the condition is due usually to paralysis of the sympathetic nerve-fibres supplying the pupil, or to drugs such as opium and eserine.

MYOSITIS (*μῦς*, a muscle) means inflammation of a muscle. (*See* MUSCLES, DISEASES OF.)

MYOTICS (*μύω*, I close), or MIOTICS, is the term applied to drugs which contract the pupil of the eye, such as eserine.

MYOTONIA (*μῦς*, muscle; *τόνος*, tension) is a condition found in occasional individuals in which the muscles, though possessed of normal power, contract only very slowly. The stiffness disappears as the muscles are used.

MYRINGITIS is the term applied to any inflammatory state of the drum of the ear.

MYRINGOTOMY is the term for describing the operation of cutting the drum of the ear in cases of acute inflammation of the middle ear.

MYRRH (*μύρρα*) is a gum-resin obtained from *Commiphora myrrha*, an Arabian myrtle tree. It stimulates the functions of mucous membranes with which it is brought in contact or by which it is excreted. Tincture of myrrh is used for a gargle in sore throat, as a tooth-wash when the gums are inflamed, and as an ingredient of cough mixtures.

MYXŒDEMA (*μύξα*, mucus; *οἴδημα*, a swelling) is a disease characterised by a swollen and degenerative condition of the subcutaneous and connective tissues throughout the body, due to some defect in nutrition, which in turn is referable to a defect in the thyroid gland.

Causes.—The series of observations and experiments which explained the nature of this disease is a matter of recent years. It had been observed that the disease was associated with atrophy, or sometimes with increase in size, of the thyroid gland, though in any case the actual gland structure was destroyed; and accordingly Horsley, Schiff, and others were led to test the effect produced in animals by artificial removal of the gland. They found that not only does a state of ill-health analogous to myxœdema appear in these circumstances, especially when the animals are exposed to the effects of cold, but that its symptoms can be prevented by transplanting a thyroid gland from another animal. The final step in the proof was supplied by observers who found that the administration by the mouth of dried thyroid glands of sheep, or extract of these glands, is sufficient to cure myxœdema.

The cause of atrophy of the gland is, however, not so certain. It has been variously ascribed to mental worry, sudden nervous shock, frequent child-bearing, prolonged suckling, and other causes; but, beyond the fact that it is about seven times more common in women than in men, and that the great majority of cases arise in middle life, between the ages of thirty and fifty, little is known as to its production. Like cretinism, myxœdema appears often to run in families, and indeed sporadic cretinism is a very similar disease, producing different symptoms in children on account of their undeveloped state.

The important part of the thyroid gland secretion is an iodine-holding body (thyroxin) which is concerned in the processes of nutrition. Deprivation of the secretion causes a deposition of fat, a varying degree of dropsy, and above all an excessive formation of loose connective tissue, from which there is often obtainable after death a considerable amount of mucoid material, a fact to which the disease owes its name. This connective tissue presses upon and destroys the proper tissues of the organs.

Symptoms.—A person suffering from myxœdema to a marked degree presents a most characteristic appearance. The face is swollen, the features coarse, and the expression dull and unrelieved by any passing emotions or interests. The

skin generally is dry and yellow, but the cheeks are usually bright red in contrast. The hair is thin, harsh, and brittle, and the person may even be completely bald. The intellectual functions also are slow, the speech is deliberate, the formation of ideas, as for example in answer to questions, and indeed all the ordinary affairs of life, take far longer than in the case of healthy persons, but there is, nevertheless, in the early stages, no impairment in the quality of mental processes. Later, memory becomes bad, and the person grows deaf and very drowsy. Though at first the temper is placid and lethargic, in the later stages irritability and delusions appear, and the person, if untreated, may ultimately become insane.

Along with these more obvious changes there is general swelling all over the body. The hands assume the so-called ' spade-like ' appearance, and the person, partly in consequence of the slowness of his movements, partly as the result of weakness, becomes very ungainly. The cold is often complained of by the invalid, who has difficulty in keeping himself warm, and, if the temperature be taken, it is usually found to be subnormal (96°–98° Fahr.).

Cases last for many years even when untreated, and the disease is seldom directly fatal. As a rule myxœdematous patients grow better and worse from time to time, though the trend is for the disease to get more marked. When the case is treated, improvement almost always takes place with great rapidity, and treatment is effective even after the person has been ill for many years.

Treatment. — The necessary and sufficient treatment consists in the administration of the thyroid gland of some animal. Sheep's thyroid is to be obtained in a dried condition, or in tablets, and in one of these forms must be made an article of diet for the remainder of life, in order to supply the place of the person's own defective thyroid gland. When the last traces of the disease have vanished, a small dose once or twice a week will suffice in most cases to maintain the health, but if the remedy be discontinued for any great length of time, symptoms of myxœdema again assert themselves.

Great care is necessary in the early stages of cure that over-large doses of the thyroid gland are not taken. Otherwise disturbance of the stomach and bowels, headache, feverishness, palpitation of the heart, and attacks of faintness and prostration may come on. These unpleasant symptoms are prevented by taking very small doses at first, after which the system gets tolerant of greater amounts.

MYXOMA (*μύξα*, mucus ; *-oma*, meaning tumor) is the name applied to a tumor consisting of very imperfect connective tissue, and containing a peculiar mucus-like juice.

NÆVUS (*naevus*, a mole) is the term applied to birth-marks consisting of a mass of dilated blood-vessels. These structures may take the form of the large ' port-wine stain ' often seen upon the face, for which little can be done, or they may occur as swellings of a more restricted nature, usually of a red or bluish colour. Many nævi tend to decrease in size as the child advances in years ; or if not, the blemish can often be removed by excision of the piece of skin that is involved, or by electrolysis.

NAILS (*see* SKIN).

NAILS, DISEASES OF.—The nails are subject to very few diseases, though any interference with the natural appearance of the finger-nails is very unsightly, while the sensitive matrix of both finger- and toe-nails is extremely tender when diseased.

INFLAMMATION of the nails and of the bed in which they rest occurs frequently in various skin diseases, *e.g.* in psoriasis, eczema, and syphilis. The nails then become rough, thickened, irregular, discoloured, and split readily into layers. Most acute febrile diseases are accompanied by irregularities in growth of the nails producing a transverse furrow in the nail, as it grows onwards, and these furrows on the nails

FIG. 332.—Nail, showing four transverse furrows, which indicate illnesses about six, four, three, and one month ago. (Balfour's *Senile Heart.*)

serve to date a severe illness fairly accurately, the furrow gradually approaching the free margin of the nail and disappearing in about six months' time. These transverse furrows must not be confused with furrows running lengthwise, which are said to indicate a gouty constitution.

Spoon-shaped or recurved nails (KOILONYCHIA) are often associated with anæmia, especially in middle-aged

FIG. 333.—Gouty nail. (Balfour's *Senile Heart.*)

women, and become normal when this is treated.

ABSCESS may occur at the root of the nail (*see* WHITLOW) or underneath it near its edge. As a rule, these abcesses are caused by a minute poisoned wound, such as that due to a splinter of wood. The condition is generally very painful, but is relieved by opening, so as to allow free exit for the pus, the nail being snipped up with a pair of scissors if necessary. The nail in these cases is often cast off.

INJURY to the nail by a blow is frequently followed by an extravasation of blood beneath it, the nail first turning black, and then often being shed. In all these cases where the nail is shed, a new nail generally appears quickly, and replaces the old one in six months, unless the matrix has been very seriously diseased or injured. While the new nail is growing, the point of the finger merely requires the protection of a finger-stall.

INGROWING NAIL is a troublesome condition affecting only the nails of the toes. It is due to a variety of causes, chief among which are the pressure of badly fitting boots, cutting away of the corners in paring the nails, and want of attention to the nails, whereby accumulations of scarf-skin and dirt collect beneath the nail, and by putrefactive changes cause ulceration of the skin at the sides. The condition also occurs in old, bedridden people, mainly for the last-named reason. The treatment is simple, though sometimes tedious. It consists in the wearing of well-made boots, cutting of the nails square across without paring away the

corners, and the packing two or three times daily of a shred of boric lint between the corner of the nail and the skin which it is chafing. These measures are generally sufficient after a little time, but sometimes the nail is so much thickened that the edges cannot be

FIG. 334.—Finger-nail, showing method of cutting nail.

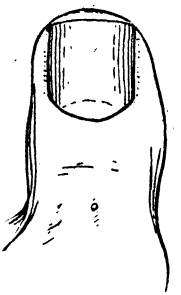


FIG. 335.—Toe-nail, showing correct method of cutting nail straight across.

raised up to admit the threads of lint. In this case the centre of the nail may be softened by dabbing on caustic potash, and then the nail is easily thinned down by scraping with a sharp knife till it becomes pliable. When the skin at the side of the nail bleeds very readily, this is remedied by touching with bluestone or with nitrate of silver.

NANISM is another name for dwarfism.

NAPHTHOL, or BETA-NAPHTHOL, is a coal-tar derivative used sometimes externally in antiseptic dressings, but much more commonly administered internally when an antiseptic is required to check putrefactive processes in the stomach or bowels, as, for example, where dilatation of the stomach, or diarrhœa due to fermentation, exists.

NAPRAPATHY (Russian, *napravlyat,* to set right; πάθος, disease) is the term applied to a system of healing which attributes disease to disorder in the ligaments and connective tissues.

NARCISSISM (*Narcissus*) is a term applied to an abnormal mental state characterised by excessive admiration of self.

NARCOLEPSY is the name of a curious condition in which uncontrollable 'attacks' of sleep occur. It is often associated with cataplexy.

NARCOSIS (νάρκωσις, a benumbing) is a condition of profound insensibility, resembling sleep so far that the unconscious person can still be roused slightly by great efforts, or at all events is not entirely indifferent to sensory stimuli. It is most commonly produced by drugs, such as opium, but may also be due to poisons formed within the body, as in the uræmia of Bright's diesase.

NARCOTICS (ναρκωτικός, making numb). (*See* HYPNOTICS.)

NARES is the Latin word for the nostrils.

NASAL DISORDERS (*see* NOSE, DISEASES OF).

NASO-PHARYNX is the name given to the upper part of the throat, lying behind the nasal cavity. (*See* NOSE.)

NASTIN (ναστός, solid) is the name of a fatty substance derived from cultures of the leprosy bacillus and formerly used to produce immunity against leprosy.

NAUSEA (ναυσία, sea-sickness; from ναῦς, a ship) means a feeling that vomiting is about to take place. (*See* VOMITING.)

NAVEL is the scar on the abdomen marking the point where the umbilical cord joined the body in embryonic life. (*See* AFTERBIRTH.)

NEAR-SIGHT (*see* MYOPIA).

NEBULA (*nebula,* mist) is the term applied to a slight opacity on the cornea producing a haze in the field of vision, and also to any oily preparation to be sprayed into the nose from a nebuliser, an apparatus for splitting up a fluid into fine droplets.

NECATOR AMERICANUS, or UNCINARIA, is the name of a parasite hookworm, closely resembling but smaller than the *Ankylostoma duodenale* and responsible in some cases for the disease of ankylostomiasis. It is found in America, West and Central Africa, India, Ceylon, China, Australia, and the Pacific Islands.

NECK is that portion of the body which extends from the upper limit of the chest to the base of the skull. Its main function is to support the head. Through its front part run the passages for the air and the food. The great bulk of the neck is composed of seven

cervical vertebræ with the muscles attached thereto, in front and behind. (*See* MUSCLES.) Within the canal formed by the rings of these vertebræ lies the cervical part of the spinal cord, from which proceed the nerves that control the movements of neck and arms.

In front of the spinal column lies the pharynx or throat-cavity, extending from the base of the skull above down to the lower edge of the sixth vertebra, where the gullet continues it directly downwards, while the larynx opens out

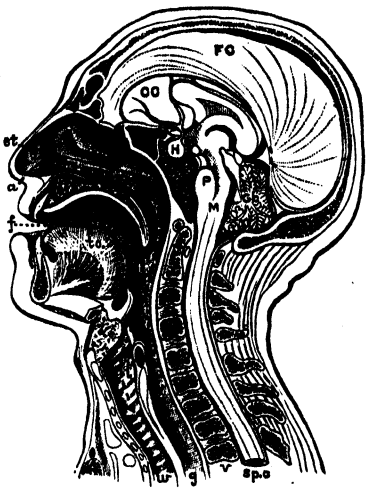


FIG. 336.—Vertical section through the middle of the head and neck. The passages for air *a*, are indicated by a heavy dotted line, those for the food *f*, by a fainter line; *st*, Eustachian tube; *l*, larynx; *w*, windpipe; *t*, tonsil; *to*, tongue; *g*, gullet; *v*, vertebral column; *sp.c*, spinal cord. For other letters see BRAIN. (After Braune.)

of it in front. The larynx is close to the surface of the front of the neck, and the thyroid cartilage can be readily seen and felt beneath the skin. (*See* LARYNX.) The larynx is continued downwards by the windpipe, and just beneath the larynx the isthmus of the thyroid gland can be felt crossing the windpipe and connecting the two lobes of the gland which lie one on either side of the larynx. The strong sterno-mastoid muscle is a prominent object on each side of the neck, running from the mastoid process of the skull down to the breast-bone and inner end of the clavicle, and under cover of it lies a fibrous sheath containing the carotid artery, internal jugular vein, and vagus nerve. The sterno-mastoid muscle divides each side of the neck into two triangular areas, in which lie several important nerves and branches of these blood-vessels, as well as chains of lymphatic glands. Several large superficial veins run down the neck, and are of importance, because, in wounds of the neck, they may give rise to much bleeding. The chief of these are the external jugular vein, running straight downwards from the angle of the jaw, and the anterior jugular vein, running downwards from beneath the chin, not far from the middle line. At the root of the neck, the apex of each lung projects a short distance from the chest into the neck.

NECROPSY (*νεκρός*, a dead body; *ὄψις*, a view) is another name for autopsy. (*See* AUTOPSY.)

NECROSIS (*νέκρωσις*, a state of death) means death of a limited portion of tissue, the term being most commonly applied to bones when, as the result of disease or injury, a fragment dies and separates. (*See* BONE, DISEASES OF.)

NEEDLING is the name for an operation performed by means of a needle especially in the discission or tearing of a cataract so as to allow the fluid in the anterior chamber of the eye to dissolve it.

NEGATIVISM means a morbid tendency in a patient to do the opposite of what he is desired or directed to do. It is specially characteristic of schizophrenia.

NEGRO-LETHARGY is another name for sleeping sickness.

NEMATODE (*νῆμα*, thread) is a general term applied to several species of parasitic worms of more or less cylindrical shape.

NEOARSPHENAMINE, also known as NOVARSENOBENZOL, NEOSALVARSAN, NOVARSENOBILLON, and by a variety of other trade names, is an organic arsenic compound, used in the treatment of syphilis. Its chemical description is: sodium diaminodihydroxyarsenobenzenemethanalsulphoxylate. It is more soluble and less toxic than arsphenamine (salvarsan).

NEONATAL MORTALITY. — The mortality of infants under one month of age. Some 40 per cent of infant

deaths occur in the first month of life, and chiefly in the first week. There has been little decline in the neonatal mortality as opposed to infantile mortality (the mortality of infants under one year of age). Neonatal mortality is the result principally of birth accidents and congenital conditions—premature birth, birth injuries, congenital malformations, convulsions, congenital debility.

NEOPLASM (*νέος*, new; *πλάσσω*, I mould), which means literally a 'new formation', is another word for tumor.

NEPENTHE is a solution of opium in alcohol and water given in the same dose as laudanum.

NEPHRECTOMY (*νεφρός*, kidney; *ἐκ*, out; *τέμνω*, I cut) means the operation for removal of the kidney. (*See* KIDNEY, DISEASES OF.)

NEPHRITIS (*νεφρός*, kidney) means inflammation of the kidneys. (*See* BRIGHT'S DISEASE.)

NEPHROLITHIASIS (*νεφρός*, kidney; *λίθος*, stone) is the term applied to a condition in which calculi are present in the kidney.

NEPHROPEXY (*νεφρός*, kidney; *πήγνυμι*, I fix) means the fixation of a floating kidney in its original position.

NEPHROPTOSIS (*νεφρός*, kidney; *πτῶσις*, falling) means the condition in which a kidney is movable or 'floating'. (*See* KIDNEY, DISEASES OF.)

NEPHRORHAPHY (*νεφρός*, kidney; *ῥαφή*, a sewing) means the operation by which a movable kidney is fastened by stitches in its proper place.

NEPHROSIS is a general term applied to any disease of the kidney, but especially to a form of degeneration characterised by anæmia, widespread dropsy, and a high degree of albuminuria.

NEPHROSTOMY means the operation of making an opening into the kidney for the purpose of draining it.

NEPHROTOMY (*νεφρός*, kidney; *τέμνω*, I cut) means the operation of cutting into the kidney, in search of calculi or for other reason.

NERVES (*nervus*, a nerve).—The nervous system consists in part of cells and in part of fibres, each of which is a long process extending from a nerve-cell. The brain and spinal cord are often spoken of together as the 'central nervous system'; the nerves which proceed from them, forty-three in number on each side, are named the 'cerebro-spinal' or 'peripheral nerves'; while the third great division, situated in the neck, thorax, and abdomen, and intimately connected with the cerebro-spinal nerves (though in its action largely independent of the brain and cord), is known as the 'sympathetic system'. The last-named consists of ganglia containing nerve-cells, which are profusely connected by plexuses of nerve-fibres.

The nerve-cells originate, or receive, impulses and impressions of various sorts, which are conveyed from them to muscles, blood-vessels, etc., by 'efferent' nerves, or received by them through 'afferent' nerves coming from the skin, organs of sense, joints, etc. The sympathetic system is concerned mainly with the movements and other functions of the internal organs, secreting glands, blood-vessels, etc., whose activities proceed independently of the will.

Structure.—(1) NERVE-FIBRES.—The nerves vary much in size. The great sciatic nerve, deeply buried in the muscles on the back of the thigh, is the largest nerve in the body, being of the thickness of a lead pencil or more; other nerves reach about the size of goose-quills, and from these there are all gradations, down to the minute single fibres distributed to muscle-fibres or to skin. A nerve, such as the sciatic, possesses a strong, outer fibrous sheath, called the 'epineurium', within which lie bundles of nerve-fibres, divided from one another by partitions of fibrous tissue, in which run blood-vessels that nourish the nerve. Each of these bundles is surrounded by a sheath of its own, known as 'perineurium', and within the bundle, fine partitions of fibrous tissue, known as 'endoneurium', divide up the bundle into groups of fibres. The blood-vessels and lymphatics of the nerves divide into fine branches, which run in these sheaths and partitions of fibrous tissue. The finest subdivisions of the nerves are the fibres, and these are of two kinds—medullated and non-medullated fibres. The *medullated fibres* vary in thickness from $\frac{1}{15000}$

inch to $\frac{1}{1800}$ inch, some nerves containing a greater proportion of the small fibres than others. All have, under the microscope, the appearance of tubes,

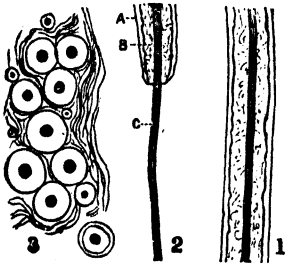


FIG. 337.—1, Medullated nerve-fibre; 2, similar fibre in which *A* points to neurolemma, *B* to medullary sheath, *C* to axis-cylinder; 3, transverse section through part of a nerve, showing the varying size of the nerve-fibres. Magnified by about 400. (Turner's *Anatomy*.)

this being due to the fact that each has an outer membranous sheath, the 'neurolemma', within which is a clear white material, the 'medullary sheath', in the centre of which runs the axis-cylinder or nerve-fibre proper. The neurolemma is a strong but thin sheath with nuclei at regular intervals on its inner surface. The medullary sheath is composed of fatty material containing lecithin and cholesterin, and to it the

FIG. 338.—Non-medullated nerve-fibres from the sympathetic system. (Turner's *Anatomy*.)

white colour of the nerves is mainly due. It is divided at regular intervals by short gaps, situated about $\frac{1}{70}$ inch apart, known as the nodes of Ranvier, but across these gaps the neurolemma and axis-cylinder are continuous. This medullary sheath is generally regarded as probably fulfilling a purpose similar to the insulating material upon electric wires and preventing nerve impulses from passing beyond the nerve-fibre by which they are conveyed. The axis-cylinder is the conducting part of the nerve, for while the neurolemma is absent from the fibre in its course through the brain and spinal cord, and while the medullary sheath is absent from non-medullated nerves, the axis-cylinder never fails. It has a striped appearance, seeming to consist of a number of fibrils which, however, cannot be separated from one another. The *non-medullated fibres* are very much thinner than the average of medullated fibres, from which they differ only in the fact of not possessing a medullary sheath, and of being therefore greyish in colour.

(2) NERVE-CELLS, from one of which springs each nerve-fibre, are found in

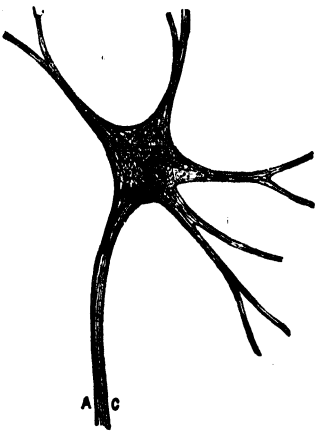


FIG. 339.—Multipolar cell from the grey matter in the anterior horn of the spinal cord. *AC*, The axis-cylinder of a nerve-fibre. (Turner's *Anatomy*.)

the grey matter of the brain and spinal cord. In the brain alone it is calculated there are some 600,000,000 of these cells. They also exist in the ganglia of the sympathetic system, in connection with some of the nerves of special sense, and on the posterior roots of the spinal nerves. The shape of these nerve-cells varies. The most common appearance is that of a large clear cell, containing an oval nucleus, and running out at various points into long processes, which, as a rule, branch again and again, after the

manner of a tree, these 'dendritic processes', as they are called, meeting with similar processes from neighbouring cells. The ends of the branching processes from one cell touch the ends of similar processes from another cell, the points of contact being known as *synapses*. The state of closure or openness of these synapses is believed to be of great importance in quickening or blocking nerve impulses. The body of the cell has a mottled appearance, owing to its containing many bodies, known as Nissl's spindles, which appear to be of the nature of food material, destined to be used up when the cell is stimulated to work till reduced to a state of fatigue.

In the cerebrum, the cells are distinctly pyramidal in shape, and one of the processes of each cell is much longer

FIG. 340.—Bipolar nerve-cell from a fish. (Turner's *Anatomy*.)

than the rest, forming indeed a nerve-fibre, which may run a long distance down the spinal cord. Other cells are bipolar, *i.e.* they possess but two processes, and others are unipolar, *i.e.* they possess only one process, which, a short distance from the cell, divides in a

FIG. 341.—Another form of nerve-cell. *Sp*, *st*, Spiral and straight nerve-fibres connected with it; *C*, fibrous tissue capsule. (Turner's *Anatomy*.)

T-shaped manner, as, for example, the cells in the ganglia upon the posterior roots of the spinal nerves. Other cells are found in the grey matter of the brain,

NERVES

which are known as neuroglia cells. These are provided with innumerable processes, that form a supporting felt-work for the nerve-cells and nerve-fibres, and act merely as connective tissue cells.

(3) NERVE-ENDINGS.—Each nerve-fibre proceeds from a nerve-cell to end in a definite organ, to or from which it carries a special form of nerve impulse. The manner in which the fibre ends in the organ to which it proceeds varies in different cases. The simplest mode of ending is that of the non-medullated fibres which proceed to the involuntary

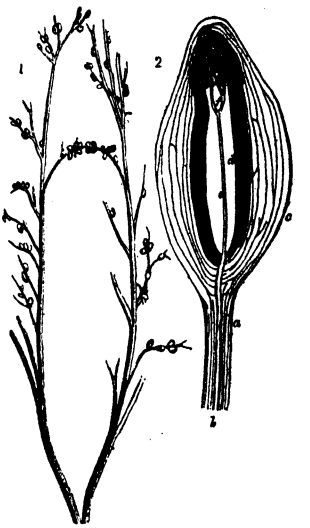


FIG. 342.—One form of nerve-ending. 1, Nerves of one finger with the Pacinian corpuscles attached: about one-half natural size; 2, a Pacinian corpuscle magnified by 175; *a*, stalk, containing *b*, a nerve-fibre; *c*, fibrous capsule; *d*, core of protoplasm containing *e*, the non-medullated fibre which branches at its end *f*. (Turner's *Anatomy*.)

muscle-fibres, as, for example, those of the intestine. These fibres form a complex network between the layers of muscle, from which fine fibres pass between the muscle-fibres. In the heart the nerves end in a similar manner. In voluntary muscles the arrangement is more complicated. Each nerve-fibre splits up into numerous branches, which go to neighbouring muscle-fibres. Each branch pierces the membrane surrounding its muscle-fibre, and ends by spreading out into a plate composed of granular material and numerous nuclei. The endings of sensory nerves in the skin

have an even more special arrangement. Most of these end, not in the cuticle, which is devoid of sensation, but in the projections of the true skin beneath it, where each nerve-fibre enters a small rounded bulb. Some of these bulbs found beneath the skin of the fingers are known as Pacinian corpuscles, and these, about $\frac{1}{10}$ inch long and half that in width, consist of a large number of thin coats enclosing the swollen end of a nerve-fibre. Other much smaller bodies, about $\frac{1}{100}$ inch long, known as 'touch-corpuscles', are found close beneath the cuticle all over the skin, and consist of a framework of connective tissue in which the nerve-fibre winds round and round. Similar bodies are found on the front of the eye. In other cases the nerves appear to end abruptly in cells situated in the deepest layer of the cuticle.

Development and repair.—The whole nervous system is developed from the epiblast or outer layer of the embryo, the brain and spinal cord arising from an infolding of the surface along the back to form a tube, and all the nerves being formed directly or indirectly as outgrowths from this tube, which increase in length till they reach the muscle,

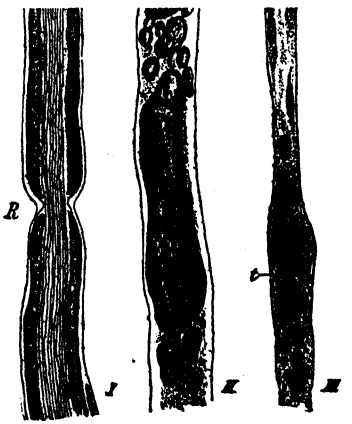


FIG. 343.—Nerve-fibres showing degeneration after an injury. I, Normal nerve-fibre, showing at *R*, a node of Ranvier; II and III, successive stages of degeneration; *t* shows the drops to which the medullary sheath is finally reduced. Magnified by 476. (Thoma's *Pathology*.)

skin, or other structure for which they are destined. Each nerve-fibre, as already stated, is the process of a nerve-cell, and, if a nerve be cut, that portion

of its fibres which is separated from the cells immediately starts to degenerate, the medullary sheath and axis-cylinder

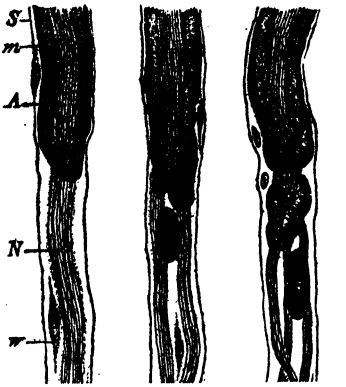


FIG. 344.—Reproduction of nerve-fibres, which have been cut, by growth downwards from the upper end. *S*, The outer sheath or neurolemma, which does not degenerate; *m*, medullary sheath; *A*, axis-cylinder in the uninjured part of the nerve; *N*, newly formed part of the axis-cylinder; *w*, newly developed nuclei from the outer sheath, which also aid in repair. Magnified by 476. (Thoma's *Pathology*.)

as a rule, breaking up. Within a few days or weeks, however, a bundle of small new fibres grows out from the cut end of each fibre in that portion which has not been cut off from connection with the nerve-cells, and these grow through the scar and down the sheath of the degenerated portion till they reach the organs to which the nerve originally proceeded. Thus the nerve is restored. This process is quickened when the cut ends have been carefully brought together, and indeed there are reasons for believing that, sometimes when this is done, no degeneration takes place, but the nerve heals and again transmits impulses at once.

Functions of nerves.—The greater part of the bodily activity originates in the nerve-cells, food material being used up in the process. As a result of this activity, impulses are sent down the nerves, which act simply as transmitters. The impulse which passes from a nerve-cell along a nerve-fibre to a muscle may be compared to the electric spark which explodes a mine, since the nerve impulse causes sudden chemical changes in the muscle as the latter contracts. (*See* MUSCLES.) Similarly, the impulse which

passes from a sensory ending in the skin along a nerve-fibre to affect nerve-cells in the spinal cord and brain, where it is 'perceived' as a sensation, may be compared to the electric current which passes along a telephone wire to affect the receiver. Nevertheless, it must be understood that the impulse passing along a nerve is a form of motion quite different from electricity; travelling at the slow rate of about 100 feet per second, and probably more nearly resembling the motion of air-particles which produces sound. (*See* NERVOUS IMPULSE.)

The important fact that the anterior root of each spinal nerve is motor in function was discovered in 1811 by Sir Charles Bell. This was confirmed by Magendie in 1822 and the discovery also made that the posterior roots are sensory in function. Therefore they concluded that the anterior roots consist of motor fibres to muscles, the posterior roots of sensory fibres from the skin. The terms 'efferent' and 'afferent' are applied to these roots more correctly, because, in addition to motor fibres, fibres through which blood-vessels are contracted and relaxed, and fibres which control secreting glands leave the cord in the anterior roots, while, in addition to sensory fibres, fibres which bring in impulses from muscles, joints, and other organs, and inform the sense of locality as well as the sense of feeling, also enter the cord by the posterior roots.

Sensation is popularly supposed to be derived through five senses—smell, sight, hearing, taste, and touch. In addition to these, impulses are brought by special nerve-fibres and converted in the brain into sensations which furnish a sense of movement and locality, a sense of pain, and a sense of heat and cold. (*See* TOUCH.)

The connection between the sensory and motor systems of nerves is important. The simplest form of nerve action is that known as *automatic action*. In this a part of the nervous system, controlling, for example, the lungs, goes on rhythmically, making discharges from its motor cells sufficient to keep the muscles of respiration in regular action, influenced only by occasional sensory impressions and chemical changes from various sources, which increase or diminish its activity according to the needs of the body.

In *reflex action* the parts engaged are a sensory ending, say in the skin; a sensory nerve leading from it to the spinal cord, where it ends by splitting up into processes near the nerve-cells; a nerve-cell which is stimulated by the sensory impulse, and which immediately sends a motor impulse down its nerve; and a muscle which contracts as the result. A simple example of reflex action is given by the drawing away of the hand when it is pricked with a pin, before and independently of the conscious perception of pain.

Voluntary acts are more complicated than reflex ones. The same mechanism is involved, but, in addition, the controlling power of the brain is brought into play. This exerts first of all an 'inhibitory' or blocking effect, which prevents immediate reflex action, and then the impulse, passing up to the cerebral hemispheres, sets up activity in a series of cells there, the complexity of these processes depending upon the intellectual processes involved. Finally, the inhibition is removed and an impulse passes down to motor cells in the spinal cord, and a muscle or set of muscles is brought into play through the motor nerves.

The *trophic function* of nerves is another most important part of their activity, for it appears as if the constant passage of nerve impulses down the nerves of any part were important for its nutrition. Thus, if sensory nerves be diseased or injured, ulceration of the skin, bed sores, and other changes are liable to occur, while muscles waste and disappear if their motor nerves be permanently destroyed.

Nervous system.—The brain and its twelve pairs of cranial nerves are treated under BRAIN; the spinal cord and the origin of its thirty-one pairs of nerves are treated under SPINAL CORD.

Each of these spinal nerves arises by two roots, the posterior being larger than the anterior, and being furnished with a ganglion. Just before they emerge from the side of the spinal canal, the two roots unite to form a single nerve, their fibres mix, and then the nerve separates into two divisions.

One division immediately turns backwards to supply the skin and muscles of the back (posterior division), the other runs forwards (anterior division).

These anterior divisions supply the skin on the front and sides of the body and on the limbs, as well as all the muscles of the trunk and limbs, excepting those on the back. They do not run straight to these parts, but form a series of plexuses in which the nerve-fibres from different levels of the cord are mingled, and from which the nerves to the limbs are given off. The upper four cervical nerves unite to produce the *cervical plexus*. From this the muscles and skin of the neck are mainly supplied, and the phrenic nerve, which runs down through the lower part of the neck and the chest to innervate the diaphragm, is given off. The *brachial plexus* is

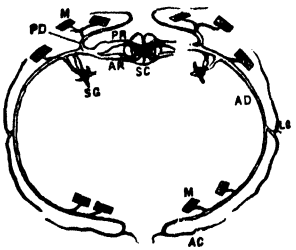


FIG. 345.—Diagram of the arrangement of a pair of nerves in the region of the chest. *SC*, Spinal cord; *AR*, anterior nerve root; *PR*, posterior root with its ganglion; *PD*, posterior division; *AD*, anterior division, which runs round beneath its corresponding rib as an intercostal nerve; *AC*, its anterior, and *LC*, its lateral branches to the skin; *M*, branches to the muscles of the chest; *SG*, ganglion of the sympathetic system connected with the anterior division. (Turner's *Anatomy*.)

formed by the union of the lower four cervical and first dorsal nerves, and, in addition to nerves which proceed to some of the muscles in the shoulder region, and others to the skin about the shoulder and inner side of the arm, it gives off the following large nerves that proceed down the arm; the musculo-cutaneous nerve, the median nerve, the ulnar nerve, and the musculo-spiral nerve, each of which is about the size of a goose-quill. The musculo-cutaneous nerve supplies the large muscles in front of the upper arm, as well as the skin on the radial side of the forearm as far as the wrist. The musculo-spiral nerve winds round the back of the upper arm, where it supplies the triceps muscle, and then gives branches which innervate the skin on the outer side of the arm and forearm, the muscles behind the forearm, and finally the skin on the outer part of the back of the hand and fingers. The median nerve and the ulnar nerve run through the upper arm without giving off branches, and it is possible to feel the ulnar nerve as a cord running between the two marked bony prominences behind the elbow. The median nerve supplies most of the muscles in front of the forearm, a few of the small muscles in the hand and the skin of the palm and front of the thumb, index finger, middle finger, and half of the ring finger. The ulnar nerve supplies two muscles in the forearm, most of the small muscles in the hand, and the skin down the inner side of the forearm and palm and the skin in front of the little finger and half the ring finger.

The *thoracic* or *dorsal nerves*, with the exception of the first, do not form a plexus, but each runs round the chest along the lower margin of the rib to which it corresponds, while the lower six extend on to the abdomen. In this course they supply both the skin and muscles of the trunk.

The *lumbar plexus* is formed by the upper four lumbar nerves, and its branches are distributed to the lower part of the abdomen, and front and inner side of the thigh.

The *sacral plexus* is formed by parts of the fourth and fifth lumbar nerves, and the upper three and part of the fourth sacral nerves. It gives branches directly to the muscles and skin about the hip and fork, and the small sciatic nerve which supplies the skin down the back of the thigh, but the main bulk of the plexus is collected into the great sciatic nerve. This, the largest nerve in the body, is buried in the muscles on the back of the thigh, which it supplies. It continues down to the back of the knee, and there divides into two branches, the internal popliteal nerve, and the external popliteal nerve, which between them supply all the muscles below the knee and the greater part of the skin covering the leg and the foot.

The *sympathetic system* is joined by a pair of small branches given off from each spinal nerve, close to the spine. This system consists of two great parts. There is first a pair of cords running down on the side and front of the back-bone, and containing on each side three

ganglia in the neck, and beneath this a ganglion opposite each vertebra. From these two ganglionated cords numerous branches are given off, and these unite in the second place to form plexuses connected with various internal organs, and provided with numerous large and irregularly placed ganglia. The chief of these plexuses are the cardiac plexus, the solar or epigastric plexus, the diaphragmatic, suprarenal, renal, spermatic, or ovarian, aortic, hypogastric, and pelvic plexuses, the name in each case indicating the organ upon which, or part of the abdomen within which, the plexus is placed.

NERVE INJURIES are produced by several causes. Continued or repeated severe pressure may be enough to damage a nerve seriously, as in the case of a badly made crutch pressing into the armpit and causing drop-wrist. Bruising due to a blow which drives a superficially placed nerve against a bone may inflict severe damage upon a nerve such as the musculo-spiral nerve behind the upper arm. A wound may sever nerves with other structures, and this accident seems specially liable to occur to the ulnar nerve in front of the wrist, owing to falls upon broken glass, and to various nerves in the armpit when the humerus is fractured near its upper end. Exposure to cold may also damage a nerve severely, as in the case of the facial nerve, when Bell's paralysis results. Or a nerve may be injured at its origin before it leaves the brain or cord, by hæmorrhage in the substance of these organs.

Symptoms.—When a sensory nerve is injured, sensation is immediately more or less impaired in the part supplied by the nerve, and when the nerve in question is a motor one the muscles governed through it are instantly paralysed. In the latter case, the portion of nerve beyond the injury degenerates and the muscles gradually waste, and lose their power of contraction in response to electrical applications. Finally, deformities result and the joints become fixed. This is particularly noticeable when the ulnar nerve is injured, the hand and fingers taking up a 'claw-like' position. The skin may also become cold, glossy, and even ulcerate, owing to the loss of its nerve supply.

Treatment.—The nerve, if wounded, should be carefully stitched with the ends touching one another, and, if injured by other causes, should be carefully protected from a repetition of the injury. In some cases recovery takes place within a few days, but usually, if the nerve be completely severed or seriously injured, the muscles supplied by it do not regain their power for several weeks at least. The reason of this is that the part cut off from connection with the brain and cord degenerates rapidly, and the new nerve has to grow all the way down the sheath of the old one. (*See* NERVES.) An operation designed to unite a damaged nerve and relieve paralysis may sometimes be successfully performed even some weeks or months after the wound has closed. When the ends of the damaged nerve are so shortened that they cannot be got to meet, a portion of a sensory nerve or of a nerve from an animal is sometimes inserted and carefully stitched between the divided ends. Nerve anastomosis is also sometimes practised by bringing the ends of the divided nerve up to a neighbouring nerve and carefully stitching them within its sheath. For example, the facial nerve when injured at the side of the face is sometimes anastomosed with the healthy hypoglossal nerve, and the facial paralysis which has resulted is thus relieved. Massage and galvanism of the muscles will keep them from wasting till the nerve is ready to take up its functions again. The power of the muscles to react again to faradic electricity is a most important sign, as showing that repair of the nerve is taking place.

NERVOUS DEBILITY (*see* NEURASTHENIA).

NERVOUS DISEASES.—This class of disease is one of the most difficult of diagnosis, and frequently the most unpromising, as regards treatment, of all bodily affections. The brain and spinal cord being enclosed in the skull and spine, beyond the reach of direct examination, and the nerves being almost everywhere deeply buried in the tissues, the nature of nervous diseases must be made out from the disturbances of organs governed by the affected nerves.

The following conditions are treated of under their proper headings:

APHASIA, APOPLEXY, BRAIN DISEASES, CATALEPSY, CRAMP, DISSEMINATED SCLEROSIS, ECSTASY, EPILEPSY, FORGETFULNESS, HYSTERIA, INSANITY, LOCOMOTOR ATAXIA, MENTAL DEFECTIVENESS, NERVE INJURIES, NEURALGIA, NEURASTHENIA, NEURITIS, PARALYSIS, ST. VITUS'S DANCE, SPINAL CORD, DISEASES OF.

Causes.—Many factors contribute to the production of nervous diseases. That certain diseases are induced by a particular temperament, or by peculiar habits of life, is proved by the fact that some of the diseases are commoner among one race, others in another people. Heredity is in several ways an important matter. Some persons, particularly those of great intellectual power, and of artistic temperament, seem born with a nervous constitution (*see* CONSTITUTION) which renders them more than ordinarily liable to the slighter nervous affections, such as headaches, neuralgia, hysterical manifestations, and bizarre forms of mental activity. Those also who come of a degenerate stock seem to suffer very readily from nervous diseases of a severe type, probably not because these diseases are inherited, but because the nervous system is specially exposed to strain by the conditions of modern life, and, in such persons, gives way early. The great pressure at which modern commercial and intellectual life is carried on tends, undoubtedly, to exhaust the nervous system and bring on many diseases, such as neuralgia, neurasthenia, digestive disturbances, and various forms of insanity. To counteract this a periodic rest and change of scene is of special importance, especially to those of nervous temperament and those subjected to much strain in life.

Shocks both to mind and body, such as the loss of a relative, money reverses, an unfortunate love affair, a railway accident, may be the starting-point of many chronic nervous complaints. The nervous system seems to be specially open to such injury about the critical periods of life (*see* CLIMACTERIC), while in young children the nervous system is always of a less stable character than in later life.

Many poisons, both of those produced within the body by disease and of those taken in from outside, have a specially harmful action upon the nervous system. Chief among these stands syphilis, which plays an important part in the production of locomotor ataxia, general paralysis, and certain tumors (gummata) of the brain and spinal cord, while in advanced life it leads to degenerative changes that bring about premature loss of mental power. Chronic alcoholism may cause severe mental derangement and multiple neuritis. Lead-poisoning and diabetes are often accompanied also by multiple neuritis. Several of the acute infectious diseases, such as diphtheria, enteric fever, and influenza, are apt to be followed by loss of power in parts, due to affection of the nervous system, though such results are in general only temporary. The form of paralysis which affects children, and is known as infantile paralysis (*see* PARALYSIS), is also due to an infective process.

As to the changes in the nervous system which are caused by disease, and to which the symptoms are due, these are various in nature. There is a broad division of nervous diseases into 'organic', in which some change, visible either to the naked eye or on microscopic examination, is discoverable in the nervous system after death, and 'functional', in which no discovery can be made. Into the latter class there fall, for example, hysteria, anxiety states, many cases of epilepsy, and many cases of neuralgia. Among the 'organic' changes, one of the commonest is 'sclerosis', consisting of an overgrowth of the connective tissue framework of the brain, cord, or nerves, accompanied by a disappearance of the nerve structures proper. Tumors, cysts, rupture or blocking of blood-vessels (with consequent loss of nutrition in a part of the nervous system), and local inflammatory processes may all be found constituting an 'organic' change. In all cases the symptoms are dependent, not so much upon the nature of the disease as upon the part of the nervous system which it happens to affect.

Symptoms.—Many slight affections of the nervous system are attributed to defects in the organs controlled by the affected nerves; for example, dyspepsia or palpitation may in some cases be due to weakness of the nervous system, and is then little or not at all benefited

by remedies directed towards the heart, stomach, or other organ in which the symptoms are manifested. It is specially important, therefore, that cases in which the nervous system is at fault should be early recognised.

There are two great symptoms of nervous disease, viz. (1) disturbances of sensation in the direction either of loss of feeling, or of great pain, or of perverted sensation, such as tingling, hot flushes, etc.; and (2) the occurrence of more or less complete paralysis of groups of muscles, or of whole limbs. One or other of these types of symptoms predominates, according as sensory or motor nerves are chiefly affected. In addition to these, there is in different diseases more or less interference with the organs of special sense, the reflex actions, the nutrition of outlying parts of the body, and the functions of internal organs.

With regard to *sensory symptoms*, loss of the sense of touch is found in locomotor ataxia, angular curvature of the spine, and, generally speaking, all maladies in which the posterior part of the cord or sensory nerves are affected. Syringomyelia is a disease affecting the central portion of the spinal cord, and characterised by loss of the power to feel pain and to recognise heat and cold in parts of the limbs. Painful sensations are present in many diseases, as, for example, shooting pains in locomotor ataxia, and the feelings of a tight band round the waist in this disease, in disseminated sclerosis, and in some other conditions.

As to *motor symptoms*, wasting of muscles and loss of power in parts of the body point usually to some affection of the motor nerves. Spasm as well as loss of power accompanies affections situated in the higher motor tracts of the brain and spinal cord, while flaccid palsy characterises diseases and injuries in the grey matter of the cord or in the motor nerves. Conditions in which the nervous system is merely temporarily weakened are manifested by loss of 'tone' in the muscular system, and speedy exhaustion on exertion. Twitchings in the muscular fibres, as in the condition popularly known as 'live flesh' in the eyelids, are also found in this passing condition. as well as in more serious conditions, such as at the onset of progressive muscular atrophy. The impairment of the power of combination among muscles, known as 'inco-ordination', which produces trembling on exertion, staggering gait, difficulty in buttoning the clothes or in taking food, etc., is found in disseminated sclerosis, St. Vitus's dance, and trembling palsy. Affecting the lower limbs, interference with the power of regulating the movements is a common symptom of locomotor ataxia.

The *reflex functions*, tested by stroking the skin of various parts and observing the resulting muscular contraction beneath (superficial reflexes), and by tapping the tendons of muscles and watching the twitch that the latter give (deep reflexes), are, generally speaking, diminished when the sensory nerves, sensory paths in the spinal cord, or motor cells in the cord and their fibres are affected. They are increased when the higher motor paths in the cord are affected, as in disseminated sclerosis, and in some diseases, like hysteria, associated with defective nerve control.

Nutritional functions are impaired in all serious nerve diseases and injuries. As a result, localised sweatings, a glassy condition of the skin, bed sores, ulcers, and even gangrene of limbs are liable to appear in the final stages of nervous maladies.

The *functions of the internal organs*, being, as a rule, governed by the sympathetic system, are not in general affected unless this system be diseased. The movement of the bowel and bladder is, however, governed by spinal nerves, and thus these natural functions are impaired in all serious diseases of the spinal cord, so that difficulty of voiding or of retaining the stools and urine appears in such cases.

When the *cranial nerves* proceeding from the brain are involved, very definite symptoms arise. Thus affection of the 1st nerve gives rise to loss of smell; of the 2nd nerve to impairment of vision; of the 3rd, 4th, and 6th nerves to squints; of the 5th nerve to neuralgia; of the 7th nerve to Bell's paralysis; of the 8th nerve to deafness or giddiness; of the 9th nerve to loss of taste; of the 10th nerve to affections of the larynx, the heart, and the stomach; of the 11th nerve to disordered action of the sterno-mastoid muscle, causing wry-neck; and of the 12th nerve to interference with

the movements of the tongue, and consequent difficulty in pronunciation. Many of these symptoms are treated of elsewhere.

Lumbar puncture and the examination of fluid withdrawn from the spinal canal is of great importance in the diagnosis of many serious nervous diseases. (*See* LUMBAR PUNCTURE.)

Treatment.—Rest, which gives an opportunity for repair to the worn-out tissues, is the great remedy in all types of disease due to overstrain of body or mind, shock, or inflammatory processes. Rest in its widest sense includes not merely cessation of activity, but suitable food, change of employment, and, it may be, active exercise in persons who have usually much mental work. Certain drugs, such as bromides, henbane, and Indian hemp have the power of dulling the activity of the nervous system, while others, such as strychnine, increase its excitability, and the administration of drugs, on one or other of these lines, often is useful in assisting the curative efforts of nature. These effects too are sometimes aided by such devices as cold applications to the head and back, and by baths. Where changes in the nervous system are the result of poisons, such as those of syphilis or lead, appropriate drugs hasten their expulsion from the body, and thus check the progress of the disease. Generally speaking, alcohol has a prejudicial effect in all forms of nervous disease, and particularly is this true in those diseases like multiple neuritis, which are caused by it, and in which its use must be absolutely stopped. Various forms of electrical application have been employed in the treatment of nervous disease, and the routine use of this form of treatment appears often to be of considerable benefit. (*See* ELECTRICITY IN MEDICINE.) There is no department of medicine in which the sub-conscious moral influence of a self-reliant and expert physician is more marked than in the treatment of functional nervous disorders, and the confidence reposed in the medical adviser and in the treatment employed is often sufficient, in these cases, to start the patient upon the road to improvement, which it requires only time, rest, and the constant exercise of a certain amount of will-power to complete.

NERVOUS IMPULSE.—The work of Professor Otto Loewi and of Sir Henry Dale (elected P.R.S. in 1940) has thrown new light on the transmission of nervous impulses. Briefly, the effects of nervous activity are now believed to be in all cases transmitted chemically, by the formation at nerve-endings of chemical substances. When, for example, a nerve to a muscle is stimulated there appears at the junction of nerve-ending and muscle the chemical substance acetylcholine. Acetylcholine appears at the endings of the parasympathetic nerves and transmits the effect of the parasympathetic impulse. When an impulse passes down a sympathetic nerve the effect of it is transmitted at the nerve-ending by the chemical liberated there—adrenaline or an adrenaline-substance.

NETTLE-RASH, or URTICARIA, is a disorder of the skin characterised by an eruption resembling the effect produced by the sting of a nettle, namely, raised red or red and white patches occurring in parts or over the whole of the surface of the body, and attended with great itching and irritation. It may be acute or chronic.

Causes.—In the acute variety the attack appears to be connected with digestive derangements, or the taking of certain articles of diet particularly of a protein nature, such as various kinds of meat, fish, shell-fish, etc., also occasionally from the use of certain drugs, such as henbane, copaiba, cubebs, turpentine, etc. The chronic variety consists of an eruption similar to that above described, but lasting with interruptions for a length of time, often extending to months or years. This form of the disease occurs independently of errors in diet, and is not attended with the feverish symptoms characterising the acute attack. It is probably connected with constitutional conditions, and is occasionally observed in the gouty.

Symptoms.—In severe cases there is at first considerable feverishness and constitutional disturbance, together with sickness and faintness, which either precede or accompany the appearance of the rash. The eruption may appear on any part of the body, but is most common on the face and trunk. In the former position, it causes swelling and

disfigurement while it lasts, and is apt to excite alarm in persons unacquainted with its nature. The attack may pass off in a few hours, or may last for several days, the eruption continuing to come out in successive patches. Occasionally a similar process takes place in the throat, and there is then considerable danger from blockage of the larynx. (*See also* ALLERGY.)

Treatment.—The acute variety generally yields quickly to a purgative and the use of some antacid, such as magnesia, or bicarbonate of soda. A powder composed of rhubarb, carbonate of bismuth, and soda is useful when taken internally. The local irritation is allayed by sponging with a warm alkaline solution (a teaspoonful of soda or ammonia to a tumblerful of warm water), with Goulard's water, or by rubbing with menthol. In the chronic form, in addition to these remedies, any constitutional morbid condition, such as gout, will demand special attention. When the condition habitually follows on taking a certain article of diet, this should be carefully noted and avoided in future.

NEURALGIA (*νεῦρον*, nerve; *ἀλγέω*, I am pained), literally *nerve pain*, is a term which is frequently employed both technically and popularly in a somewhat loose manner, to describe pains the origin of which is not clearly traceable. In its strict sense it means the existence of pain in some portion or throughout the whole of the distribution of a sensory nerve, without any distinctly recognisable structural change in the nerve or nerve-centres. This strict definition, if adhered to, however, would not be applicable to a large number of cases of nerve pain; for in many instances the pain is connected with pressure on, or inflammation of the nerve. Hence the word is generally used to indicate pain affecting a particular nerve or its branches, whatever be the cause.

Causes.—It may be generally stated that neuralgia rarely occurs in the midst of good health, its existence betokening, as a rule, a depressed or enfeebled state. Constitutional causes, hereditary or acquired, are among the most powerful of the predisposing influences in its production. Thus it is often found to affect the rheumatic or gouty. In weakened conditions of the system from unsuitable or insufficient food, or as the result of any drain upon the body, or in anæmia from any cause, or when certain disease poisons are present, such as syphilis or malaria, it is common for neuralgia to come on. Further, any strain upon the nervous system, such as mental overwork or anxiety, is a powerful predisposing cause. Among the exciting causes of an attack of neuralgia, by far the most common is exposure to cold and damp, which seems to excite irritation in a nerve already disposed to suffer. But irritation may be produced by numerous other causes, such as bruising of a nerve by a blow, a decayed tooth, diseased bone, local inflammations in which nerves are implicated, or some source of pressure upon a nerve-trunk, such as swelling of the sheath in its passage through a bony canal. Also a foreign body, or even the scar of an old wound, has been found to be sufficient cause of irritation when situated close to a nerve. Further, there are causes of a reflex character which are capable of setting up neuralgia at a distance, such as intestinal or uterine derangements. Those cases in which, after removal of a piece of nerve, inflammatory changes and thickening of the nerve-sheath are found, receive the name of 'neuritis', but, as regards the question of pain, there is no difference between neuritis and neuralgia due to other causes, except that pain caused by neuritis tends to be continuous and is very difficult to treat.

The practical importance of ascertaining the probable nature of the cause is obvious.

Symptoms.—There are few ailments which give rise to greater human suffering than neuralgia, and, though the pain is generally localised, it may spread beyond the area where it first occurs. It is usually of paroxysmal character, and often periodic: that is to say, it occurs at a certain time of the day or night. It varies in intensity, being often of the most agonising character, and again less severe and more of a tingling kind. Various forms of perverted nerve function may be found along with or following neuralgia. Thus there may be oversensitiveness of the skin, loss of feeling, paralysis, or alterations of nutrition, such as wasting of muscles, whitening

of the hair, etc. Attacks of neuralgia are apt to recur, particularly when the general health is low, and some persons unhappily continue to suffer from occasional attacks during the greater part of their lifetime.

Varieties.—The nature of the disease will be best described under the names of the forms in which it most commonly occurs. These are facial neuralgia, or 'tic douloureux'; migraine, also known as hemicrania or brow-ague; intercostal neuralgia, and sciatica. Other forms, affecting the arm, neck, etc., are of much less frequent occurrence.

FACIAL NEURALGIA, or TIC DOULOUREUX, is one of the most common forms of neuralgia, and one of the most severe. It affects the great nerve of sensation in the face (fifth nerve), and may occur in one or more of the three divisions in which the nerve is distributed. It is usually confined to one side. Females suffer, on the whole, more frequently than males, and adults or young persons more than children or the aged. Among the more prominent conditions associated with it may be mentioned a low state of health resulting from previous disease, any drain upon the system (such as excessive menstruation, over-lactation, etc.), and, very specially, over-exertion of body or mind and mental anxiety. The attack is often precipitated by the irritation of a decayed tooth or by exposure to cold air. When the *first or upper division of the nerve* is involved, the pain is mostly felt in the forehead and side of the head. It is usually of an intensely sharp, cutting, or burning character, either constant or with exacerbations, and often periodic, returning at a certain hour each day while the attack continues. Occasionally the paroxysms are of extreme violence, and are brought on by the slightest provocation, such as a draught of cool air. The skin over the affected part is often red and swollen, and, even after the attack has abated, feels stiff and tender to the touch. In this, as in all forms of neuralgia, there are certain localities where the pain is more intense, these 'painful points', as they are called, being for the most part in those places where the branches of the nerves emerge from bony canals or pierce the fascia to ramify in the skin. Hence, in this form, the greater severity of the pain above the eyebrow and along the side of the nose. There is also pain in the eyelid, redness of the eye, and flow of tears. When *the second division of the nerve* is affected, the pain is chiefly in the cheek and upper jaw, the painful points being immediately below the lower eyelid, over the cheek-bone, and about the upper lip. This form is accompanied by pain of similar character to that affecting the first division, and the pain often appears suddenly on slight provocation such as by taking a mouthful of hot or cold fluid. When *the third division of the nerve* suffers, the pain affects the lower jaw, and the chief painful points are in front of the ear and above the chin. As a result of this malady important nutritive disturbances may appear in the affected area, such as thickening of the tissues, falling out or blanching of hair, etc., as well as various alterations of sensibility. Attacks of tic douloureux, extremely distressing as they are, may recur occasionally for years; and although, by depriving the sufferer of sleep and interfering with the taking of food, they may in some measure impair the health, they rarely appear to lead to any serious results. Nevertheless, in occasional cases, the pain is so intolerable as to render life a burden.

HEMICRANIA, MIGRAINE, BROW AGUE, and SICK HEADACHE are various terms employed to describe a condition which appears to be of similar nature to neuralgia. In some instances it would seem to be hereditary. It most frequently affects females, and generally occurs in early life, tending to disappear as age advances. An attack may come on suddenly, but, in general, begins by a dull aching pain in the brow or temple, which steadily increases in severity and extent, but remains usually limited to one side of the head. It attains at times an extreme degree of violence, and is apt to be aggravated by movement, loud noises, or bright light. Accompanying the pain, there is more or less of nausea, and when the attack reaches its height vomiting may occur, after which relief comes, especially if sleep supervene. (*See* HEADACHE.)

INTERCOSTAL NEURALGIA is pain affecting the nerves which emerge from the spinal cord and run along the spaces between the ribs to the front of the body. This form of neuralgia affects

the left side more than the right, is much more common in women than in men, and occurs generally in enfeebled states of health. It might be mistaken for pleurisy or some inflammatory affection of the lungs; but the absence of any chest symptoms, its occurrence independently of the acts of respiration, and other considerations establish the distinction. The specially painful points are chiefly at the commencement of the nerve as it issues from the spinal canal, and at the extremities towards the front of the body, where it breaks up into filaments which ramify in the skin. This form of neuralgia is occasionally the precursor of an attack of shingles (*Herpes zoster*) as well as a result of it. (*See* HERPES.)

SCIATICA is another of the more common forms of neuralgia. It affects the great sciatic nerve which emerges from the pelvis and runs down the back of the thigh. It is in many instances traceable to exposure to cold or damp; but there are many other possible causes. Any source of pressure upon the nerve within the pelvis, such as may be produced by a tumor, may excite an attack of sciatica. It is often connected with a rheumatic or gouty constitution. In general, the nerve of one side only is affected. Pressure upon a nerve by a prolapsed intervertebral disk between the 4th and 5th lumbar vertebræ is regarded by many surgeons as a not uncommon cause of pain along the course of the sciatic nerve. In such a case the treatment is operative release of the pressure. The pain, which is felt at first a little behind the hip-joint, steadily increases in severity and extends along the course of the nerve and its branches in many instances as far as the toes. The specially painful points are where the nerve issues from the pelvis at the lower margin of the buttock, and about the knee and ankle joints; besides which a feeling of numbness is sometimes experienced throughout the whole limb. In severe cases all movement of the limb, and particularly the motion of stooping forwards, or of bending the hip with the knee straight, aggravates the pain, and the patient is obliged to remain in bed. In prolonged attacks the limb may waste and be drawn up and fixed in one position. Attacks of sciatica are often attended with great suffering, and are apt to be little benefited by treatment.

Treatment.—With all forms of neuralgia it is of the first importance to ascertain, if possible, whether any constitutional condition is associated with the malady, and, if evidence of the presence of rheumatism, gout, anæmia, etc., be discovered, to administer along with the local remedies for neuralgia, the salicylate of soda, iodide of potassium, iron, etc., required for the constitutional condition.

Naturally also one looks for, and as speedily as possible removes, any source of local irritation, such as a decayed tooth, and also any such reflex source as uterine or intestinal disorder.

During the time an acute attack lasts various local applications give relief, the most useful being, perhaps, hot fomentations containing laudanum applied over the painful part. Bathing with water as hot as can be borne is also beneficial in many cases. Rubbing or painting with anodyne liniment, such as a mixture of the liniments of aconite, belladonna, and chloroform; or a mixture, in equal parts, of chloral, camphor, and menthol, rubbed up together and painted over the part, is very soothing, especially, perhaps, for those cases in which the pain begins as soon as the sufferer gets warm in bed at night. Ointment of aconitine is also recommended by some to be rubbed on the painful spot. Hypodermic injections of morphia or cocaine, although they give temporary relief, are not to be recommended, because of the great danger, in such cases, that their use will become a habit. In the case of purely sensory nerves, like the fifth nerve, injection of pure alcohol into the nerve has a deadening effect and often gives relief for a long time.

Internally, during an acute attack, many remedies are given. Those which are most generally useful, and which may be safely used without any tendency to bring about habitual use, are phenacetin, antipyrine, and other coal-tar preparations. (*See* ANTIPYRINE.) When tic douloureux is the form of neuralgia present, gelsemium and butyl-chloral appear to be specially useful drugs. In cases of migraine, caffeine is particularly recommended. When the neuralgia is of a periodic type, quinine,

n an hour or two before the ex-
ed attack, is the drug which most
nctly gives relief. Among other
;s which are often used, we have
m, belladonna, henbane, chloral,
nide of potassium or of ammonium,
tincture of aconite.

'hen the neuralgia has assumed a
nic type, or when the acute attacks
r with great frequency, a totally
rent type of treatment is in general
isite. The anodyne and depressant
;s mentioned above are then of little
ıanent use, and indeed some of them,
epressing still further the exhausted
ous system, are distinctly hurtful.
tiful nourishment and tonics, such
'senic and strychnine, in these cases
nore often beneficial.

ı regards local measures in the
nic state the application of blisters
ounter-irritation by touching the
with the button-cautery is the
ɛdy most employed. The blister is
e of an oblong shape, with its length
ɜsponding to the line of the nerve,
the spots at which the cautery is
ied generally also follow the affected
e. The use of galvanic electricity
:en beneficial in both the acute and
hronic stage. A weak current should
ɜed, and applications, lasting fifteen
'enty minutes, may be made daily.
negative pole should be applied
ıe neck or back, and the positive
over the course of the painful
e. (*See* ELECTRICITY IN MEDICINE.)
hermy is also frequently employed
soothing effect. (*See* DIATHERMY.)
ıs of various sorts, particularly alter-
hot and cold baths, or douches, and
ıot-air bath are also sometimes of
(*See* BATHS, DOUCHES.) Massage,
gh it increases the pain in the acute
ı, may be of great benefit in chronic
ı due to some inflammatory process
.e nerve. In cases of sciatica, par-
arly, great and often surprising
fit is derived from occasional
purgation by a large dose of castor

ıny cases resist all forms of medici-
reatment, and for these the follow-
urgical procedures are often tried.
ɛedling is applicable to large nerves,
as the great sciatic, and is a trifling
practically painless operation, in
h six or eight long needles are
ed from the back of the thigh into
the sciatic nerve or its neighbourhood. They are left in place for twenty minutes or longer, and then withdrawn, and their use is often followed by great benefit. Injections of large quantities of saline solution (20 c.c. or more) into the nerve or into its immediate neighbourhood have a similar beneficial effect, which may be temporary, but which after being repeated several times is often curative.

Nerve-stretching, an operation introduced some fifty years ago, is also mainly used for cases of sciatica. An incision is made through the muscles on the back of the thigh, the sciatic nerve secured and gently stretched with the fingers. The operation is often successful in those cases which are due to some inflammation in the nerve accompanied by the deposit of new fibrous tissue, which is torn down by the act of stretching.

Division and removal of a portion of the nerve, or injection of absolute alcohol into the nerve, is practised in the case of sensory nerves, such as the branches of the fifth nerve on the face. This method is, of course, inapplicable to mixed nerves like the sciatic, which carry not only sensory but also motor fibres, the division of which would cause paralysis. When only one division of the fifth nerve is affected, the operation is a simple one, consisting of an incision on the eyebrow, beneath the lower lid, or on the jaw, to expose the affected nerve; but, when the whole nerve is affected, a formidable operation is necessary, in which the skull is opened and the nerve removed inside it, along with its Gasserian ganglion.

NEURASTHENIA (*νεῦρον*, nerve; *ἀσθένεια*, weakness) means a condition of nervous exhaustion in which, although the patient suffers from no definite disease, he becomes incapable of sustained exertion. The condition is closely allied to several unusual mental states, such as hypochondriasis and hysteria, and there is no sharp line between neurasthenia and hysteria, intermediate cases of every grade being met with. To these conditions the general name of neuroses is given.

Causes.—The condition comes on much more readily in some persons than in others, and people who in middle

life suffer from neurasthenia have often shown other nervous manifestations in youth. It must not be supposed that persons who suffer from neurasthenia do so because they have worn out the store of 'nerve-force' with which they start life; but, just as in commercial life persons with a small capital must be content to do a moderate business, so the nervous organisation of some people is capable of producing nerve-energy only at a moderate rate, and such persons must avoid the full strain and competition of life. Granted that a person has such a nervous constitution, overstrain in business or through intellectual efforts, loss of relatives, disappointment in love, worry caused by disagreeable family relations or over other matters may be sufficient to sink him or her into a condition of neurasthenia. On the other hand, a luxurious and care-free life, which provides no training for the nervous system, often renders a person liable to succumb to some slight worry or shock which would have no effect upon a more tried nature. Cases of this sort are generally on the borderland of hysteria. Another fruitful cause of neurasthenia is found in injuries of the head and back received in situations likely to cause great anxiety or fright, such as railway accidents. Indeed slight forms of neurasthenia due to this cause are often known as 'railway spine', and severe examples are afforded in cases due to shell-shock or accidental burial. A disturbing factor which often prolongs such a case of neurasthenia is found in the settlement of its financial side. When the manifestations of neurasthenia follow an accident for which the injured person claims 'damages' or compensation, the symptoms are apt to last for an unusual length of time and to disappear quickly as soon as the claim is settled. In many such cases the mental uncertainty is a real source of aggravation of the disorder, but in other cases there is a strong element of conscious malingering. (*See also* SHELL-SHOCK.)

Symptoms.—The most prominent and constant symptom is that of weakness and weariness on exertion. The person may feel fresh enough in the early part of the day, but after very slight effort he becomes exhausted, and trembles. The appearance changes, the person becoming puffy under the eyes, sallow and bloodless. Generally, the neurasthenic person loses appetite and digestive power and becomes painfully thin as well as weak, but in some cases the change is towards a fat, flabby habit of body. A condition of 'irritable weakness' develops throughout the body, in the heart, stomach, bowels, and other organs so that the person suffers from palpitation, loss of appetite with dyspepsia after taking the simplest food, and griping pains in the abdomen, generally associated with obstinate constipation. As a result colitis is apt to appear in neurasthenics, and this by leading to further poisoning of the system prolongs the disease and makes its treatment more difficult. Though in the early stages the person may be overcome with sleep when tired, sleeplessness is a wearisome symptom later on. The temper changes also, the sufferer becoming, as a rule, intensely irritable and emotional. Another mental peculiarity is a failure to distinguish trifling from essential things, so that the neurasthenic becomes worried by the smallest incidents and a prey to groundless fears and to anxiety over unlikely misfortunes, rendering himself thus unfit for transacting business. In the case of women especially, the patient becomes convinced of her inability to do anything, and broods over it till she becomes a helpless or even bedridden invalid. The urine in these cases deposits a great quantity of phosphates or urates, so that the condition is sometimes mistaken for gout.

In those cases due to shell-shock or to other severe accident, in addition to headache, mental irritability, exaggeration of the reflexes, easily induced fatigue and shakiness on making an effort, severer symptoms such as paralysis of one or more limbs, stammering, blindness, partial or complete deafness or dumbness may occur. These are, however, all of a 'functional' nature and pass away under treatment.

Treatment.—In early and slight cases, a complete holiday, with the cessation of all business and intellectual work, is often sufficient in a month or two to bring about a cure. The person should always leave home for a new environment, and, generally speaking, the cares and associations of daily life should be cut off by a complete severance for a

time from relatives and friends. An attempt should be made to stimulate the appetite by tonics, fresh air, etc., and the amount of exercise must be proportional to the food taken, growing more vigorous as the appetite improves. The treatment of constipation and sleeplessness is also of great importance.

In those cases where thinness and loss of appetite are marked features, so that physical effort becomes a great burden, the form of feeding known as Weir-Mitchell treatment is often advantageous. Briefly put, this consists of: (*a*) complete rest in bed with entire absence of physical and mental effort; (*b*) feeding, which begins with small quantities of milk, and is gradually increased as the digestion will stand it, till the patient takes three full meals of highly concentrated food every day; and (*c*) regular massage, by an attendant, which takes the place of exercise in causing muscular waste and thereby permitting of the digestion and assimilation of food, but is unaccompanied by any discharge of nervous energy. This treatment is continued for one or two months, and is often attended by surprising benefit. For the headaches and for sleeplessness, bromide of sodium or of ammonium in small doses (5 grains) frequently repeated is the most useful drug. For sleeplessness, veronal or sodium veronal is also used. The class of patient who is suffering from anxiety or morbid apprehension is especially improved when the cause of anxiety can be discovered and removed. In cases of accident this is often achieved by a financial settlement of any outstanding claim. In cases with functional blindness, deafness, paralysis, etc., striking results are sometimes obtained by hypnotism, or by forcible suggestion. But recovery brought about by these methods is often only temporary. They do little more than remove an outstanding symptom of a deep-seated disorder, the nature of which should be unearthed by psychological analysis. Either complete Freudian psychoanalysis or other forms of psychological analysis are now looked upon as necessary in the treatment of any functional nervous disorder which is incapacitating.

After the course of treatment is over, in severe cases a change of scene or long sea voyage may be necessary before the person takes up the ordinary routine of life.

NEURECTOMY (*νεῦρον*, nerve; *ἐκτομή*, excision) is the term applied to an operation in which part of a nerve is excised, for example, for the relief of neuralgia.

NEURILEMMA (*νεῦρον*, nerve; *λέμμα*, sheath) is the name of the thin membranous covering which surrounds every nerve-fibre.

NEURITIS (*νεῦρον*, a nerve) means inflammation affecting a nerve or nerves which may be localised to one part of the body, as, for instance, in sciatica, facial neuralgia due to this cause, etc., or which may be general, being then known as 'multiple neuritis', or 'polyneuritis'. Owing to the fact that the most peripheral parts of the nerves are usually at fault in the latter condition, viz. the fine subdivisions in the substance of the muscles, it also frequently receives the name of 'peripheral neuritis'.

Causes.—In cases of LOCALISED NEURITIS the fibrous sheath of the nerve is usually at fault, the actual nerve-fibres being only secondarily affected. This condition may be due to inflammation spreading into the nerve from surrounding tissues, to cold, or to long-continued irritation by pressure on the nerve, and the symptoms produced vary according to the function of the nerve, in the case of sensory nerves being usually neuralgic pain (*see* NEURALGIA), in the case of motor nerves more or less paralysis in the muscles to which the nerves pass. A typical example of this kind of neuritis is found in neuritis of the facial nerve. (*See* PARALYSIS.)

In MULTIPLE NEURITIS, which is always due to some general or constitutional cause, the nerve-fibres themselves in the small nerves degenerate and break down. Hence the very protracted nature of this malady, since, if recovery takes place, it must be brought about by the growth of new nerve-fibres from the healthy part of the nerve, down the sheath of the nerve, to the muscle. The cause of this degeneration may be said, in general terms, to be in every case some poison either taken into or produced in the body, and circulating in the blood. By far the commonest of these poisons is alcohol, and the disease

especially affects women who are quiet, steady tipplers. The condition also arises in men, though much more rarely, the abuse of alcohol in this sex tending more to produce delirium tremens, from which women are almost exempt. Next in importance comes lead, wrist-drop and other features of neuritis being among the most prominent symptoms of lead-poisoning. (*See* LEAD-POISONING.) Arsenic is occasionally responsible for neuritis, particularly when the effect of arsenic is combined with over-indulgence in alcohol, as in an epidemic of neuritis, due to beer contaminated with arsenic, in the Midlands of England about the year 1900. Bisulphide of carbon, naphtha, and other solvents of india-rubber are apt to produce the disease when inhaled in large quantity by the workmen engaged in india-rubber factories. Those who suffer from diabetes are prone to neuritis, the condition sometimes being the result of deficiency of vitamin B1 in the diet. This deficiency probably also accounts for some cases of alcoholic neuritis. In both diabetes and chronic alcoholism the diet is far from normal. Gout, too, is occasionally accompanied by neuritis. Several of the acute infectious diseases, especially diphtheria and typhoid fever, are apt to be followed by neuritis. The disease known as 'beri-beri' (*see* BERI-BERI) is a form of neuritis which persists in certain localities of the globe, in consequence of vitamin B1 deficiency.

Symptoms.—The chief symptom of a LOCALISED NEURITIS, whether pain or paralysis, has been already stated to vary according to the functions of the nerve. In cases following diphtheria, typhoid fever, or other infective disease, the neuritis of an outlying nerve often shows, as its most prominent and annoying feature, a paralysis of a group of muscles in the arm, leg, etc., leading to weakness of the part concerned. This may cause inability for some months to grasp objects with the hand; to lift the foot in walking, and similar troublesome symptoms. These, however, usually pass off completely in course of time. The area of skin associated with the affected nerve is, in addition, often much changed, becoming glossy, or developing an ulcer, or, especially about the face and trunk, breaking out in 'shingles'. (*See* HERPES.) A case of neuritis of this type may come on very quickly, developing fully in a few days.

MULTIPLE NEURITIS, as a rule, takes longer to show itself, even in the case of diphtheria, seldom developing till two or three weeks after the onset of the trouble in the throat. In most cases it begins with vague pains and tingling in the limbs; weakness and wasting of the muscles in the feet and legs, in the hand and arms, or in other parts, following later. Wrist-drop, the peculiar 'steppage' gait in which the person lifts his feet as if he were constantly stepping over small obstacles, squinting, loss of voice, difficulty of breathing, enfeeblement of the heart's action appear according to the muscles whose nerves are affected. There is usually some loss of sensation in scattered areas over the skin, but a very characteristic sign, in the alcoholic form of neuritis at least, is that the muscles are extremely tender when squeezed. There is almost always some swelling of the feet, and in the neuritis of beri-beri, dropsy is often a very marked symptom. The knee jerks and other deep reflexes are generally lost in all forms of neuritis, if severe in character. A peculiar feature of alcoholic neuritis is the wandering delirium from which the patient often suffers, her imagination conjuring up the most vivid delusions as to journeys she is making, and the mind being quite confused in matters regarding time and place especially.

The course of the disease is, as stated above, usually very slow, and particularly is this the case when a poison, as in the case of alcohol or lead, has been taken into the system over a long period. Months, or even a year or two, may elapse in one of these cases before the health is restored. The ultimate hope of recovery is, however, good. Except in the case of beri-beri, which is fatal unless treated, and in those cases of poisoning by alcohol, or of diphtheria, in which the mechanism of the heart or that of respiration becomes affected, the mortality is low.

Treatment.—For the treatment of LOCALISED NEURITIS see under NEURALGIA.

The first essential in the treatment of MULTIPLE NEURITIS is to discover and remove the cause by which the nerves

are being poisoned. Particularly does this apply to alcoholism, lead-poisoning, and neuritis due to manufacture of india-rubber. In the case of alcoholism there is always present the moral difficulty of preventing the patient from obtaining fresh supplies of stimulants, so that treatment must be carried out in a hospital or nursing home. Rest in bed is the next essential to prevent over-fatigue of the weakened nerves and muscles. In the early stages, the muscles are too tender to permit of much handling, but, later on, massage helps to prevent wasting of muscles, and the deformities which arise through fixation of the joints in one position. These deformities must be prevented as far as possible during the earlier stages by frequently changing the position of the patient's limbs as he lies in bed. Electrical treatment may also help as recovery advances. The use of strychnine or of iodide of potassium is helpful, and much benefit is sometimes gained from injections of vitamin B1 or administration of foods containing it, such as Bemax or Marmite.

NEUROGLIA (*νεῦρον*, nerve; *γλία*, glue) is the name applied to a fine web of tissue and branching cells which supports the nerve fibres and cells of the nervous system.

NEUROLOGY is the name given to that branch of medical practice and science which deals with the nervous system and its diseases.

NEUROMA (*νεῦρον*, nerve; *-oma*, termination meaning tumor) means a tumor connected with a nerve, such tumors being generally composed of fibrous tissue, and of a painful nature.

NEURONE (*νεῦρον*, nerve) is the name given to a single unit of the nervous system consisting of a nerve cell with its various processes and the nerve fibre or fibres to which it gives origin. As applied to the motor part of the nervous system, two neurones are specially recognised: the *upper neurone*, which includes a cell on the surface of the brain and a fibre extending down into the spinal cord; also a *lower neurone*, which consists of a cell in the grey matter of the cord with a nerve fibre extending outwards to end in a fibre of the muscle with which it is connected. The former has a controlling influence over the latter, while the latter is more directly concerned with the changes that result in the contraction of the muscle fibre and with nutritional influences over it.

NEUROSIS (*νεῦρον*, nerve) is a general term applied to any nervous disease, but especially to disorders of the function of parts of the nervous system not dependent on any discoverable disease or injury. (*See* NERVOUS DISEASES, HYSTERIA, NEURASTHENIA.)

NEUROTIC is a general term of indefinite meaning applied to a person of nervous temperament, whose actions are largely determined by emotions or instincts rather than by reason.

NEVUS (*see* NÆVUS).

NICOTINE is the active principle, of a fluid nature, upon which the action of tobacco depends. (*See* TOBACCO.)

NICOTINIC ACID has recently been isolated as a part of the vitamin B 'complex'. It is known as the pellagra-preventing factor of vitamin B, and absence of it from the diet is largely responsible for this disease.

NIGHT BLINDNESS is a condition in which a person becomes blind in dim lights, although able to see quite well in the full glare of sunlight or artificial light, in some cases inherited and in others the result of an insufficiency of vitamin A in the diet, this vitamin being essential for the formation of visual purple.

NIGHTMARE (*see* SLEEP).

NIGHT SWEATS consist in copious perspiration occurring in bed at night and found in conditions of general weakness, especially in tuberculosis.

NIGHT TERRORS form a kind of nightmare in children of nervous temperament. (*See* SLEEP.)

NIKETHAMIDE (*see* CORAMINE).

NIPPLES, DISEASES OF (*see* BREAST, DISEASES OF).

NITRATE OF POTASSIUM is the technical name for nitre. (*See* NITRE.)

NITRATE OF SILVER, also known as LUNAR CAUSTIC, is a heavy crystalline salt of silver, very soluble in water, and generally prepared in sticks. In weak solution it has a strong astringent action, and in the pure form it acts

as a powerful caustic. It is very slowly discharged from the system, and, if used for any great length of time, it is apt to produce a brown discoloration of the skin all over the body, known as 'argyria'.

Uses.—Locally it is used as a caustic, acting painlessly on warts, etc. As an astringent it is used in many inflammatory conditions of mucous membranes, in the form of gargles, sprays, and douches, usually in the strength of about ½ to 2 grains to the ounce of distilled water, but often stronger. Its local action can be checked, and any pain it may cause can be stopped by simply moistening the part and placing common salt upon it. It is much used to drop into the eye in cases of conjunctivitis, the usual strength for this purpose being from ½ to 1 per cent. Internally, nitrate of silver is given in small doses in pills to exert an astringent action upon the stomach and bowels in gastric ulcer, and in diarrhœa due to intestinal ulceration. It was formerly also used in nervous diseases.

NITRE (*νίτρον*, natron or mineral alkali, with which nitre has been confounded), also known as SALTPETRE (*sal petræ*—salt of the rock), NITRATE OF POTASSIUM, and, in the form of sticks, as SAL PRUNELLE, is a crystalline substance of a sharp saline taste, found native in India, Persia, and other places. It is very irritating to the stomach and is not now used internally, but is of great use for inhalation in the treatment of asthma, since the nitrate in burning gives off nitrites. Two and a half ounces of the saltpetre are dissolved in a tumblerful of water, and squares of thin white blotting-paper, or bibulous paper about 6 inches in diameter, are dipped in this brine and then allowed to dry. When used they are folded like a tent, set on a plate, and lighted at the edges. Several of these burned in the room of a person suffering from asthma generally give speedy relief.

NITRIC ACID is one of the strongest of the mineral acids, and is a clear, heavy liquid, becoming brownish with age. It is kept in dark, stoppered bottles, and immediately the stopper is removed from the bottle, irritating white fumes are given off.

Action.—In its pure state, nitric acid acts as a powerful caustic upon the tissues of the body, which it turns a bright yellow colour. In weaker solution it is, like all acids, an antiseptic, but is very irritating. Internally, in small doses it has a stimulating action upon the gastric mucous membrane.

Uses.—Nitric acid is one of the most effective caustics for warts, and is also used as a powerful antiseptic and caustic for destroying foul ulcers which threaten to spread, leaving clean ulcers in their place. It is applied to warts drop by drop with a glass rod, and its action can be checked by applying similarly a few drops of solution of common salt.

NITRITES are salts which have a powerful effect in paralysing the action of involuntary muscle, and they therefore dilate the blood-vessels, and check spasm of all sorts. The most commonly used nitrites are nitrite of amyl, of ethyl, and of sodium. Erythrol-tetranitrate and nitroglycerin have a similar action. (*See* NITROGLYCERIN.)

NITROGENOUS FOODS are those that contain a large proportion of protein (albuminous) material in their composition. Generally speaking, this class comprises the foods of animal source, though some vegetables, notably the pulses, contain large quantities of protein. The use of a certain amount of nitrogenous food is necessary to the system, as from this source alone can the body derive all the building material it requires to repair daily waste. (*See* DIET.) Even carbohydrate foods contain a certain amount of protein (*see* FARINACEOUS FOODS), but if all the necessary protein were to be obtained from these it would incur the waste of much starch, or its formation into fat in the bodily tissues. Hence the main value of a mixed diet. The nitrogenous foods may be grouped as follows:

Meat, including beef, mutton, pork, and other forms of flesh, poultry, game, and the internal organs.
Jellies.
Soups and beef-extracts.
Fish.
Milk and cheese.
Eggs.
Pulses and other nitrogenous vegetables.

Meat in structure consists of long

cylinders of semi-fluid, protein material enclosed in thin, fibrous tubes, and known as muscle fibres. (*See* MUSCLE.) These are bound together by fibrous tissue, enclosing more or less fat in its

FIG. 346.—A muscle fibre dividing up into fibrils. (Turner's *Anatomy*.)

meshes. The protein material consists mainly of myosin, which clots when the muscle dies, and contains also albumin and hæmoglobin. In addition, there are several chemical substances which can be extracted by steeping the meat in hot water, and which are therefore known as 'extractives'. To these the flavour of meat is due, and the varying taste of different meats is to be explained by slight chemical differences in the extractives present. The feeding and habits of animals have much to do with these differences, and explain the variety in taste between the flesh of wild and tame rabbits, and of grouse and poultry. The shape of the muscle fibres has much to do with the digestibility of meat, short or fine fibres, as in poultry, haddock, and whiting, being the most quickly dissolved. The fatness of meat has even more to do with its digestibility, pork, duck, and goose, which are very fat, being notoriously indigestible. The liver, kidneys, and heart of animals, being of dense structure, are very difficult to digest; while liver and kidney, which contain much nuclein, a substance closely allied to uric acid, are bad for gout. Sweetbreads and tripe, being held together by loose connective tissue, are, on the other hand, quickly digested, and therefore highly suitable for invalids.

Jellies contain little but gelatin, obtained from the fibrous tissue of meat, sinews, etc., and when made with a large quantity of water, *i.e.* weak in gelatin, they are very easily digested. Gelatin is of little or no use as building material, but it spares the proteins of the body even more than starchy foods do, and hence jellies form excellent articles of diet for invalids, particularly during fevers.

Soup consists of a small quantity of gelatin, fat, salts, and extractives in hot water. To make soup or beef-tea from meat does not remove the nutritious materials, though it extracts all the flavour and hardens the meat. Clear soup contains practically no nourishment, though it is highly stimulating to the digestion by reason of the extractives it contains. Thick soup is nutritious only by reason of the vegetables and gelatin added to it. The same is true of the extract of meat introduced by Baron Liebig in 1865, and of its many more recent imitations. Each pint of beef-tea made from this extract represents the salts and extractives in about half a pound of lean meat, though it contains little or none of the nutritive materials. Its use is valuable, because it has great stimulating power upon the system, and appears to play an important part in helping on the processes of nutrition. It is very useful, therefore, in fevers and in feeble conditions, when little food is needed, or when the digestive powers are very weak. Beef-juice, obtained by chopping meat up finely, mixing with a little water and squeezing out cold, is quite another article, and contains a large proportion of the nutritive materials as well as extractives.

Fish is both less stimulating and less nourishing than meat, because it contains little extractive material, and is much poorer in proteid material than the latter. Haddock and whiting are among the most digestible fish, some of which, like cod, have a coarse fibre, and others, like salmon, are very fat. Herring is one of the cheapest as well as one of the most palatable forms of nitrogenous food, and two herrings contain as much animal protein as need enter into the daily dietary of an ordinary working man.

Milk is practically the only form of animal food in which protein, fat, carbohydrate, and salt are all represented in sufficient amount. It contains 2 to 3 per cent of casein, from which cheese, an almost purely proteid and fatty food, is made; a small quantity of milk-albumin; 4 per cent of fat in the form of a fine emulsion, which gradually rises to the surface as cream; and 4 to 5 per cent of milk-sugar, to the decomposition of which souring of milk is due. (*See* DIET, INFANT-FEEDING, MILK.)

Eggs, each of which contains the material necessary to form a chicken, present the building material for the formation of bone and muscle in an easily convertible form, and the yolks are therefore an excellent food for convalescents, and for weak or rickety children. They do not contain any carbohydrate material, and therefore, to form a good article of general diet, should be mixed with rice, flour, or other cereals, as is done in the shape of puddings. The digestibility is increased when an egg is beaten up with milk or water, and still more when the eggs are lightly boiled. One egg corresponds in nutritive value to about half a tumblerful of good milk, or to about 1 ounce of meat.

Pulses, of which the chief are peas, beans, and lentils, have been called the 'poor man's beef'. This is, however, misleading, because, though they are very cheap, they are not so digestible and are far from being so completely absorbed as meat, while in some persons the gases formed by their decomposition in the bowels give rise to great flatulence. They are also poor in fat, hence the habit of eating them combined with fat foods, as pork and beans, duckling and peas, and butter with beans. Nevertheless, for persons with strong digestive powers, the pulses form a concentrated and valuable form of food.

The necessity for nitrogenous food and the reason for its combination with other foods is described under the article on DIET.

The following table gives the average *percentage composition* of different nitrogenous foods, compiled from various sources:

	Water.	Proteins and Gelatin.	Fat.	Carbohydrates.	Salts.	Extractives.
Beef and mutton	50 to 65	15 to 20	15 to 30	..	.8 to 1.8	.5
Meat-juice	51	15.5	..	..	12	15.5
Meat-extract	16 to 21	..	..	..	18 to 22	6 to 60
Poultry	70	23	3	..	1	
Fish (42 per cent waste)	44	10.5	2.5	..	1	
Eggs	74	15	10.5	..	1	
Milk	87 to 88	2 to 4	3 to 5	4 to 5	.7	
Peas	10 to 15	18 to 23	1.2 to 2.4	59 to 66	2 to 3	

NITROGLYCERIN, also known as TRINITRIN and GLYCERYL TRINITRATE, is a thick oily liquid of sweet taste and explosive properties. When a small quantity is taken internally it produces marked effects in about two minutes, relaxing the arteries so as to cause the skin to flush visibly, quickening the pulse, and causing a sense of fullness all over the body and throbbing in the head. It greatly lessens the blood-pressure and temporarily relaxes all muscle, whether striped or unstriped.

Uses.—This sudden action in relaxing muscle fibres and lessening blood-pressure proves very valuable in conditions where serious effects are produced by spasm. For example, in angina pectoris, in bronchial asthma (due in part to spasm of the small bronchial tubes), in gall-stone and renal colic, and in the vomiting of sea-sickness, it diminishes the spasmodic condition and gives relief. In cases of chronic Bright's disease with excessive blood-pressure, the slackening of blood-tension has the effect of relieving the strain on the heart, and of diminishing the escape of albumin from the kidneys.

It is used in the form of liquor of glyceryl trinitrate, of which one or two drops is taken in water every few hours; or tablets made up with chocolate may be carried in the pocket and taken from time to time.

Other substances have a similar action to that of nitroglycerin. Nitrite of sodium and nitrite of potassium are used in doses of 3 to 5 grains, and have the advantage of producing their effect more slowly and more permanently. Erythrol tetranitrate has a similarly prolonged effect. Nitrite of amyl, on the other hand, produces its effect in a few seconds, and, being volatile, may be inhaled as well as swallowed. For this purpose small thin glass perles are prepared, and are carried in the pocket by those liable to angina pectoris or other sudden convulsive seizure. Immediately the spasm comes on one of these perles is crushed between the finger and thumb and held to the nostrils.

NITROHYDROCHLORIC ACID, or AQUA REGIA, so called because of its power to dissolve gold, is a yellow liquid prepared by adding 1 part of nitric acid to 4 parts of hydrochloric acid. It is a

caustic in its pure state, but is only used for internal administration in a diluted form. It stimulates the gastric secretion like each of its components, and, in addition, is proved to be of special value in increasing the flow of bile, having therefore a considerable use in affections of the liver.

NITROUS OXIDE GAS, also known as LAUGHING GAS, is at ordinary pressures a gas devoid of odour but of a slightly sweetish taste. It is kept under pressure in steel cylinders, from which it can be allowed to escape at any desired rate by turning a stop-cock. Its use in medicine is to produce insensibility to pain, which it does very quickly, and with a great degree of safety, though the effect is of very short duration, not extending beyond two or three minutes. Its use is therefore applicable only for short operations, such as extraction of a tooth, unless it be repeatedly administered in association with oxygen. (*See* ANÆSTHETICS.)

NOCTAMBULATION (*nocte*, by night; *ambulo*, I walk) is another name for sleep-walking. (*See* SLEEP.)

NODE (*nodus*, a swelling) means a localised swelling upon the surface of a bone, resulting from some irritation of the periosteal membrane covering the bone, and, in the great majority of cases, due to syphilis. These nodes occur especially upon the front of the tibia.

The term node is also applied to a collection of nerve cells forming a subsidiary nerve centre found in various places in the sympathetic nervous system, such as the sino-auricular node and the atrio-ventricular node which control the beating of the heart.

NOGUCHI'S REACTION is a skin reaction which forms a test for the presence of syphilis. It consists in injecting a drop of luetin, an extract made from the organisms of syphilis, into the skin of the arm. In a person affected with syphilis a distinct swelling surrounded by a red ring appears at the point of injection in a few hours, while no reaction occurs in a healthy person.

NOMA (νομή, a devouring sore) is another name for cancrum oris. (*See* CANCRUM.)

NORMAL is a term used in several different senses. Generally speaking, it is applied to anything which agrees with the regular and established type. In chemistry the term is applied to solutions of acids or bases of such strength that each litre contains the number of grams corresponding to the molecular weight of the substance in question. In physiology the term normal is applied to solutions of such strength that when mixed with a body fluid they are isotonic and cause no disturbance, *e.g.* normal saline solution. (*See* ISOTONIC.)

NORMOBLAST (*norma*, rule, and βλαστός, germ) is the term applied to a red blood corpuscle which still contains the remnant of a nucleus.

NOSE.—The nose has two functions to perform, being the upper end of the air passages which lead to the lungs, and also lodging the organ which furnishes the sense of smell. As in the case of the ear, the part of the nose which projects from the surface is comparatively unimportant, except from an æsthetic point of view, the main part of the cavity being placed above the roof of the mouth, from which it is separated by the hard palate, and opening behind by the posterior nares into the throat.

The *external nose* is formed partly of bone and partly of cartilage, covered by skin. In its upper part, the two nasal bones, one on each side, project downwards from the frontal bone for about an inch, and, supported by a process of the upper jaw-bone, form the hard bridge of the nose between the eyes. The ending of the bony part can be seen or felt on most noses, and, beneath this, two cartilages on each side, the lateral cartilages, and the cartilages of the aperture give shape, firmness, and pliability to the lower two-thirds of the nose. The gap between the cartilages of the aperture can be distinctly felt on the point of the nose. The spaces between the cartilages are filled up, and the cartilages firmly bound to the bones and to one another by fibrous tissue. When the nose is injured, some of the cartilages are apt to be dislocated, thus altering the shape of this organ.

In its *interior*, the nose is completely

NOSE

divided into two narrow cavities, one on each side, by a septum or partition running from front to back. This septum

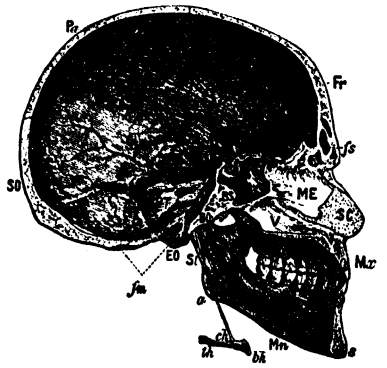


FIG. 347.—A section through the skull immediately to the right of the middle line of the body, showing the septum of the nose. *ME*, Middle plate of the ethmoid bone; *V*, vomer bone; *SC*, septal cartilage. The sphenoidal sinus *PS*, and the frontal sinus *fs*, are also shown. For other letters see SKULL. (Turner's *Anatomy*.)

is a thin plate composed partly of bone, partly of cartilage, consisting in about its hinder two-thirds of the central plate of the ethmoid bone and of the vomer bone, and in about its anterior third of a four-sided plate of cartilage, which along one edge touches the nasal bones, the lateral cartilages, and the cartilages of the aperture. On both surfaces this septum is covered by the general mucous membrane that lines the nose.

The cavities on either side of the septum, known as the *nasal fossæ*, are extremely narrow, being at their widest point less than ½ inch in breadth, though in height they correspond to the length of the nose, and run directly backwards about 2 inches. At its upper end each cavity is separated from the interior of the skull by a thin plate of bone containing many minute apertures for the passage of the filaments of the olfactory nerve. The front part of each cavity consists of the space enclosed by the cartilages of the nose, is lined by skin, which is furnished with stiff hairs that grow downwards and protect the entrance, and is known as the 'vestibule'. Farther back the outer surface of each cavity is rendered very complicated, and the space in the cavity greatly filled up, by three projections known as the turbinated bones. These bones form ridges which run from before backwards with an inclination downwards, and, in section, each ridge is curled over so that its edge looks downwards. There are therefore three passages (meatus) running from before backwards, each under cover of a corresponding turbinated bone. As each of these bones, in common with the whole of the cavity, is covered with very vascular and thick mucous membrane, the air in its passage through the nose is by this arrangement brought in contact with a large surface of mucous membrane, and thus is considerably warmed before it enters the bronchial tubes and lungs. The front portion of the inferior and of the middle turbinated bones can be seen as two red projections by looking up the nostril with a bright light, when the nostril is slightly opened by a speculum. The

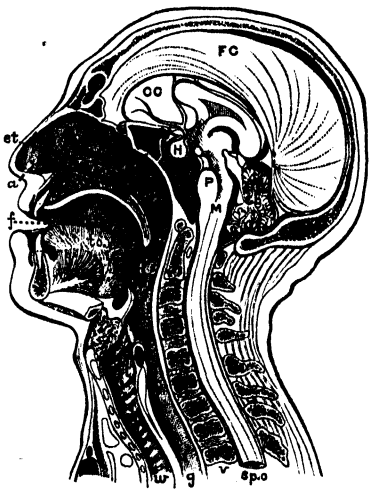


FIG. 348.—Vertical section through the middle of the head and neck, showing the outer wall of the nose with the three turbinated bones. The passages for air, *a*, are indicated by a heavy dotted line, those for the food, *f*, by a fainter line; *et*, Eustachian tube; *l*, larynx; *w*, windpipe; *t*, tonsil: *to*, tongue; *g*, gullet. The sphenoidal and frontal sinuses are shown. Note the very thin plate of bone above the superior turbinated bone which separates the cavity of the nose from the interior of the skull. For other letters see BRAIN. (After Braune.)

superior meatus beneath the superior turbinated bone is a narrow passage, and, upon this bone and passage as well as upon the corresponding part of the

septum, the nerves of smell end in the mucous membrane. The wider and longer middle meatus and inferior meatus are the passages through which the air mainly passes out and in during respiration.

Certain *sinuses* lie concealed in the bones of the skull, into which air enters freely by apertures connecting them with the nose. These cavities occupy spaces in the frontal bone over the eyebrow (frontal sinus), in the upper jaw-bone, filling in the angle between the eye and the nose (maxillary sinus or 'antrum of Highmore'), in the sphenoid bone (sphenoidal sinus), and in the lateral part of the ethmoid bone (ethmoidal sinus). These both give lightness to the skull, and serve to diminish the violence of blows upon the face. The most capacious is the antrum of Highmore, which is a cubical cavity, often over half an inch in measurement each way. The frontal sinus, antrum of Highmore, and ethmoidal sinus open by small apertures about the centre of the middle meatus, the sphenoidal cells above this. Into the front part of the inferior meatus opens the nasal duct, which carries the tears off from the eye. (*See* EYE.) The latter fact explains the frequent blowing of the nose, which becomes necessary when a person is weeping. On a level with the inferior meatus, but situated in the part of the throat into which the nose opens, is placed the orifice of the Eustachian tube leading to the drum of the ear. (*See* EAR.)

NOSE, DISEASES OF.—The nose, so far as the skin covering is concerned, is subject to the same diseases as the skin of other parts. Redness of the skin of this part may be, on account of its disfiguring character, very annoying. It may be due to poor circulation in cold weather, partaking of the nature of a chilblain (*see* CHILBLAINS); very frequently it is due to constant indulgence in alcohol (*see* ACNE ROSACEA); habitual indigestion also tends to bring on a condition of redness (*see* DYSPEPSIA), while any chronic state of inflammation or source of irritation in the interior of the nose may manifest itself by redness on the surface. Among the skin diseases acne (*see* ACNE), lupus (*see* LUPUS), and erysipelas (*see* ERYSIPELAS) are specially prone to affect this site.

ACUTE INFLAMMATION of the nose (ACUTE RHINITIS) is generally a catarrhal condition affecting the mucous membrane, and is commonly known as a 'cold in the head'. (*See* CHILLS AND COLDS.) It may be due, though less commonly, to the inhalation of irritating gases. Injuries to the nose are specially liable to be followed by erysipelas in some persons. (*See* ERYSIPELAS.) Boils occasionally develop just within the entrance to the nose in connection with the hairs there, and in this locality give rise to great pain and considerable danger. (*See* BOILS.) Diphtheria is a form of acute inflammation which occasionally spreads to the nose. (*See* DIPHTHERIA.) Hay fever is a peculiar form of acute inflammation. (*See* HAY FEVER.)

CHRONIC INFLAMMATION (CHRONIC RHINITIS) is a very common condition of the nose, and in a mild form may exist for years without attracting much attention.

Causes.—Generally it follows upon repeated colds in the head, which do not pass off completely. It may also be due to the constant inhalation of dust or irritating vapours at work. There seems to be a hereditary tendency also for this type of inflammation to run in families, probably in consequence of some peculiarity in the structure of the nose. The mucous membrane covering the turbinated bones swells up in consequence of the inflammation, and, by blocking the passage of the air to some extent, as well as by producing irritating discharges, forms a source of constant irritation which perpetuates the condition. Any malformation, such as great bulging of the septum to one side, or the presence on it of a 'spur', has a similar effect, and such malformations have often the effect of rendering persons who have a slight tendency to hay fever additionally liable to this malady, in consequence of the degree of chronic inflammation the malformations produce.

Symptoms.—The most marked symptom is increased secretion from the swollen mucous membrane, causing constant running at the nose, together with a feeling of 'stuffiness'. It is necessary to blow the nose very frequently, or the person is continually 'hawking' mucus in the back of his throat. In some

persons, however, instead of constant running of the nose, the inflammation is of a dry type, and the swollen mucous membrane becomes covered by crusts which are difficult to dislodge. Sneezing is also a common symptom, resulting from the constant irritation in the nose, and a feeling of obstruction in the nose is usually experienced when the person lays his head down at night. The external nose too is liable to become large and red. When the condition becomes a little worse than usual, as the result, for instance, of a fresh cold, the person must breathe through his mouth, his voice takes on a nasal twang, and there is temporary loss of the senses of smell and taste. Occasionally the hearing is much impaired, and there may be neuralgia, aching over the bridge of the nose, and redness of the eyes. Hay fever and asthma are liable to come on in those predisposed to them, as already mentioned.

Occasionally, in young persons of poor constitution, especially girls, the nose after suffering from this state for a short time takes on an atrophic process, and both the mucous membrane and the bones waste, so that the former loses its secretion and becomes covered by evil-smelling crusts, which make the breath very offensive, while the changes in the bones produce a small, tip-tilted nose. Happily, this condition, known as 'ozæna', tends to pass off between the ages of twenty and thirty.

Special forms of chronic inflammation come on occasionally in persons who are the subjects of consumption, owing to the disease attacking the interior of the nose, more commonly in those who suffer from lupus of the face, and still more commonly in children who are the unhappy subjects of inherited syphilis. As a result of all these conditions considerable ulceration takes place, leading to more or less complete destruction of the delicate bones and cartilages supporting the nose. These conditions are not attended by much pain, as a rule, but they give rise to a very offensive smell, and result in more or less disfigurement, the bridge of the nose falling in, and the nostrils looking more directly forward.

Treatment.—Care must be taken by those with a tendency to chronic inflammation of the nose to avoid catching colds. The condition of the mucous membrane can be greatly improved and the inflammation soothed by the use every night and morning of one of the following lotions, applied to the nose either by means of a hand-spray or from a nasal syringe or douche. (1) Sodium

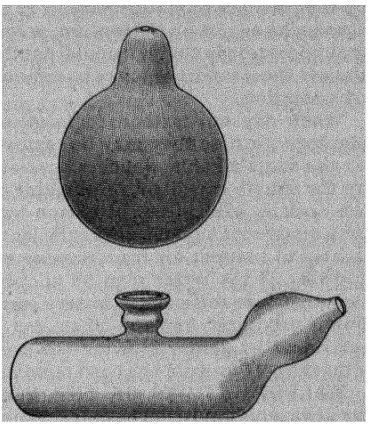


FIG. 349. — Rubber ball-syringe and glass boat-douche, either of which may be used for applying lotions to the interior of the nose.

bicarbonate 30 grains, sodium chloride 30 grains, borax 30 grains, white sugar 60 grains, rose water 8 ounces: a small quantity of this to be mixed with an equal quantity of hot water before use. (2) A teaspoonful of sodium bicarbonate and common salt mixed in equal parts,

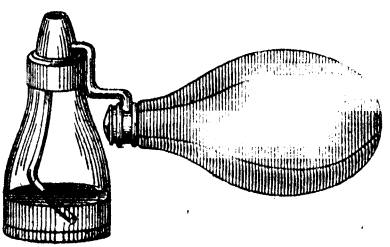


FIG. 350.—Nebuliser for applying remedies in fine spray to nose or throat.

added to a tumblerful of warm water. When the mucous membrane is much swollen and the nasal passage in consequence much blocked up, it becomes necessary to reduce this swelling in order to relieve the inflammation. This is done most effectively by the galvano-cautery, the little operation being re-

peated several times at short intervals, and being quite painlessly carried out after the nose is sprayed or swabbed with cocaine solution. Or, after a similar preparation, the mucous membrane is touched with chromic acid. In cases where the inflammation is perpetuated by the presence of malformations in the nose such as spurs on the septum, polypi, or suppuration in the sphenoidal or other sinuses, these conditions may be removed by operation.

When dry crusts tend to form and block up the nose they may be removed by the same alkaline douches, and also by the simple expedient of plugging up the nostrils with pieces of cotton-wool for a quarter of an hour, just sufficiently tightly to prevent air from passing out and in. If the latter plan be adopted the crusts are softened, a watery secretion is produced, and the crusts can be got rid of by gently blowing the nose, after the cotton-wool has been removed.

MALFORMATIONS OF THE NOSE are of various kinds. The external nose varies much in shape in different races, even in different families, and persons who desire for æsthetic reasons to alter the character of this feature can mould the cartilages to a considerable extent by constant manipulation or by wearing various appliances. Noses, which have become tip-tilted through sinking in of the bridge, may, after the disease which has caused the sinking has subsided, be improved by the injection of paraffin under the skin. (*See* ARTIFICIAL LIMBS AND OTHER PARTS.) As to the interior of the nose, the two cavities are practically never of equal size, the septum always bulging to one or other side, so that the passage of air is freer on one side than on the other. When this bulging is so marked that the septum touches the turbinated bones on one side, or when, owing to injury or other cause, 'spurs' and 'crests' have developed on the septum, considerable irritation may arise, and this may form the starting-point for chronic inflammation of the nose, hay fever, or asthma. These imperfections, though they often exist without the least ill-effect, and are only discovered accidentally, are readily removed by the specialist if necessary, with the knife, chisel, saw, or galvano-cautery, such operations being attended by but little pain. A more common abnormality is that in which the nose becomes pinched and narrow as the result of blockage by polypi, adenoids, and similar causes, and the person breathes in consequence through the mouth.

ADENOIDS, or ADENOID VEGETATIONS, means an overgrowth of the glandular tissue which is naturally found in small amount on the back of the upper part of the throat, into which the nose opens.

Causes.—This glandular tissue is in structure similar to the tonsils and lymphatic glands, and in children between the ages of five and twelve, particularly after some inflammatory condition of the respiratory passages or after one of the acute infectious diseases, such as measles, it is liable to develop to such an extent as to fill up this portion of the throat and obstruct the passage of air through the nose and into the Eustachian tubes.

Symptoms.—Generally this overgrowth subsides as the child passes through his 'teens, but its continuance for even a few years may produce serious effects upon the child's physique and mental powers. The appearance of a child suffering from adenoids is highly characteristic. The mouth is kept constantly open, since breathing proceeds through it, and, as a result, the child is very liable to bronchitis, and he snores at night. The point of the nose is pinched and the nostrils narrow, since very little air passes through them, and the bridge of the nose is often flattened. The palate is highly arched and the front teeth often prominent. If the child be weak or rickety, the obstruction to the entrance of air into the chest is very apt to produce a 'pigeon-breast'. Deafness, as the result of inflammation spreading up the Eustachian tubes from the throat to the drum of the ear, is very common, and may be permanent. Hall and Tilley made the statement that 90 per cent of all the cases of deafness among children were due to adenoids. There is also some interference with the senses of smell and taste, though this is not so serious as deafness. A peculiar mental condition is very common among children thus affected, the child being generally listless and lacking in the power of concentration; a fact that is made more noticeable by the heavy, stupid look which the open

mouth and the deafness give to the face. The irritability of the nervous system, occasioned by the difficulty of breathing during sleep, renders these children, much more than others, prone to suffer from nightmare, and from the habit of wetting the bed at night.

Treatment.—As already stated, it is not the occurrence, but the overgrowth of adenoids that gives rise to trouble in children, and, even if large, they tend to subside as the child advances in years. It is often difficult to decide, therefore, whether an operation for their removal should be performed or not. Apart from any serious symptoms that may be occasioned, such as deafness or choking, which certainly call for operation, the usual test employed is the question as to whether the child can go about quietly without becoming short of breath, and can sleep with his mouth shut. The operation—which is simple, consisting in scraping the adenoids away with the curette or other instrument, and in cutting out the tonsils which, as a rule, are enlarged, along with the adenoids—is performed under an anæsthetic such as ethyl chloride.

POLYPI are growths of a soft, jelly-like character, with more or less of a stalk, arising usually from the middle turbinated bone. They are the result of

FIG. 351.—Simple mucous polypi growing in the nasal passages from the middle turbinated process. (Miller's *Surgery*.)

chronic inflammation in the hinder part of the nasal cavity, produced by frequent colds, following on some of the acute infectious diseases, or due to suppuration in one of the air cavities adjoining the nose.

Symptoms.—There is usually a sense of 'stuffiness', and obstruction to breathing through the nose, while frequently the patient distinctly feels something flapping as he breathes or talks. Many of the symptoms mentioned under chronic inflammation are present, as this condition is found in a greater or less degree along with polypi and is the cause of their development. When the nose is examined with a bright light and mirror, part of the polypus is often seen, and being of a glistening, greyish colour, contrasts strongly with the red mucous membrane of the nose.

Treatment.—These polypi occasion no danger to life. Malignant tumors are occasionally found growing in the nose, but are very rare, and when they do occur are hard in texture, unlike these soft mucous polypi. The polypi are, however, seldom or never single, and after a large one has been removed the smaller ones around grow into its place and must in turn be removed. The removal is generally effected, quite painlessly, by passing a wire 'snare' along the corresponding nostril, catching the polypus, and tightening the wire around its stalk till it can be pulled off, and when periodically done may at last result in a complete cure. Recurrence is also prevented in many cases by scraping the inflamed mucous membrane from which the polypi are growing, or, in cases due to suppuration in the ethmoidal air-cells, by a severer operation designed to remove completely the lateral part of the ethmoid bone.

BLEEDING FROM THE NOSE is treated of under hæmorrhage. (*See* HÆMORRHAGE.)

FOREIGN BODIES, such as buttons, slate pencils, peas, and small stones are often pushed into the nose by children, and as the floor of the nose slopes slightly backwards and downwards, they readily pass in beyond reach. Concretions form in the nose, as in other hollow organs, round small blood-clots, hairs, and the like, and these may grow to a considerable size.

Symptoms.—At first the foreign body may, if smooth, set up no symptoms, but soon swelling of the nose, discharge from one nostril, headache and various pains appear, especially if the body be one which swells, like a pea. These symptoms may to a certain extent pass off, and if the body be wedged in tightly beneath the inferior turbinated bone, it may remain there for years, causing

little discomfort, till a severe attack of inflammation comes on. When there is a constant discharge of matter from one nostril without any known cause, it is very probably due to some foreign body which has previously been introduced into the nose.

Treatment.—Tickling the nostril with a feather, or giving a large pinch of snuff, to provoke a vigorous sneeze, while the opposite nostril is closed by pressure with the finger, should be tried first of all. Very often this will drive out the stone, pea, etc. If not, removal by a medical man, aided by a speculum and a bright light, is comparatively easy, much more so than in the case of bodies pushed into the ear. In the case of children, chloroform is generally necessary, as the child will not remain still.

LOSS OF SENSE OF SMELL may be caused by conditions which block the lower part of the nose, and produce a sodden condition of the mucous membrane in which the olfactory nerves end. Such conditions are polypi and chronic inflammation. Certain drugs, such as carbolic acid, are very destructive of this sense, and douching the nose with carbolic lotion has been known to produce loss of smelling power. Influenza and even a severe cold in the head sometimes cause it, and so do injuries to the brain and fractures of the skull involving the olfactory nerves. A powerful odour, when allowed to act upon the nose for long, may paralyse the sense of smell for that particular odour, though the sense may remain quite acute for all other smells. For this reason the nose is an uncertain guide to the presence of poisonous gases in the air, for the smelling power may quickly become numbed by such a gas as coal gas or prussic acid.

SUPPURATION IN THE SINUSES connected with the nose is of fairly frequent occurrence. Suppuration in the *frontal* sinus is rare, because of the very efficient drainage from this cavity straight downwards into the nose, while suppuration in the *cells of the sphenoid and ethmoid* bones, unless it causes polypi, is apt to escape notice, but the *antrum of Highmore* or *maxillary sinus* lying in the maxillary bone close to the roots of the upper row of teeth, from which it is separated only by mucous membrane and thin bone, and opening only by its upper part into the nose, is very liable to become inflamed and to have pus collect in it.

Symptoms.—When suppuration occurs in the *frontal sinuses*, severe headache is apt to result as well as discharge from the nose. When suppuration takes place in the *sphenoidal sinuses*, there is constant purulent discharge either from the nose or into the throat, and defects may be produced leading to general debility or inflammatory changes may be set up in the eye or its optic nerve, which lie in close relation to these sinuses. The effects of a collection of pus in the *maxillary sinus* may be very slight; intermittent pain of a neuralgic character often felt above one eye, toothache, and slight swelling of one cheek may be the only signs for a long time. Generally, however, attention is called to the nose by a slight intermittent discharge of matter from one nostril, especially when the head is laid upon the opposite side. The small operation of pushing a hollow needle through the plate of bone separating the nose from the antrum, which is no thicker than a calling-card, is bloodless and almost painless, and if matter runs from the needle the diagnosis is confirmed.

Treatment.—As regards the maxillary sinus, an opening must be made into the cavity, and a small silver drainage tube is usually inserted into it, either through the socket of a carious tooth, if there be one, or through the angle between the gum and lip above the eye-tooth. There is little pain in making this opening, and the cavity is thereafter syringed daily with some weak antiseptic lotion till the pus disappears, when the drainage tube is removed and the opening allowed to close. Frequently the suppurating maxillary sinus is drained by making a large opening between it and the cavity of the nose.

A more serious operation is necessary in order to explore and drain the frontal sinuses, the incision being made usually along the line of the eyebrow. In the case of the sphenoidal sinuses, these are explored and scraped out through the nose under a general anæsthetic.

NOSOLOGY (*νόσος*, disease; *λόγος* discourse) is the term applied to scientific classification of diseases.

NOSOPHOBE is a person who has a morbid fear of contracting a certain disease.

NOSTALGIA (*νόστος*, return home; *ἄλγος*, grief) means a form of melancholy or aggravated home-sickness occurring in persons who have left their home. It seems particularly to affect mountaineers who are forced to live in lowland countries, and it may come to such a state of mental and physical depression as to end in death.

NOTIFIABLE DISEASES are diseases, usually of an infectious nature, which are required by law to be made known to a health officer or Local Authority.

NOVARSENOBENZOL is another name for neosalvarsan.

NOVOCAIN is the proprietary name for PROCAINE HYDROCHLORIDE, a synthetic substance having a similar action to the natural alkaloid cocaine. It is a powerful local anæsthetic with transitory effect. In 5 per cent strength it is used to drop into the eye to anæsthetise it for superficial operations. It is especially used for infiltration anæsthesia by injection in large quantity round a tumor which it is desired to remove, or round an area upon which it is desired to practise some reparative operation in cases where a general anæsthetic is undesirable. For this purpose it is generally used in strength of 0·5 per cent, and large quantities of 200 c.c. or more of the solution can be employed without ill effect. It is also used for producing temporary loss of sensation in the lower part of the body during the performance of an operation, by means of injection into the spinal canal. It is used in similar manner in a 2 per cent solution to inject round the root of a tooth in order to make extraction painless. Novocain solutions are often combined with adrenalin, so as to contract the blood-vessels of the part, and thus produce as little bleeding as possible during the performance of the operation. Novocain possesses the anæsthetic properties of cocaine, but has an advantage over the latter in being very much less poisonous, so that it can be administered in larger doses, and also in producing no tendency to contract a habit for its use.

N-RAYS (*see* LIGHT TREATMENT).

NUCHA is the Latin name for the back of the neck.

NUCLEIN is the name of a protein forming part of nucleoprotein, which so largely enters into the composition of cell nuclei. Different nucleins are formed by the combination of nucleic acid with protein. They can be derived from yeast and from various tissues containing large numbers of cells such as the thymus gland. Nuclein and nucleic acid have the power when administered of increasing the formation of white blood corpuscles and of stimulating them to increased activity. Either of these preparations is therefore used in the treatment of anæmia, some infectious diseases, and especially mild states of general septic poisoning, such as those occurring in the course of pneumonia and puerperal fever.

NUCLEUS (*nux*, a nut) means the central body in a cell, which controls the activities of the latter. (*See* CELL.)

NULLIPARA is the term applied to a woman who has never borne a child.

NUMBNESS (*see* TOUCH).

NUMMULATED SPUTUM (*nummulus*, money) is expectoration which when spat into water flattens out into a shape like coins. (*See* EXPECTORATION.)

NURSING as a profession requires an elaborate training, though persons are often called upon to nurse relatives and friends without any previous experience of the subject. It is with reference to the latter contingency that the following remarks apply, as it would be quite impossible even to state briefly the many duties which hospital training teaches.

Professional nursing falls into four divisions: (a) *Hospital nursing*, which forms a training for all the other kinds of nursing. The best training is to be got in one of the large hospitals, and it may be said generally that it is impossible to obtain a satisfactory training in any hospital having less than a hundred beds. The certificates granted by smaller hospitals, or for a training in general nursing lasting less than four years, are of little value. Special de-

partments, such as fevers and midwifery, require only short courses, particularly if a nurse has already had general nursing experience. (b) *Private nursing, i.e.* nursing of a single patient, to whom the nurse's undivided attention is given, at home. (c) *District nursing*, which is the most arduous, and requires the greatest skill in the nurse. In this type of nursing, a large number of patients, especially in the poorer classes, are visited at home, and not only a long and varied training but great self-reliance is required of the nurse, who has to do much, unaided by medical supervision. (d) *Midwifery nursing*, which includes the care of mother and child for about a month after the latter is born.

Information on various special subjects arising in the course of a nurse's duties will be found under ANTISEPTICS, ASEPSIS, BATHS, BED, BED CHANGING, BED SORES, BLISTERS AND COUNTER-IRRITANTS, BLOOD-LETTING, CATHETERS; CHILDREN, PECULIARITIES OF; CUPPING, DIET, DISINFECTION, DOUCHE, DYSPEPSIA (Stomach washing), ELECTRICITY IN MEDICINE, ENEMA, FEEDING, FOMENTATIONS, GARGLES, HÆMORRHAGE, INFANT-FEEDING, INFECTION, LIGHT, MASSAGE, PEPTONISED FOODS, POULTICES, TEMPERATURE, VENTILATION, WET PACK, WOUNDS.

The following remarks upon home nursing are made under the two headings of—(1) *The sick-room.* (2) *The patient.*

(1) **The sick-room.**—The *situation* of the room is a matter of some importance. It must be bright and sunny, and should therefore, if possible, look to the south or south-west. It should be as much cut off from the general household as possible, and should, therefore, be at the end of a corridor or top of the house, and in infectious cases may be still more effectively isolated by hanging, outside the door, a sheet sprinkled from time to time with weak antiseptic lotion. This allows of the door being left open if necessary. Good drainage is of the utmost importance, and in surgical and lying-in cases particularly, there should be no sink or fixed basin in the room, as septic poisoning has been traced to impurities derived from these. The room should in every case be as large and airy as possible, for coldness is a minor danger and of far less importance than defective ventilation. The great test of *ventilation* is the presence or absence of the faintest 'stuffy' smell in the room, and if the room be of fair size this may be prevented by leaving the window constantly open so far that the two sashes are clear of one another less than an inch, and filling in with a strip of wood the space at top or bottom. If the patient complains of any draught, the window should not be shut, but the stream of air is kept off the bed by a screen or a sheet supported on a clothes-screen. A thermometer should always hang on the wall, so that the *temperature* of the room can be kept fairly uniform, and a good average temperature is about 60° to 65° Fahr., though in bronchitis and other chest complaints it may be advisable to keep the air warmer. A *fire* should always be kept on in a sick-room, for the purpose of burning dressings, rags, etc., even if not needed for warmth. In serious cases there should be no fire-irons, but the fire should be poked with a stick, and in the evening, pieces of coal should be laid on the hearth and placed on the fire with a paper or an old glove as required during the night, so as to avoid noise. When a patient is wakeful at night, a screen should be placed in front of the fire to keep the flickering light off the patient's eyes. There should be as little *furniture* as possible in a sick-room. A bed, table, and two chairs are all that is absolutely necessary, and there need be no carpet save a small piece of drugget at the bed-side. Furniture should not be dusted, nor must the floor be swept during an illness, but the furniture may be wiped daily with a damp cloth, and the floor may be washed when required. As to the disinfection of a room after the nursing of an infectious case, see DISINFECTION. When preparations are being made for a *surgical operation* at home, a large but narrow, strong deal table should be placed immediately before the window, and on it should be laid a couple of blankets, a large sheet of macintosh, and a clean pillow. Several basins and a large supply of clean linen towels should be at hand, as well as a plentiful supply of boiling water, and a ewer full of water which has been boiled and set aside to cool, covered by a towel.

(2) **The patient.**—In putting an injured person to bed, it is important to remove the *garments* first of all from the sound arm or leg, and lastly from the injured limb, which is then moved as little as possible. On the other hand, and for the same reason, in putting on garments the injured limb should be the first to have the garment drawn over it. While a patient, and especially one greatly prostrated, lies in bed, one of the chief duties of the nurse is the care of his *skin*. The patient should be washed daily all over with warm water. The ordinary bed-clothes are removed before commencing the washing and aired at the fire; while the patient is covered during the process of washing by another blanket. During the washing it is quite unnecessary that the skin should be exposed, the blanket being raised over one part, which is washed and dried before the washing of another part is begun, so that there ought to be no risk of chill. Further, the back and all bony prominences must be examined at the same time for any trace of redness, which is the first sign of a bed sore, and treated promptly if any sign of a bed sore appears. (*See* BED SORES.) When the chest is affected, jackets made of two flaps of gamgee tissue, secured by tapes on the shoulders and beneath the arms, keep the chest warm, and are more easily removed for examination than more closely-fitting flannels.

Hot tins or bottles are often put in bed for warmth, and these should *never* be put in bed unprotected by a woollen covering. They may be placed in flannel bags, in stockings, or wrapped in shawls, and this precaution is specially necessary in the case of patients unconscious after a severe operation, or paralysed, and so to some extent insensible of heat. Otherwise very serious burns may result.

In cases of rheumatism and Bright's disease, patients are generally placed directly between *blankets without sheets*, though a draw-sheet is necessary for cleanliness. The patient also wears a flannel night-dress, and the blankets and night-dress must then be changed and washed very frequently. In cases of heart disease, there should be a number of pillows, if not a *bed-rest*, breathing being easier when the patient reclines in a half-sitting posture. When the patient has to sit up for long periods, an *air-cushion* makes this position easier, or a high table placed across the bed and provided with a pillow upon which he can lean his arms. Care should always be taken to keep the shoulders warmly wrapped up. When the legs are swollen or inflamed, they should be raised on a pillow, or the foot of the bed may be tilted up on wooden blocks. Paralysed or helpless cases should be placed upon a *water-bed* from the first. A water-bed is most easily managed if it be in two sections, each covering half the bed. The water-bed is filled with water before the patient is laid upon it, and should not be quite tightly filled. It is separated from the patient by a blanket and sheet. The more modern *air-bed* is in many respects preferable to a water-bed. (*See* BED.) If, in paralysed or other cases, the weight of the bed-clothes be found irksome, they should be raised from the patient by an *iron-wire cage*, and it is then necessary to add an extra blanket to the coverings. Finally, it is well in nursing cases of long duration to have *two beds*, in one of which the patient spends the day and in the other of which he sleeps at night. Still better, if the circumstances of the house and the nature of the case permit, is the plan of having a day bedroom and a night bedroom.

Any *medicines* which the patient may have to take should be kept in a different part of the room from bottles containing lotions and other fluids intended for external application, and the nurse should never pour out a dose without previously reading the label on the bottle.

In *dressing* surgical cases, the nurse should boil any instruments she uses every day, and should wash her hands thoroughly with soap and water, and then steep them in such an antiseptic lotion as corrosive sublimate (1 in 4000) or lysol (1 in 100), before touching the injured part. She should also remember that abrasions or pustules upon her hands form a source of danger both to herself and still more to the patient, and these should be carefully covered with collodion.

The nurse attending an *infectious case* should have in the room constantly a basin containing corrosive sublimate lotion (1 in 2000), in which she can rinse her hands each time she touches

the patient, and before going out to mix with other people she should take a bath, and put on a complete change of clothing.

In all cases the nurse must, in order to discharge her duties well, have good food, sleep eight hours in every twenty-four, quite free from any chance of being roused to attend the patient, and have two hours daily for exercise.

NUTMEG is the kernel of the seed of *Myristica fragrans*, an East and West Indian plant, mace being its outside covering. Being a powerful sedative and narcotic, the oil of nutmeg or spirit of hutmeg is used as an ingredient in sleeping draughts. Externally the oil is sometimes used as an application for baldness.

NUTS (*see* FRUIT).

NUX VOMICA is the seed of *Strychnos nux-vomica*, an East Indian tree. The seed is circular, flattened, with a depression in the centre, greyish in colour, and covered with short satiny hairs. It has an intensely bitter taste. The medicinal properties of the plant are almost entirely due to two alkaloids, strychnine and brucine, which it contains. Tincture of nux vomica is a favourite preparation as a tonic in doses of 10 to 30 drops. (*See* STRYCHNINE.)

NYCTALOPIA (νύξ, night; ἄλαος, blind; ὤψ, eye) is another name for night blindness.

NYSTAGMUS (νυσταγμός, drowsiness, nodding) means a condition in which the eyeballs show constant, fine, jerky movements of an involuntary character. The movement may be from side to side, from above down, or rotary; and it may be present only when the person looks in a certain direction. It appears in children who have some defect in vision, such as that due to an opacity on the cornea, and it is caused by some occupations, such as that of miners, being caused by working in a dim light or possibly by breathing air containing much carbon monoxide. It may also be caused by various nervous diseases.

O

OATMEAL is a meal made from oats. Two-thirds of its weight consists of carbohydrate in the dry state, but when cooked in the form of porridge it contains in addition about seven times its weight of water. Dry oatmeal contains approximately 12 per cent of protein, 5 per cent of fat, and 70 per cent of carbohydrate; and 1 oz. has an energy-producing equivalent of over 100 calories.

OBESITY (*obesus*, corpulent). (*See* CORPULENCE.)

OBSESSION (*obsessio*, a besieging) in medicine means the sudden domination of the mind by an idea or emotion, leading to impulsive acts which are beyond the control of the will, the power of judgement being for a time lost.

OBSTETRICS (*obstetrix*, a midwife) means the art of midwifery. (*See* LABOUR.)

OBSTRUCTION OF THE BOWELS (*see* INTESTINES, DISEASES OF).

OCCIPUT (*occipitium*, the back of the head) is the name given to the lower and hinder part of the head where it merges into the neck.

OCCUPATIONAL DISEASES (*see* TRADE DISEASES).

OCHRONOSIS is the term given to a very rare condition in which the ligaments and cartilages of the body, and sometimes the conjunctiva, become stained by dark brown or black pigment. This may occur in chronic carbolic poisoning, or in a congenital disorder of metabolism in which the individual is unable to break down completely the tyrosine of the protein molecule, the intermediate product, homogentisic acid, appearing in the urine—this being known as alkaptonuria.

OCULENTUM is an ointment for application to the eye.

ODONTALGIA (ὀδούς, tooth; ἄλγος, pain) is another name for toothache.

ŒDEMA (οἴδημα, swelling) means dropsical swelling due to the passage of fluid through the walls of blood- or lymph-vessels into the spaces of cellular tissue beneath the skin, or beneath a mucous membrane, or into internal organs. (*See* DROPSY.)

ŒSOPHAGUS (οἰσοφάγος), or GULLET, is the tube which conveys the food and drink from the throat down to the stomach. It begins above at the level of the sixth cervical vertebra, and, lying close against the left side and front of the spinal column, passes downward through the neck and chest to pierce the diaphragm, and then opens into the stomach. It consists of three coats: a strong outer coat of muscle fibres in two layers, the outer running lengthwise, the inner being circular; inside this a loose connective tissue coat containing blood-vessels, glands, etc.; and finally a strong mucous membrane lined by epithelium, which closely resembles that of the mouth and skin. For diseases to which the œsophagus is liable see THROAT, DISEASES OF.

ŒSTRADIOL is the name now given to the hormone secreted by the ovarian follicle. Œstradiol is responsible for the development of the female sexual characteristics, of the breasts, and of part of the changes that take place in the uterus before menstruation. It is especially useful, given by mouth or by injection, in controlling the disturbances of the menopause.

ŒSTRIOL (*see* ŒSTROGEN).

ŒSTROGEN is the general term applied to any one of the female sex hormones, among which are the follicular hormone œstradiol (*q.v.*), its excretion product ŒSTRONE (obtained from urine), and ŒSTRIOL, which is obtained from pregnancy urine and from the placenta. The general action of these œstrogens is to maintain the normal function and structure of the female generative organs.

ŒSTRONE (*see* ŒSTROGEN).

OFFICIAL (*officialis*) is a term applied to drugs and preparations which are authorised by pharmacopœias and other recognised lists.

OFFICINAL (*officina*, shop) is a term applied to drugs and preparations which are regularly kept for sale in the shops of druggists.

OÏDIUM ALBICANS is a vegetable parasite belonging to the group of moulds which causes the condition known as 'thrush'. (*See* MOUTH, DISEASES OF.)

OILS are divided into *fixed oils* and *volatile* or *essential oils*. FIXED OILS are of the nature of liquid fats composed of a fatty acid and glycerin, for example olive oil, which consists of a mixture of glycerin compounds of oleic acid and palmitic acid. Other examples of fixed oils are almond oil, linseed oil, and cod-liver oil. Fixed oils are used as foods, and in large quantities as mild aperients. Some fixed oils have important special properties by virtue of active principles that they contain, for example castor oil and croton oil, which act as purgatives. Fixed oils are obtained from the fruits or seeds of plants or from animal tissues by pressure, or by boiling with water and skimming off the melted oil. Fats are fixed oils which are solid at ordinary temperatures and are extracted by combination of heat and pressure. An example of an animal fat is lard, and of a vegetable fat cocoa butter. Fixed oils can be dissolved in ether and chloroform.

VOLATILE or ESSENTIAL OILS resemble fixed oils in being soluble in ether or chloroform and in being lighter than water. Examples of these are the oils of dill, anise, cajuput, caraway, cloves, cinnamon, eucalyptus, juniper, lavender, lemon, peppermint, rosemary, rue, mustard, and turpentine. The volatile oils have some actions in common by being in small doses antispasmodic, dullers of pain, and cardiac stimulants, and by possessing a powerful antiseptic and disinfectant action. Most of them are prepared by distillation. Their composition varies considerably, some being of the nature of alcohols, others ketones, others allied to carbolic acid. Volatile oils can be dissolved to a small extent in water, to which they communicate their scent and other properties, and these aquæ or waters are much used in treating colic and other spasmodic conditions, usually in doses of one or two tablespoonfuls. Volatile oils are also readily soluble in spirit containing 90 per cent of alcohol, and these spirits usually contain about 10 per cent of the volatile oil and are given in doses of from 5 to 30 drops.

For oils of the petroleum series see PARAFFIN.

OINTMENTS are mixtures of medicinal substances with lard, benzoated lard, paraffin or vaseline, and wool-fat (lanoline), intended for external application. Those made up with lanoline, which is a natural skin fat, are much more readily absorbed than those, for example, made from paraffin, which is used for ointments designed simply to lie upon the surface.

Other substances occasionally used to form the body of an ointment are almond oil, bees-wax, camphor, glycerin, oleic acid, spermaceti, and prepared suet.

Among the most useful ointments are the following: *Simple ointment* is made from wool-fat, hard and soft paraffin, and is used for application to chafed surfaces. *Cold cream*, made of bees-wax, spermaceti, almond oil, rose water, and attar of rose, is used for a similar purpose. *Boric acid ointment* is much used for lubricating instruments, dressing ulcers, etc. *Yellow oxide of mercury ointment* is much used for treating inflammation about the eye.

OLD AGE (*see* AGE, NATURAL CHANGES IN).

OLEIC ACID is the commonest of naturally occurring fatty acids, being present in most fats and oils in the form of triglyceride. Its formula is $CH_3).CH_2)_7.CH=CH.(CH_2)_7.COOH$.

OLEOTHORAX means (1) the presence of oil in the thoracic cavity, and (2) the operation of injecting oil into the pleural cavity in order to compress a tuberculous lung.

OLFACTORY NERVE, or NERVE OF SMELL, is the first cranial nerve.

OLIGÆMIA (ὀλίγος, small; αἷμα, blood) means a diminution of the quantity of blood in the circulation.

OLIGURIA means an abnormally low excretion of urine, such as occurs in acute nephritis.

OLIVE OIL is the oil obtained by pressure from the fruit of *Olea europæa* (*see* OILS). It is practically a pure fat, and one ounce has an energy equivalent of about 270 calories.

OMENTUM (for *operimentum*, a coverlet) is a long fold of peritoneal membrane, generally loaded with more or less fat, which hangs down within the

abdominal cavity in front of the bowels. It is formed by the layers of peritoneum that cover the front and back surfaces of the stomach, in their passage from the lower margin of this organ to cover the back and front surfaces of the large intestine. Instead of passing straight from one organ to the other, these layers dip down and form a sort of fourfold apron. It is to the increasing deposit of fat in this structure that the large size of the abdomen in luxurious persons of middle age is largely due. This omentum is often known as the great omentum, to distinguish it from two smaller peritoneal folds that pass from the stomach, the one to the liver (gastro-hepatic omentum), the other to the spleen (gastro-splenic omentum).

OMPHALUS (*ὀμφαλός*) is another name for the navel or umbilicus.

ONCHOCERCIASIS.—Infestation with the nematode worm *Onchocerca volvulus*. This worm is found on the west coast of Africa and infests the subcutaneous and connective tissues of man, forming nodular cystic tumors which contain masses of worms and their embryos.

Larval forms (microfilariæ) may appear in the blood and lymph channels. Microfilariæ may invade the eye, causing conjunctivitis, iritis, keratitis, choroiditis—and blindness. The parasite is transmitted to man by the buffalo gnat, *Simulium damnosum*.

Onchocerca cæcutiens, found in Guatemala and Mexico, is doubtfully distinguished as a separate species.

ONCOLOGY is that part of medical science which is concerned with the problems of tumors of the body.

ONYCHIA (*ὄνυξ*, the nail) means an inflammation affecting the nails. (*See* NAILS, DISEASES OF.)

ONYCHOGRYPHOSIS is the term applied to a distortion of the nail in which it is much thickened, overgrown and twisted on itself. This usually affects a toe-nail and is the result of chronic irritation and inflammation.

OOPHORECTOMY (*ᾠόν*, egg; *φέρω*, I carry; *ἐκ*, out, *τέμνω*, I cut) is a term applied to removal, by operation, of an ovary. When the ovary is removed for the presence of a cyst, the term 'ovariotomy' is usually employed.

OOPHORITIS is another name for ovaritis or inflammation of an ovary.

OOPHORON (*ᾠόν*, egg; *φέρω*, I carry) is another name for the ovary.

OPACOL is another name for iodophthalein.

OPEN-AIR TREATMENT (*see* CONSUMPTION).

OPERATION.—The general principles upon which an operation is conducted are mentioned under ANTISEPTICS and ASEPSIS. The preparations for an operation in a private house are mentioned in the article NURSING. The method of healing after an operation is mentioned under WOUNDS.

OPHTHALMIA (*ὀφθαλμία*) means inflammation of the eye, the term being used sometimes instead of conjunctivitis. (*See* Conjunctivitis *under* EYE, DISEASES OF.)

OPHTHALMOPLEGIA (*ὀφθαλμός*, the eye; *πληγή*, a blow) means a paralysis affecting one or both eyes, due to some disorder in the brain. When the condition affects the muscles that move the eyeballs from outside, the term external ophthalmoplegia is applied to it; when the intrinsic muscles of the eye are affected, causing interference with the size of the pupil and with the accommodation of the eye for near and distant vision, internal ophthalmoplegia is the name given.

OPHTHALMOSCOPE (*ὀφθαλμός*, the eye; *σκοπέω*, I look at) is an instrument used for the examination of the back of the eye, and for the detection of defects

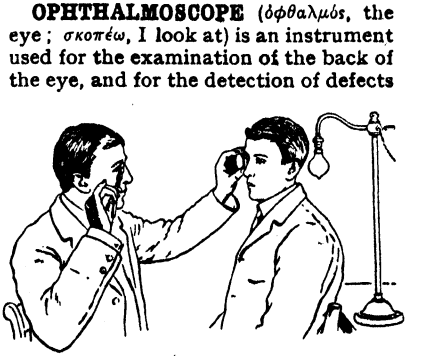


FIG. 352.—Indirect method of examining the eye.

in its transparent contents. Owing to the fact that the interior of the eye, like the inside of a camera, is black, and that

the light enters only by a small opening in front, one cannot look into the eye under ordinary circumstances without, in the act of so doing, obstructing the entrance of direct light sufficient to light it up. Therefore the ophthalmoscope, consisting of a small concave mirror which reflects a beam of light into the eye, and has a hole in its centre through which the observer looks, must be used. It is employed in two ways. Either the observer brings it close up to the face of the person examined, and by the aid of a bright lamp placed at the side of the latter's head, shines a beam into his eye and *directly* examines it, using the lens of the eye as a sort of microscope, and obtaining a magnified view of the interior; or the observer, with the same arrangement of light, sits away at arm's length and examines the eye *indirectly*, placing, at a distance of two inches or so in front of it, a large glass lens, which forms an image of the interior in front of the eye, and allows the observer to obtain a less magnified view. An electric ophthalmoscope, in which light is produced from a dry cell in the handle of the instrument, is often used.

The ophthalmoscope is of immense value, not only to the ophthalmic surgeon, but also to the physician in the diagnosis of general diseases. The eye is the only position in the living body where the end of a nerve (optic nerve), together with an artery and vein (retinal artery and vein), is exposed to view; so that the physician, by examining them, gains important information as to the general condition of the nervous and circulatory systems,

OPISTHOTONOS (ὀπισθότονος, drawn backwards) is the name given to a position assumed by the body during one of the convulsive seizures of tetanus. The muscles of the back, by their spasmodic contraction, arch the body in such a way that the person for a time may rest upon the bed only by his heels and head.

OPIUM (ὄπιον), which is perhaps the most valuable remedy in the whole range of medicine, is the dried juice of the unripe seed-capsules of the white Indian poppy, *Papaver somniferum*. It is cultivated mainly in India, where nearly 1000 square miles are devoted to the growth of the poppy annually, but it is also produced in Persia, China, and the Asiatic provinces of Turkey. The opium possesses its peculiar properties only when produced under favourable conditions of soil and climate, and the juice of other species of poppies grown in temperate climates is almost useless. The juice is obtained by scarifying the seed capsules of the poppies before they are ripe, and next day collecting the gummy sap which has exuded from the cuts. This is dried with great care, kneaded, and carefully tested. Good opium should contain about 10 per cent of morphine, to which its action is chiefly due, and it is a brown, resinous-looking substance, or brown powder, with peculiar smell and bitter taste. The opium used in China is mixed with linseed oil, which renders it more suited for smoking. The action of opium depends upon the alkaloids it contains, of which no fewer than seventeen are available from different kinds. Of these, the chief are morphine or morphia, codeine, narcotine, thebaine, papaverine, and narceine, and as the action of these differs considerably, the effect of the opium naturally varies according to the proportion of each that it contains. Turkey opium, which is purest in morphine, is generally regarded as the best, the use of Indian opium, which contains a large proportion of narcotine, being apt to occasion sickness. Opium, which is exported from the country of its production in balls or cakes, is very often adulterated with sugar, vegetable extracts, gum, molasses, and even stones concealed in the middle of the cakes, and it is therefore very carefully tested before sale.

The importation into Britain of opium is very carefully regulated under the *Dangerous Drugs Act*. Similar regulations govern the sale and distribution of any preparation of morphine or diamorphine (heroin) stronger than 1 part in 500.

The preparations of opium are numerous. Powdered opium (containing 10 per cent of morphine) is frequently used in doses ranging from ½ to 3 grains. Among the other solid preparations are the dry extract of opium (containing 20 per cent of morphine), of which the dose is ¼ to 1 grain; ipecacuanha and opium powder, better known as Dover's powder (containing

10 per cent of opium), in doses of 5 to 10 grains; aromatic chalk powder with opium (containing 0·25 per cent of morphine), much used for the treatment of diarrhœa, in doses of 10 to 60 grains. Of the liquid preparations, the tincture of opium, better known as laudanum (containing 1 per cent of morphine), is the most used, in doses of 5 to 30 minims; the camphorated tincture of opium, also known as paregoric (containing 0·05 per cent of morphine), is given in doses of ½ to 1 teaspoonful; a solution of opium in water, known as "nepenthe," is sometimes used in the same doses as laudanum. A suppository of lead and opium (containing 3 grains of lead acetate and 1 grain of opium) is also used.

The alkaloids morphine and codeine are administered in various forms. Morphine hydrochloride and morphine tartrate are given in doses from ¼ to ½ grain; codeine phosphate in doses from ½ to 1 grain. The liquor of morphine hydrochloride (containing 1 per cent of morphine) is used like laudanum, in doses from 5 to 30 minims. A lozenge of morphine and ipecacuanha is used for inflamed conditions of the throat, and a suppository of morphine (containing ¼ grain of morphine) for painful conditions of the lower bowel.

Action.—The action of opium varies considerably, according to the source of the drug and the preparation used; it varies even more according to the age, race, and temperament of the individual. The unstable nervous system of children is profoundly affected by even the smallest doses, and the death of an infant has been caused by a few drops of laudanum, so that the drug is unsuited for use, except with great care, during childhood.

In small doses, opium produces a state of gentle excitement, the person finding his imagination more vivid, his thoughts more brilliant, and his power of expression greater than usual. This stage lasts for some hours, and is succeeded by languor. In larger, *i.e.* medicinal, doses this stage of excitement is short and is followed by deep sleep, from which the person can still be aroused as from natural sleep. When very large, *i.e.* poisonous, doses are taken, sleep comes on quickly, and passes into coma and death. The habitual use of opium obtains for it a great degree of tolerance, so that opium-eaters require to take large quantities, even many ounces, of laudanum daily, before experiencing its pleasurable effects. The need for opium also confers tolerance, so that persons suffering great pain may take, with apparently little effect beyond dulling the pain, quantities which at another time would be dangerous.

It checks all secretions, except the sweat, and slows the processes of tissue change, this action being sometimes useful, sometimes a hindrance to its employment.

Uses.—Externally, opium has a wide use for application to areas which are painful and inflamed, as in lumbago, inflammation of joints, pleurisy, peritonitis, shingles, etc., and it is generally applied in the form of laudanum fomentations. (*See* FOMENTATIONS.) In toothache, a few drops of laudanum may be put on wool into the cavity of the tooth, and in earache dropped into the ear.

Internally, its great use is to quiet severe pain, such as that of colic or cancer, and for this purpose morphine is often given with atropine, which aids the effect in diminishing any spasm present, and at the same time is an antidote to the poisonous qualities of morphine. In various inflammatory conditions, from a commencing cold in the head to serious conditions like inflammation of the bowels and peritonitis, it is of great value. (*See* CHILLS AND COLDS, DIARRHŒA, PERITONITIS.) In consumption, where there is constant, irritating, useless cough, some preparation of opium or morphine is used as an ingredient in cough mixtures to relieve this. In all cases of pelvic pain, whether arising in the bowel, bladder, womb, or ovaries, morphia is used in the form of suppositories to afford relief. Finally, in many diseases due to overaction of certain functions, such as diarrhœa, or in cases of excessive secretion, opium is used with beneficial results.

OPIUM EATING (*see* DRUG HABITS).

OPIUM POISONING is responsible for a number of the deaths by poison that take place in England and Wales. Laudanum is the form generally responsible for fatalities, next in frequency comes opium, while morphine is only now and then responsible in the pure

state. Perhaps there is no drug in which the amount that can produce serious consequences varies so much as in the case of opium. Two drops of laudanum have been recorded as fatal to an infant, while *habitués* of the drug have, on the other hand, been known to drink it like wine, with only a stimulating effect.

Symptoms.—When a poisonous dose of any of the preparations of the drug has been taken, sleep rapidly comes on, becomes deeper and deeper, and passes gradually into a state of complete insensibility, usually within half an hour, although the effect may be postponed for several hours, particularly when the drug is taken along with spirituous liquors. Convulsions sometimes occur, especially in children, and vomiting may take place before sleep becomes deep, or as the person is recovering. The breathing is slow, quiet, and shallow; and these characters become more and more marked as death draws nigh, the person dying, indeed, as the result of paralysis of the respiratory centre in the brain. The lips and face become livid and covered with cold sweat, and the pupils are much contracted. As a rule, death occurs in from seven to eighteen hours after the dose has been taken.

It is important to distinguish opium poisoning from the effect of alcohol, and from apoplexy, in the case of persons found unconscious. If the person can be roused, the case is probably not one of apoplexy. Further, when apoplexy is the cause there is usually paralysis in one arm or leg, which lies perfectly helpless, or paralysis all down one side. In distinguishing the effect of alcohol from that of opium, the smell of the breath may give assistance, but the state of the pupils, which are contracted in opium poisoning and dilated in alcoholism, is more important. Help may also be gained from the facts that in opium poisoning the perspiration is greater and the person is at first more easily roused. In no case should the person be handled roughly, and if there be any doubt he should be treated as for opium poisoning.

Treatment.—An emetic should be given as soon as possible (*see* EMETICS), and after this has acted, a cup of strong coffee should be swallowed. Even after an emetic has acted, and certainly if it fails to act, the stomach should be washed out with water containing potassium permanganate, which destroys the alkaloids of the opium. As an antidote, full doses of sulphate of atropine ($\frac{1}{100}$ grain) and of strychnine ($\frac{1}{30}$ grain) may be injected beneath the skin, and the injection repeated later.

It is important to keep the patient awake; and for this purpose he must be walked up and down the room if possible, or one may tap him on the forehead with the finger-nails, flick him with wet towels, or apply other painful stimuli. From time to time strong coffee, spirits, and other stimulants may be given internally. If, in spite of all these measures, he becomes unconscious and the breathing begins to fail, artificial respiration must be performed. Generally speaking, by twelve hours after taking the poison the patient is either dead or is showing signs of recovery.

OPODELDOC is an old name for soap liniment.

OPOPANAX (*ὀπός*, juice; *πάναξ*, a plant) is a resinous substance of strong smell, obtained from *Opopanax chironium*, a plant of Turkey. It was formerly used as an antispasmodic in nervous complaints.

OPOTHERAPY (*ὀπός*, juice; *θεραπεία*, treatment) means treatment by juices, and is a general term applied to treatment of disease by the administration of extracts from the organs of animals.

OPSONINS (*ὀψωνέω*, I get food) are substances present in the serum of the blood which act upon bacteria, so as to prepare them for destruction by the white corpuscles of the blood. In the year 1903 the subject was first studied by Wright and Douglas, who obtained white corpuscles in a neutral fluid and serum separated from corpuscles by means of the centrifugal machine. It was found that when bacteria were first mixed with healthy serum, the power of white corpuscles, which were subsequently added, to devour the bacteria was many times greater than that of other white corpuscles acting without the aid of serum, and deprived therefore of the help of opsonin.

In estimating the opsonic power of a patient a few drops of blood are drawn

from his finger into a fine glass tube and the serum separated with the centrifuge. To the serum are added equal quantities of an emulsion of the bacteria the resistance to which is being tested, and of saline fluid containing white corpuscles derived from the blood of the same or another person. The three are drawn into a small tube and incubated at 37°C. for fifteen minutes, thus giving the corpuscles time to attack the bacteria. A microscope preparation is then made, suitably stained, and the average number of bacteria devoured by each corpuscle is determined. This number, divided by the number similarly obtained when tested with the serum of a person known to be healthy, gives the 'opsonic index' of the patient tested.

The opsonic power of the blood against various bacteria can be raised by the hypodermic injection of suitable 'vaccine'. Upon the injection of the vaccine, a fall in the opsonic index of the blood first takes place (negative phase), then a rise (positive phase) to a higher level than before.

OPTIC NERVE is the second cranial nerve, and connects the eye with the brain, conveying from the retina the impressions produced by light. (See EYE *and* VISION.)

ORANGE is used as a flavouring agent in the form of infusion, tincture and syrup of the peel. Fresh orange is also employed, often mixed with glucose, in feverish conditions for the action of the citric acid it contains. (*See* CITRIC ACID.)

ORBIT (*orbita*, a track) is the pyramidal hollow in the skull, situated on each side of the nose, in which the eye is placed. In addition to the eye, each orbit contains the lacrimal gland, a quantity of soft fat upon which the eye rests, and various blood-vessels, nerves, etc.

ORCHITIS (ὄρχις, a testicle) means inflammation of the testicle. (*See* TESTICLE, DISEASES OF.)

ORGANIC DISEASE is a term used in contradistinction to the word functional, to indicate that some structural change is responsible for the faulty action of an organ or other part of the body. (*See* FUNCTIONAL DISEASES.)

ORGANIC SUBSTANCES are those which are obtained from animal or vegetable bodies, or which resemble in chemical composition those derived from this source. Organic chemistry has come to mean the chemistry of the carbon compounds.

ORGANISMS (ὄργανον, a formed body). (*See* BACTERIOLOGY.)

ORGANOTHERAPY (ὄργανον, organ; θεραπεία, treatment) means the treatment of disease by the administration of animal organs or their extracts. In some cases in which the secretion of a gland is defective in consequence of atrophy or after removal of the gland, it is necessary to supply the defect by prolonged administration of an extract derived from the same gland of an animal such as the sheep. For example, in the disease known as myxœdema, which is caused by atrophy of the thyroid gland, the affected persons require to take a small but regular supply of thyroid extract. (*See* MYXŒDEMA.) In cases of Addison's disease extract of the suprarenal cortex is given, and in cases of hypogonadism œstradiol or testosterone according to whether the female or male gonad is at fault. In cases of diabetes, where the muscles are unable to take up the sugar that they require from the blood in consequence of failure of the pancreas to secrete a substance that normally effects this, the disease is relieved by the injection of insulin or other pancreatic extract.

In another class of cases, extracts are administered because of certain ferments which they contain and which supply the place of similar ferments defective in the human body. For example, rennin and pepsin derived from the mucous membrane of the pig's stomach and liquor pancreaticus extracted from the pancreas are used to supply defects in the digestive juices.

In other cases the organs of animals or materials derived from them are used because they contain quantities of vitamins necessary to aid assimilation of food-stuffs. Cod-liver oil, for example, is used both for this reason and because the fat it contains affords a valuable food.

In still other cases where an individual organ is beginning to fail, as, for

example, the heart or the kidney, an extract derived from the same organ in an animal is sometimes administered, and there are now some grounds for believing that kidney extract may be of use in treating high blood-pressure. (*See* RENIN.)

ORIENTAL PLAGUE (*see* PLAGUE).

ORIENTAL SORE, also known as DELHI BOIL and as ALEPPO EVIL, is a disease of tropical climates in which an ulcer begins in a small pimple, spreads, and then heals very slowly, leaving an unsightly scar. It is caused by a minute animal parasite *Leishmania*, similar to that responsible for kala-azar. From the fact that the sore affects not only persons of all ages and social positions, but also the lower animals, it appears to be contagious and may be conveyed by biting insects. Intravenous injection of tartar emetic has been successfully employed, or tartrate of antimony may be given by the mouth.

OROTHERAPY (ὀρός, whey; θεραπεία, treatment) means treatment by serum. (*See* SERUM THERAPY.)

ORTHOCAINE, or ORTHOFORM, is a whitish crystalline powder with soothing and antiseptic properties.

ORTHODIAGRAPH (ὀρθός, straight; διαγράφω, I delineate) is the term applied to an X-ray apparatus for recording accurately the form and size of structures inside the body.

ORTHOPÆDICS (ὀρθός, straight; παῖς, child). — The general measures, surgical and mechanical, which can be used for the correction or prevention of deformities in children. Now, more commonly, that branch of medical science dealing with bodily deformity, congenital or acquired.

ORTHOPNŒA (ὀρθόπνοια) is a form of difficulty in breathing so severe that the patient cannot bear to lie down, but must sit or stand up. As a rule, it occurs only in serious affections of the heart or lungs.

ORTHOPTIC TREATMENT is the term applied to the treatment of squint by giving special exercises for the muscles of the eye.

OSMOSIS (ὠσμός, a thrust) means the passage of fluids separated by a membrane through this, so as to become mixed with one another. Osmotic pressure is a term applied to the strength of the tendency which a fluid shows to do this, and depends largely upon the amount of solid which it holds in solution.

OSSIFICATION (*os*, bone; *facio*, I make) means the formation of bone. In early life, centres appear in the bones previously represented by cartilage or fibrous tissue, and from these the formation of true bone and deposit of lime salts proceed. When a fracture occurs, the bone mends by ossification of the clot which forms between the fragments. (*See* FRACTURES.) In old age an unnatural process of ossification often takes place in parts which should remain cartilaginous, *e.g.* in the cartilages of the larynx and of the ribs, making these parts unusually brittle.

OSTEITIS (ὀστέον, a bone) means inflammation in the substance of a bone. (*See* BONE, DISEASES OF.)

OSTEO-ARTHRITIS (ὀστέον, bone; ἄρθρον, joint) is a term applied to a chronic inflammation of the bones composing a joint, and leading to deformity. (*See* RHEUMATISM.)

OSTEOMALACIA (ὀστέον, bone; μαλακός, soft) is a rare disease, in which the bones become slowly softened as the result of the absorption of the lime salts they contain. The cause of the disease is believed to be a deficiency of vitamin D in the food combined with lack of sunshine, and it affects especially mothers who have borne many children in rapid succession.

The most serious feature of the disease is the deformity which occurs in the softened bones owing to the weight of the body and the action of the muscles. This deformity, when it affects the bones of the pelvis and spine, may cause difficulty in parturition, and is a source of great danger to mother and child.

As to treatment, good food, containing especially cod liver oil or other sources of vitamin D, and exposure to

sunlight or ultra-violet radiation are essential. Excision of the ovaries to prevent further pregnancies has also been practised.

OSTEOMYELITIS (*ὀστέον*, bone; *μυελός*, marrow) means inflammation in the marrow of a bone. (*See* BONE, DISEASES OF.)

OSTEOPATHY is the name applied to a system of healing in which diseases are treated by manipulating bones and other parts with the idea of thereby restoring functions in the bodily mechanism that have become deranged.

OSTEOPOROSIS means increased porousness of bone due to abnormal drainage of calcium salts from it.

OSTEOSCLEROSIS FRAGILIS GENERALISATA is an uncommon condition characterised by the appearance in the bony skeleton of scattered patches of abnormally dense bone. The cause of this abnormality is unknown, which may account for the number of long names given to it, for example:— ALBERS-SCHÖNBERG DISEASE, OSTEITIS CONDENSANS GENERALISATA, OSTEOPETROSIS, OSTEOPOIKILOSIS, MARBLE BONES, CHALKY BONES.

OTITIS (*οὖς*, the ear) means inflammation of the ear. (*See* EAR, DISEASES OF.)

OTOLOGY is that branch of medical science which is concerned with disorders and diseases of the organ of hearing, one practising this branch being called an OTOLOGIST.

OTORRHŒA (*οὖς*, the ear; *ῥέω*, I flow) means discharge from the ear. (*See* EAR, DISEASES OF.)

OTOSCLEROSIS is the term applied to the condition in which spongy bone forms in the capsule of the labyrinth of the ear and progressive deafness develops.

OUABAIN.—G-Strophanthin. Crystalline strophanthin. A glucoside first obtained from the South African tree *Acocanthera ouabaia*: it was used as an arrow poison in E. Africa. Ouabain is now obtained from the S. African tree *Strophanthus gratus*. It is a cardiac stimulant, having a similar action to that of digitalis.

OVARIES.—The ovaries are the glands in which are produced, in the female sex, the ova, capable, if fertilised, of developing into new individuals. They are situated one on each side in the cavity of the pelvis, corresponding on the surface of the body nearly to the centre of the groin. Each is shaped something like an almond, is about 1½ inches long, ½ inch wide, and ¼ inch in thickness, and is whitish in colour. It is attached to the broad ligament running from the womb to the side of the pelvis, by one edge along which blood-vessels and nerves enter. One end is connected to the expanded end of the Fallopian tube, as well as by a ligament to the side of the pelvis, and the other end a ligament to the side of the womb. The ovary, therefore, lies to a considerable extent free in the pelvis.

The chief bulk of the ovary is made up of connective tissue, which differs from ordinary fibrous tissue in being composed of spindle-shaped cells. On the surface is a layer of columnar cells, and beneath this a dense connective tissue layer, the 'tunica albuginea'. Beneath the tunica albuginea the structure appears to the naked eye to be of a granular character, this appearance being due to the presence of a layer of 'Graafian follicles', variously estimated at from 30,000 to 70,000 in number in the two ovaries. Each Graafian follicle is about $\frac{1}{100}$ inch in diameter, and contains one (seldom more) ovum, each of these ova being capable of developing into a new individual. Every Graafian follicle consists essentially of a hollow ball of cells, embedded in which is a single large cell, the ovum, and each ovary contains Graafian follicles in all stages of maturity, from the rudimentary ones described above to several which are greatly increased in size through multiplication of the cells surrounding the ovum and the formation among them of a cavity distended with fluid. It is supposed that one at least of these follicles comes to maturity about half way between two menstrual periods, distends till it reaches the surface of the ovary, and finally bursts, allowing of the escape of the contained ovum, which finds its way down the corresponding Fallopian tube into the womb. This process is known as ovulation. (*See* MENSTRUATION.)

OVARIES, DISEASES OF

For ovarian secretions *see* Ovaries under ENDOCRINE GLANDS, and also ŒSTRADIOL, ŒSTROGEN, and PROGESTERONE.

OVARIES, DISEASES OF.—Because of the position of the ovaries within the abdomen, the repeated changes which take place in them, and their important nervous connections, disease in them may produce marked effects upon the general bodily and mental health.

INFLAMMATION OF THE OVARY (OVARITIS) may be acute, but is more often chronic with acute relapses. It has many causes, arising, for example, after childbirth or a miscarriage which has been attended by some infective process. The occurrence of peritonitis localised to the pelvis, in which adhesions are formed between the ovary and neighbouring organs, is also a cause. Displacement of the ovary, with or without displacement of the womb, is practically always attended by more or less inflammation, often of a very severe type. After fevers and other infectious diseases, and most of all, perhaps, as the result of infection passing upward from the vagina and womb, ovaritis comes on.

Symptoms. — These are very indefinite. There is always pain in the side and back, accompanied by great tenderness to touch over the position of the inflamed ovary. In the chronic form the menstrual periods may be characterised by excessive discharge, and at such times the pain becomes much worse. Later on, as the ovary shrivels up (cirrhosis), the periods often prematurely pass off altogether, and sterility results. In many cases, as the result of long-continued pain and discomfort, the person becomes a permanent invalid. Sometimes, as the result of ovaritis, an abscess forms, and this is a very serious complication.

Treatment.—Prolonged rest in bed, with the patient lying on her back, and subsequent avoidance of violent exercise, together with great care of the general health, are essential. Fly-blisters over the region of the ovary, the internal administration of bromides and other sedative drugs, the use morning and evening of the hot vaginal douche, and the careful regulation of the bowels by saline aperients, form the course of treatment generally adopted. Pessaries of various sorts are introduced in order to give support to the ovary if displaced, or to exert some medicinal action upon its state of congestion and inflammation. A course of waters at Woodhall, Kreuznach, or certain other spas is often beneficial. Finally, if all these milder means fail, the condition of pain and discomfort may occasionally be so great as to justify the serious operation of removing the inflamed ovary entirely.

OVARIAN TUMORS may be of several kinds. Solid tumors, either simple or malignant, are rare, far commoner being the cystic forms, which often reach a huge size. These cysts are of several types, sometimes consisting of a distended condition of the Graafian follicles, at other times being simple cysts filled with a complex papillary growth, again being dermoid tumors and containing fat, hair, teeth, and other structures associated with the skin, and yet again arising from the distension of some part of the parovarium, a rudimentary structure attached to the ovary.

The fluid in these cysts is sometimes of a greenish-grey or brown colour and viscid, ropy consistence, at other times clearer and thinner, and, in the case of dermoid tumors, usually of a greasy nature.

Symptoms. — These tumors generally remain quite painless till the weight and distension caused by their increasing size give trouble. They arise often in young women without any apparent cause. If they are not removed, some, which stand on the verge of being malignant tumors, increase rapidly in size, and all lead to great discomfort and loss of health, and finally shorten life.

Treatment.—The one method of treatment adopted now consists in *ovariotomy*. This operation should be performed early in the course of the disease, because, as the tumor grows, it contracts adhesions to surrounding organs, and these are the source both of the most distressing symptoms and of the chief difficulty and danger in a later operation. The mortality of the operation, including all cases, does not exceed 1 in 20, and most cases operated upon at an early stage recover well, the operation being one of the safest major operations in surgery.

The method by which it is now performed consists in making an incision in the middle of the abdomen, draining the tumor, then seizing the collapsed sac and separating it carefully from its adhesions, and cutting through the 'pedicle' by which it is fixed. Finally, the stump of the pedicle is ligatured, cauterised, clamped, or otherwise prevented from bleeding, and the wound in the abdomen closed. The chief difficulty in the operation consists, as already stated, in freeing the cyst from the bowels and other organs to which it may have become adherent.

The credit of having first performed this operation, which has rescued many from a life of misery and from premature death, belongs to Ephraim M'Dowell of Kentucky, who in 1809, in the face of violent public opposition, successfully removed an ovarian cyst. It was established in England as a regular operation by Clay of Manchester, whose first case was treated in 1842, and subsequently this department of surgery was placed upon a firm basis by the successful work of Spencer Wells, Thomas Keith, and Lawson Tait.

OVARIOTOMY (*see* Ovarian Tumors *under* OVARIES, DISEASES OF).

OVI ALBUMEN is a Latin term for white of egg; OVI VITELLUM is that for yolk of egg.

OVUM (*ovum*, an egg) is the single cell derived from the female, out of which a future individual arises, after its union with the spermatozoon derived from the male. (*See* EMBRYO.)

OXALIC ACID is not used in medicine, but it is of importance because it is an irritant poison, and has a domestic use for cleaning purposes. Oxalic acid, or binoxalate of potassium (salts of sorrel), is occasionally taken by mistake for Epsom salts or for cream of tartar. This substance is also important, because oxalate of lime is found in urinary sediment, and sometimes composes urinary calculi. (*See* BLADDER, DISEASES OF.) Oxalate of lime in the urine is derived partly from articles of food, like rhubarb, that contain it, and is partly produced within the body as the result of tissue change.

When poisoning is the result of taking oxalic acid or binoxalate of potassium, a large amount of chalk or whiting mixed with water should be given, and, if vomiting be not already present, an emetic; afterwards the irritation resulting in the stomach and bowels is to be soothed by demulcents.

OX-GALL, in a purified and dry condition, is used in medicine for the purpose of relieving certain forms of indigestion which depend upon deficient secretion of bile, or which occur in persons who digest fats badly. It is given in doses of 5 to 15 grains in pill form, and is to be taken several hours after meals, since it is concerned not in gastric but in intestinal digestion.

OXYCEPHALY, or STEEPLE HEAD, is the term for describing a deformity of the skull in which the forehead is high and the top of the head pointed. There is also poor vision and the eyes bulge.

OXYGEN (*ὀξύς*, acid; *γεννάω*, I produce) is a colourless gas, devoid of smell, slightly heavier than common air. It was discovered almost simultaneously by Priestly in England and Scheele in Sweden in 1774. It forms rather more than one-fifth by volume of the atmosphere. It is prepared by heating chlorate of potash along with

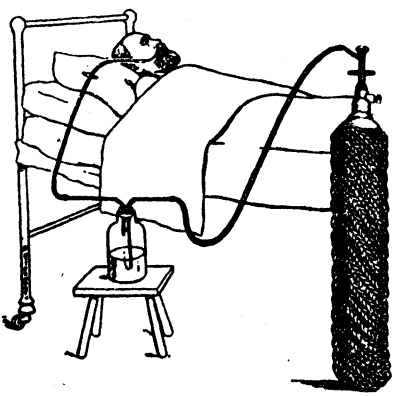


FIG. 353.—Apparatus for oxygen inhalation.

peroxide of manganese; and, in greater quantities for commercial purposes, by passing air over oxide of barium (BaO) at a high pressure, and then diminishing the pressure while the dioxide of barium (BaO_2) is heated to drive off the oxygen

it has taken up. Thus prepared, it is stored at high pressure (up to 120 atmospheres) in steel cylinders, from which it is obtained at any desired rate by turning a stop-cock.

Action.—Oxygen is necessary to life, and the process of respiration (*see* RESPIRATION) has, as one of its main objects, the supply of oxygen to the blood. Applied to the unbroken skin oxygen has little effect, but when brought in contact with a wound or ulcer, it increases the circulation and acts as a stimulant.

The condition of oxygen want, or anoxemia, may be produced by various conditions, such as damage to the lung by tumors, anæmia, etc., or defects of the circulation, *e.g.* valvular disease of the heart, in which the circulation is so slow that the tissues do not receive their proper amount of oxygen, and in cases of anæmia and poisoning where the blood is not capable of carrying its normal amount of oxygen. In these states, and above all in cases of anæmia and valvular disease, when the pulse is quick and feeble, when the patient's lips and ears are blue, and when the breathing is rapid and shallow, the administration of oxygen gives great relief.

Uses.—Oxygen is stored in cylinders which usually contain 20 or 40 cubic feet of the gas, but larger cylinders containing 100 cubic feet can be obtained. In severe cases of anæmia the rate at which oxygen may require to be delivered to the patient is between 2 and 3 litres per minute. A rubber tube is attached to the head of the cylinder, which passes through the glass tubes of a wash-bottle and is continued to either a mask, which fits over the patient's nose and mouth, or, preferably, to a rubber catheter which is passed into one of the nostrils and fixed in position at the side of his face by a strip of sticking plaster. The use of the latter is unaccompanied by any sense of oppression to the patient.

Great advances have been made in recent years in the development of oxygen tents. These may be of such a nature that the patient's head is enclosed in a 'tent' into which oxygen is continuously flowing. The gas masks devised for babies at the beginning of the Anglo-German war in 1939 have been adapted as oxygen tents for babies with pneumonia. The advantage of the tent is that the patient is breathing all the time in an atmosphere saturated with oxygen. Another very effective way of giving oxygen is by what is known as the 'B.L.B. mask', from the American doctors who introduced it—W. M. Boothby, W. R. Lovelace, jun., and A. H. Bulbulian.

Substances which contain oxygen and are capable of giving it off, such as permanganate of potassium, peroxide of hydrogen, and charcoal, have a powerful effect as disinfectants either by destroying organisms or oxidising noxious products of their growth. Such substances are therefore much used in the treatment of ulcers and various skin diseases and as antiseptics.

OXYMEL (ὀξύς, acid; μέλι, honey) is an old-fashioned remedy for colds and sore throats, composed of vinegar and honey. It is given in doses of one or two teaspoonfuls.

OXYTOCIC.—Hastening parturition. Stimulating uterine contraction.

OXYURIASIS.—The condition of being infested with thread- or pin-worms.

OXYURIS (ὀξύς, sharp; οὐρά, tail) is another name for the thread-worm. (*See* PARASITES.)

OZÆNA (ὄζαινα, a fœtid polypus in the nose) is a chronic disease of the nose of an inflammatory nature, combined with atrophy of the mucous membrane and the formation of extremely foul-smelling crusts in the interior of the nose. (*See* NOSE, DISEASES OF.)

OZONE (ὄζω, I smell) is a specially active form of oxygen in which three volumes of the gas are condensed into the space ordinarily occupied by two. It has a peculiar smell, which may be noticed in the neighbourhood of dynamos, as ozone is produced by the passage through the air of electric sparks. It exists free in small quantities in the air of pine-clad mountains and of the seaside, where the invigorating properties of the fresh air may be partly due to its presence. It has also a powerful deodorant action.

P

PACHYDERMIA (παχύς, thick; δέρμα, skin) means hypertrophy or thickening of the skin. PACHYDERMIA LARYNGIS is a name applied to thickening of the vocal cords due to chronic inflammation or irritation.

PACHYMENINGITIS (παχύς, thick; μῆνιγξ, a membrane) means inflammation of the dura mater of the brain and spinal cord. (*See* MENINGITIS.)

PACINIAN CORPUSCLES are minute bulbs at the ends of the nerves scattered through the skin and subcutaneous tissue, and forming the end organs for sensation.

PACKS (*see* WET PACK).

PAGENSTECHER'S OINTMENT is a name sometimes applied to ointment of yellow oxide of mercury.

PAGET'S DISEASE OF BONE, or OSTEITIS DEFORMANS, is the term applied to a chronic disease in which the bones—especially those of the skull, limbs, and spine—gradually become thick and also soft, causing them to bend. The cause is not known.

PAIN is a necessary part of conscious existence, all our sensations being accompanied by more or less feeling of pleasure or pain. In the former case we seek the repetition of the sensations; in the latter case we instinctively avoid them, unless, by an act of will, we avoid the sense of pleasure or bear that of pain for some ulterior motive. The ability to perceive pain constitutes a special sense which the body has evolved, or with which it has been furnished, in order that it may preserve itself, by avoiding conditions that produce damage.

Pain is of various types. The most important is that caused by injury of the skin, as by a prick, burn, or pinch. This sense is quite distinct from that of touch. There are special nerve-fibres for the conduction of painful impressions running up the spinal cord near its central canal, while the fibres conveying the impressions for touch run up in the posterior part of the cord. This is proved by the destruction of the sense of pain in the disease known as 'syringomyelia' (which affects the central part of the cord), notwithstanding the fact that the slightest touch can still be felt in the parts of the body incapable of feeling pain. This loss of the power to feel pain while the power to feel touches is retained is called 'analgesia'. Further, it is probable that these nerves of pain have special endings in the skin, since pain does not appear to be felt uniformly, but, like the other senses, at special spots thickly scattered over the surface. And it is also likely that there is a special centre in the brain for the reception of painful impressions.

Internal parts are much less sensitive than the skin, and diseases in them usually give rise to quite a different sensation. Indeed these parts, not being liable to damage by external objects, are not endowed with the power of feeling pain due to sudden injury, so that the bowel, when brought out through the skin, may be cut with scissors or knife, though the individual, unless he sees it, is quite unaware of what is taking place; tendon, muscle, and bone are also very insensitive, so that the two former may be cut or scraped without more than a slightly sickening sensation, or the ends of a broken bone rubbed together without causing severe pain.

Nevertheless inflammatory changes in these deep-seated structures, and disturbances in their functions, are capable of influencing the brain so as to produce the severest type of pain. This inflammation, particularly when seated in dense structures which cannot expand so as to prevent the congested blood-vessels of the part from pressing upon its nerves, is accompanied by 'throbbing' pain, and, in bone particularly, this is apt to be of a 'boring', excruciating character. The 'gnawing' pain of a tumor invading surrounding tissues is of a similar nature, and any source of irritation on the course of a nerve is apt to produce the severe pain of 'neuralgia'. Overaction of a weak part or muscle leads to continued pain of an 'aching' character, due probably to an irritating deposit of the chemical

products of muscular activity, or may produce spasm, as in the 'stitch' of the side caused by unwontedly violent exercise. Of a similar nature is the colic or 'griping' pain, caused by irritation of the bowels, bile-ducts, ureters, etc., which in its severest forms may properly be designated 'agony'. (*See* COLIC.) The 'burning' pain of certain forms of dyspepsia is due to the action of an excessively acid gastric juice, and, like burns of the skin, is apparently due to irritation of the sensitive nerve-endings at points where the surface of the mucous membrane has become eroded.

Ordinary sensations of all sorts become painful when they are excessive, and thus liable to damage the organ in question, *e.g.* bright light, loud sound.

Painful sensations depend much also upon the state of the nervous system, varying according to the power of the nerves to conduct, and of the brain to receive, impressions. Some persons are notoriously better at bearing pain than others, and the healthy and strong are less affected by trivial injuries than those whose nervous system is in a state of ready irritability through chronic ill-health. Persons of strong will-power can undoubtedly inhibit painful impressions, like those from a surgical operation, just as they can control irregular movements, and so by a mental effort not only do such persons bear pain better, but they actually feel less pain. Similarly the mind that is dominated by an idea unconsciously inhibits painful impressions, so that they gain no entrance for the time, as in the case of soldiers wounded in the heat of battle, orators or preachers who are the victims of neuralgia, or even, in olden times, martyrs at the stake.

On the other hand, pain may be of a purely 'functional' character, and a person of highly-strung or disordered nervous system may suffer pain without any external cause, the mind misinterpreting or exaggerating sensations which by the healthy person would not be noticed. (*See* HYSTERIA.)

These facts are well known to those 'faith-healers' and others who attempt to cure by a direct mental impression, and who by this means often succeed in alleviating pain, though only in special cases, such as the 'functional' pains just mentioned, are they fortunate in curing the disease to which the pain is due, and of which it is the warning.

Pain in a certain part is not necessarily due to disease in the same part. In the case of injury to the skin covering the body, the mind, as the result of experience, very accurately refers the painful impressions down the nerves which bring them, to the parts from which they come. But when impressions come to the central nervous system from organs or parts of the body not usually liable to injury or disease, the mind is very apt to refer the pain to some other part which is more commonly the seat of pain, and whose nerve-fibres enter the same part of the brain or spinal cord as do those coming from the part which is really affected. For example, in the early stages of hip-joint disease, the pain is more frequently felt down the inner side of the thigh and knee than in the deep-seated hip-joint, since branches from the same nerves (obturator and anterior crural) supply the hip-joint and the skin of this particular area. For the same reason, the pain of spinal disease, due to pressure upon the large nerve roots close to the point where they enter the cord, is often referred, not to this unfamiliar seat of pain, but to the sides and front of the body where these nerves end in the skin. In this connection it may be stated that pain felt equally on both sides of the body is almost always due to some affection of the central nervous system.

In the case of the internal organs whose nervous control is derived from the sympathetic nervous system (in the case of the heart, lungs, stomach, and bowels partly also from the tenth cranial or pneumogastric nerve), through which they often obtain complicated and very distant connections with the brain and cord, pain is frequently referred, in what seems at first sight to be a bizarre manner, to distant points. Much precise knowledge on this subject has, however, been gained by the researches of Head. *Referred pain* is often, in the case of the heart, stomach, liver, and bowels, felt on the surface situated over these organs, and the skin may be so tender that gentle pressure or even the slightest touch cannot be borne. Heart conditions are very liable also to cause pain running down the inner side of the left, and, in some cases, of the right arm

to the elbow. In dyspepsia, due to irritation of the stomach, the pain is often referred to the pit of the stomach or middle of the back. In conditions affecting the liver there may be pain in the region of the right shoulder. Affections of the lower end of the bowel commonly cause pain down the back of the thighs, especially of the left thigh, to the knee. Pain due to disorders of the womb is felt internally much less often than in the lowest part of the back and the thighs; and, where the ovaries or Fallopian tubes also are affected, the pain may have a very wide distribution, including the small of the back, the groin, and the front of the thigh, or it is occasionally referred to the hip or knee-joint, so that the case may for a time be mistaken for disease in one of these joints.

Treatment of pain.—There are three general principles by which the relief of pain may be attempted. (1) The most natural way is to remove the cause of pain, such as a decayed tooth, ulcer, abscess, or inflammatory condition of some internal organ, or to soothe the nerves of the affected part by warmth or some other means. (2) The nerves which convey impressions from the affected region may be treated so that their conducting power is lessened or stopped, as, for example, by administration of bromides, use of electricity, or division of the nerves, as in neuralgia, or by chordotomy (*q.v.*). (*See* NEURALGIA.) (3) The part of the brain which receives the impressions of pain may be dulled by drugs, such as opium and antipyrine, or the influence of these impressions may be 'inhibited' by powerful mental impressions, as in hypnotism, faith-healing, etc. (*See also* ANÆSTHETICS, ANALGESICS, ANODYNES, and under the headings of the various diseases that give rise to pain.)

PAINS (*see* LABOUR).

PAINTER'S COLIC (*see* COLIC, LEAD POISONING).

PALATE (*palatus*, the roof of the mouth) is the partition between the cavity of the mouth, below, and that of the nose, above. It consists of the *hard palate* towards the front, which is composed of a bony plate covered below by the mucous membrane of the mouth, above by that of the nose; and of the *soft palate* farther back, in which a muscular layer, composed of nine small muscles, is similarly covered. The hard palate extends a little farther back than the wisdom teeth, and is formed by the superior maxillary and palate bones. The soft palate is concave towards the mouth and convex towards the nose, and it ends behind in a free border, at the centre of which is the prolongation known as the 'uvula'. When food or air is passing through the mouth, as in the acts of swallowing, coughing, or vomiting, the soft palate is drawn upwards so as to touch the back wall of the throat and shut off the cavity of the nose. Movements of the soft palate, by changing the shape of the mouth and nose cavities, are important in the production of speech.

PALATE, MALFORMATIONS OF.—The palate is subject to certain alterations, as the result of defective development. The hard palate may be much more arched than usual, and this is said often to be the sign of a feeble brain, though it may also be due to the failure to breathe through the nose, caused by the presence of adenoid vegetations in the throat. (*See* NOSE, DISEASES OF.)

In early embryonic life (*see* EMBRYO) there are certain clefts in the region of the throat and face, the nose being formed by the junction of one process which grows down from between the eyes (fronto-nasal process) and two which grow in, one from either side (maxillary processes). The fronto-nasal process produces the external nose, the septum of the nose, the central part of the upper lip, and that part of the upper jaw which carries the two front teeth. The maxillary processes form the remainder of the upper jaw and the palate on each side. These three should unite completely prior to birth, but if they fail to do so, a Y-shaped gap is left. This gap runs from the back of the palate forward to a point a little distance behind the front teeth, from which point a limb of the gap runs forward to each nostril and through the upper lip. This complete state of 'cleft-palate' may occur; or there may be only a partial gap in the soft palate, the parts having closed in front; or again, there

may be closure behind and only a notch be left in the lip or a single cleft in the edge of the upper jaw. The notch of

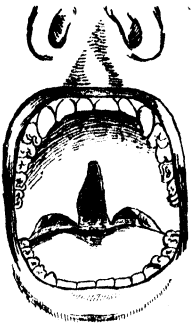


FIG. 354.—Cleft in the hinder part of the palate. (After Miller.)

the lip is known as ' hare-lip ', from a fanciful resemblance to the hare, which has a notch in the centre of its lip.

Cleft-palate and hare-lip should, if

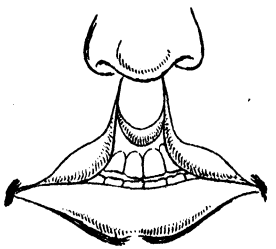


FIG. 355.—Double hare-lip. (After Miller.)

possible, be rectified by operation, because both are a serious drawback to feeding in early life, while later, hare-lip is a great disfigurement, and cleft-palate gives to the voice a peculiar twang. When there is merely a slight degree of hare-lip, it is usual to operate a few weeks or even some days after birth, though, when the notch is very large, it may be necessary to wait till the child is several months old. The closure of a large cleft in the palate, which is a more formidable operation and accompanied often by much bleeding, is usually deferred till the child has gained some strength, and the most suitable time is generally held to be between eighteen months and two and a half years of age, because the fault must be remedied before the child has learned to speak. The operations that are performed vary greatly in details, but all consist in paring the edges of the gap and drawing the soft parts together across it.

Until a hare-lip has been remedied, it is often necessary to feed the child with a spoon, as he cannot suck. When a cleft-palate is too wide for operation, its effects can be diminished in later life by wearing an artificial palate.

PALINDROMIC RHEUMATISM.—A form of rheumatism in adults characterised by multiple, afebrile attacks of acute arthritis, periarthritis, and occasionally para-arthritis, with pain, swelling, redness, and disability of one or more small or large joints, the attacks coming on suddenly, lasting a few hours to a few days, then disappearing completely, to recur at irregular intervals.

PALLÆSTHESIA (πάλλω, I quiver; αἴσθησις, feeling) means sensibility to the vibrations of a tuning-fork applied to the neighbourhood of a bone. Loss of this sense is an early feature of locomotor ataxia.

PALLIATIVE is a term applied to the treatment of incurable diseases, in which the aim is to mitigate the sufferings of the patient, not to effect a cure.

PALPATION (*palpo*, I touch gently) means the method of examining the surface of the body and the size, shape, and movements of the internal organs, by laying the flat of the hand upon the skin.

PALPEBRA is the Latin term for eyelid.

PALPITATION (*palpito*, I throb) is a condition in which the heart beats forcibly or irregularly, and the person becomes conscious of its action.

Causes.—As a rule we are quite unconscious of the beating of the heart, but when the nervous system is unduly excited its action may become unpleasantly palpable. It is liable to come on at the time of puberty or of the change of life, and also in the weak state of body that accompanies great anæmia, acute fevers, or neurasthenia. Sudden emotions, such as fright, and occasionally dyspepsia, may bring it on. A very frequent cause consists in over-use of tobacco, tea, coffee, or alcohol. Sometimes it may appear in bad cases of

organic heart disease or with the hypertrophied heart of chronic Bright's disease.

Symptoms.—There may simply be a fluttering of the heart and a feeling of weakness, which is often expressively described as 'goneness'; or the heart may be felt pounding and the arteries throbbing, causing great distress to the affected person. In some cases the subject of palpitation is conscious of the heart missing beats.

Treatment.—Mental quietness is the great requisite to still the overaction, and all sources of excitement must be avoided. The person should understand that, however unpleasant the condition may be, there is no danger from it, and that serious disease is not usually the cause. Moderate exercise is a good thing. If the person be a heavy smoker, this is probably the cause, and tobacco should be given up. Similarly tea, coffee, and alcohol should be most sparingly partaken of, and any food likely to cause flatulent dyspepsia should be avoided. In the occasional cases due to serious organic disease, the condition causing palpitation must be treated.

PALSY (for parlesy, from παραλύομαι, I am disabled) is another name for paralysis. (*See* PARALYSIS.)

PALUDISM, or PALUDAL FEVER (*palus*, a marsh) is another name for malaria.

PAMAQUIN is the *British Pharmacopœia* name for PLASMOQUINE (*q.v.*).

PAN- (πᾶς, all) is a prefix meaning all or completely.

PANACEA (πανάκεια) is a term applied to a remedy for all diseases, or more usually to a remedy which benefits many different diseases.

PANARITIUM (*panaritium*) is a term applied to a whitlow which remains chronic and destroys part of the finger.

PANCARDITIS means inflammation of the pericardium, myocardium, and endocardium at the same time.

PANCREAS (πάγκρεας). — The pancreas or sweetbread is a long secreting gland situated in the back of the abdomen, at the level of the first and second lumbar vertebræ. It lies behind the lower part of the stomach, an expanded portion called the 'head' of the pancreas occupying the bend formed by the duodenum or first part of the small intestine, while a long portion known as the 'body' extends to the left, ending in the 'tail', which rests against the spleen. A duct runs through the whole gland from left to right, joined by many small branches in its course, and leaving the head of the gland, unites with the common bile-duct from the liver to open into the side of the small intestine about 3 or 4 inches below the outlet of the stomach.

Minute structure.—The gland resembles one of the salivary glands, being

FIG. 356.—Diagram of the organs drained by the portal vein. *d*, The pancreas; *q*, its duct; *P*, the point where it enters the small intestine. For other letters see PORTAL VEIN. (Turner's *Anatomy*.)

composed of tubes of columnar cells bound together by loose connective tissue. These cells are arranged with one end abutting on a central lumen into which the secretion of the cells passes, and each group of tubes ends in a small duct, which unites with other small ducts to join the main pancreatic duct running to the intestine. The cells present an outer, clear zone, and an inner zone filled with granules of the materials secreted by the activity of the cell. Blood-vessels and nerves in large numbers run in the connective tissue of the gland.

Scattered through the pancreas is

found a large number of collections of cells known as the ' Islands of Langerhans '. These do not communicate with the duct of the gland, and the internal secretion of the pancreas — insulin—is formed by these cells and absorbed directly into the blood.

Functions.—The most obvious function of the pancreas is the formation of the pancreatic juice, which is poured into the small intestine after the partially digested food has left the stomach. This is the most important of the digestive juices, is alkaline in reaction, and contains, in addition to various salts, four ferments. These ferments are: trypsin, which digests proteid bodies; amylase, which converts starchy foods into the disaccharide maltose; lipase, which breaks up fats; rennin, which curdles milk; and maltase, which converts maltose into glucose. The action of these is described under DIGESTION.

When the islands of Langerhans are atrophied or partially destroyed diabetes results. (*See* DIABETES.) In addition to insulin, another hormone believed to be produced by the pancreas has been called LIPOCAIC (*q.v.*); it is thought to play a part in fat metabolism.

PANCREAS, DISEASES OF.—Owing to the depth at which this gland is situated, diseases affecting it seldom give very definite signs of their presence. The occurrence of diabetes in connection with pancreatic disease has been already mentioned. Abscess, cysts, calculi and tumors may occur in this as in other organs, and a disease peculiar to the pancreas appears to be the occurrence of hæmorrhages into its substance, especially in fat people, this being an occasional cause of sudden death.

PANCREATIN (*see* PEPTONISED FOODS).

PANDEMIC (πανδήμιος, belonging to the whole people) is the term applied to an epidemic which affects a vast area, such as a country or a continent.

PANHYSTERECTOMY (πᾶς, all; ὑστέρα, womb; ἐκτομή, excision) is a term applied to an operation by which the uterus is completely removed.

PANNICULITIS means inflammation of the subcutaneous fat, and may occur anywhere on the body surface.

PANNUS (*pannus*, cloth) is the name applied to the growth across the cornea of an abnormal opaque membrane with minute blood-vessels, due to some serious form of irritation. It is found especially in cases of trachoma and tends gradually to cause blindness.

PANTOTHENIC ACID, which has now been prepared synthetically, is part of the vitamin B2 complex. It is known as the ' chick anti-dermatitis factor ', because if it is absent from the chick's diet the bird develops dermatitis, and degeneration of nerve-fibres in the spinal cord also occurs. In rats given a diet from which pantothenic was absent necrosis of the suprarenal glands was observed. It is possible that pantothenic acid may play some part in the development of human skin diseases. The vitamin is present especially in liver and kidney, and appears to be heat stable.

PAPAIN, PAPYAOTIN, and PAPOID are names given to a ferment obtained from the root of *Carica papaya*, which has an action similar to that of the ferments of the gastric and pancreatic juices. It is, accordingly, sometimes used to peptonise foods for invalids, as it does not give them the same bitter taste that pepsin gives.

PAPILLA (*papilla*, a nipple) means a small projection, such as those with which the true skin is covered, and which project into the scarf-skin and make its union with the true skin more intimate; or those covering the tongue and projecting from its surface.

PAPILLITIS is the term applied to inflammation of any papilla, but especially of the prominence formed by the end of the optic nerve in the retina, also known as optic neuritis.

PAPILLŒDEMA is the term applied to congestion and swelling of the optic disc, at the point of entry of the optic nerve into the interior of the eyeball. Such congestion is the result of increased pressure within the skull—*e.g.* from a cerebral tumor.

PAPILLOMA (*papilla*, nipple ; *-oma*, termination meaning tumor) means a tumor composed of papillæ growing from the surface of skin or mucous membrane. These tumors may be either simple or malignant in nature. Such a tumor is found occasionally in the bladder, and the chief symptom of its presence is the painless presence of blood in the urine.

PAPULE (*papula*) means a pimple.

PARA- (παρά, beside) is a prefix meaning near, aside from, or beyond.

PARACENTESIS (παρακέντησις). — The puncture by hollow needle or trocar and cannula of any body cavity (*e.g.* abdominal, pleural, pericardial), for tapping or aspirating fluid pathologically accumulated. (*See* ASPIRATION.)

PARACUSIS (παρά, beside ; ἄκουσις, hearing) means any perversion of the sense of hearing.

PARÆSTHESIA (παραισθάνομαι, I am deceived by my senses) is a term applied to unusual feelings, apart from mere increase, or loss, of sensation, experienced by a patient without any external cause ; for example, hot flushes, numbness, tingling, itching. Various paræsthesiæ form a common symptom in some nervous diseases.

PARAFFIN (*parum*, little ; *affinis*, akin) is the general name used to designate a series of saturated hydrocarbon bodies, discovered by Reichenbach in 1830 and first produced as a commercial product by Young in 1850. The higher members of the series, paraffin-waxes, are solid at ordinary temperatures, some being hard, others soft. The preparation known as 'vaseline' is a composition of soft paraffins, so are adepsine, cosmoline, saxoline, etc. Lower in the scale comes petroleum, which is liquid at ordinary temperatures and which is also known as paroleine and oleum deelinæ. Naphtha, petroleum spirit, and hydramyl are lower members of the series which are very volatile, and lowest comes methane, better known as marsh-gas, which is a gaseous body.

These paraffins do not mix with water or form soaps with alkalies, nor do they turn rancid like fats. Bacteria will not grow on them, and therefore they are not poisonous to broken surfaces.

Uses.—The thicker liquid paraffins are used as an internal lubricant for prolonged administration in habitual constipation.

Externally, the hard and soft paraffins are used in various consistency, being very useful as ointments and lubricants by reason of their apparently harmless nature. Petroleum, petrol, and various liquid paraffins are used to form the basis of sprays containing menthol and other drugs for application to the throat and nose.

PARAGANGLIOMA, also known as CHROMAFFINOMA and PHÆOCHROMACYTOMA, is the term used to describe a tumor made up of chromaffin cells. These tumors occur especially in the medulla of the suprarenal gland, where chromaffin cells are normal constituents. An important sign of these tumors is a high blood-pressure.

PARAGONIMUS is the term applied to a genus of small fluke-worm, several of which are found in the lung and occasion spitting of blood. This occurs especially in Asiatic countries and in Central America.

PARAGRAPHIA.—Misplacement of words, or of letters in words, or wrong spelling, or use of wrong words in writing as a result of a lesion in the 'speech region' of the brain.

PARALDEHYDE is a clear, colourless liquid with a penetrating ethereal odour, and a burning taste followed by a cool sensation in the mouth. It is a form of aldehyde made by acting on this substance with dilute nitric or sulphuric acid. Although in small quantities it may cause excitement, in larger doses it is a soporific, with little depressing effect, and productive, it is said, of more natural sleep than any other drug.

Uses.—It is given in sleeplessness, particularly when the heart's action is feeble, and when other drugs might be dangerous. It has the disadvantages of an unpleasant taste and a clinging smell resembling that of alcohol. A large dose must be taken to be of any use, one or two teaspoonfuls or even more. When regularly taken, the drug loses its effect, and therefore it is not likely to give rise to any 'habit'.

PARALYSIS (*παράλυσις* from *παραλύω*, I relax), or PALSY, means loss of muscular power due to interference with the nervous system. When muscular power is weakened as the result of some affection of the nervous system, but not entirely lost in the parts concerned, the term '*paresis*' is often used instead of paralysis. Various terms are used to designate paralysis distributed in different ways. Thus '*hemiplegia*' is the term applied to paralysis affecting one side of the face, with the corresponding arm and leg, as the result of disease on one side of the brain; '*diplegia*' means a condition of more or less total paralysis, in which both sides are affected in this manner; '*monoplegia*' is the term applied to paralysis of a single limb; and '*paraplegia*' signifies paralysis of both sides of the body below a given level, usually from about the level of the waist.

Certain descriptive terms are used in popular language in connection with the word paralysis to indicate different diseases; thus '*creeping paralysis*' is a vague term applied most often to locomotor ataxia, '*shaking paralysis*' is the popular name for paralysis agitans, and '*wasting paralysis*' commonly means progressive muscular atrophy.

Paralysis should be regarded rather as a symptom than as a disease by itself, and it is generally connected with some well-marked disorder of some portion of the nervous system. According to the locality and extent of the nervous system affected, so will be the form and completeness of the paralysis. It is usual to classify paralysis as it depends upon disease of the brain, of the spinal cord, and of the nerves; and hence the terms *cerebral*, *spinal*, and *peripheral paralysis*. The distribution of the paralytic condition may be very extensive, involving more or less all the functions of the body, as in *general paralysis* of the insane (*see* GENERAL PARALYSIS), or it may, as already stated, affect half the body, or only certain limbs, or it may even be restricted to single muscles or single groups of muscles supplied by a particular nerve.

Reference can here be made only to the more common types of paralysis, and that merely in general terms.

1. **PARALYSIS DUE TO BRAIN DISEASE.**—Of this by far the most common form is palsy affecting one side of the body, or **Hemiplegia.** It usually arises from disease of the hemisphere of

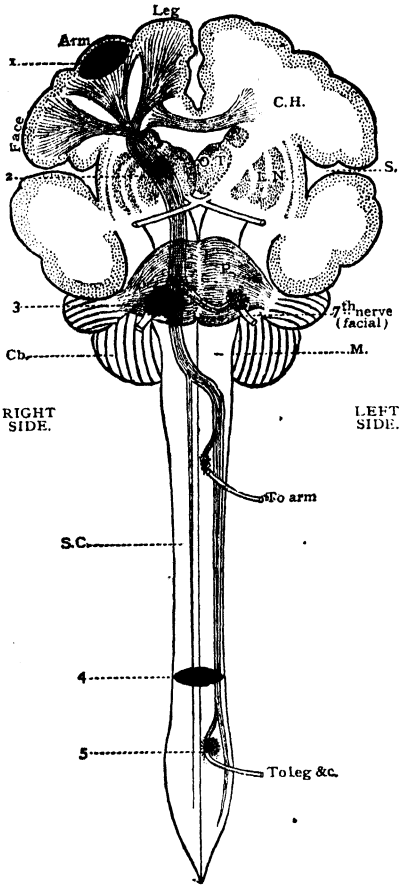


FIG. 357.—Diagram of the brain and spinal cord, showing the motor paths, and the positions of injuries causing different forms of paralysis. The front half of the brain is supposed to have been removed and the reader is looking at its interior. *CH*, Cerebral hemisphere; *Cb*, cerebellum; *OT*, optic thalamus; *LN*, lenticular nucleus; *M*, medulla; *P*, pons; *SC*, spinal cord. 1, The position of a hæmorrhage causing paralysis of left arm; 2, position of a hæmorrhage causing complete paralysis of the left side; 3, position of a hæmorrhage followed by paralysis of left arm and leg, with right side of face (crossed paralysis); 4, position of the disorder causing paralysis of both lower limbs (paraplegia); 5, position of the disease responsible for infantile paralysis in the left leg.

the brain opposite to the side of the body affected, such disease being in the form of hæmorrhage into the brain sub-

stance, or the plugging up of blood-vessels, and consequent arrest of blood supply to an area of the brain ; or again, it may result from an injury, or be due to a tumor in the tissues of the brain. The character of the seizure and the amount of paralysis vary according to the situation of the disease or injury, its extent, and its sudden or gradual occurrence. The attack may come on as a stroke of apoplexy (*see* APOPLEXY), in which the patient becomes suddenly unconscious, and loses completely the power of motion of one side of the body, or a like result may arise more gradually and without loss of consciousness. In either type of ' complete hemiplegia ', the paralysis affects on one side the muscles of the face, tongue, body, and limbs. Speech is indistinct and thick, and the tongue, when protruded, points towards the paralysed side owing to the unopposed action of its muscles on the unaffected side. The muscles of the face implicated are chiefly those about the mouth. The paralysed side hangs loose, and the corner of the mouth is depressed, but the muscles closing the eye are, as a rule, unimpaired, in consequence of the fact that movements like that of shutting the eyes, which are performed usually on both sides together, are controlled from either side of the brain. As a result the eye on the paralysed side can be shut, unlike what occurs in another form of facial paralysis (Bell's palsy), in which the fault lies in the nerve. The muscles of respiration on the affected side are seldom more than slightly weakened for deep breathing, but those of the arm and leg are completely powerless. Sensation may at first be impaired (anæsthesia), but as a rule returns soon, unless the portion of the brain involved be that which is connected with this function. Rigidity of the paralysed members is usually present as a later symptom. In many cases of even complete hemiplegia, improvement takes place after the lapse of weeks or months, and is in general indicated by a return of motor power first in the face, next in the leg, while that of the arm follows after a longer or shorter interval, and is rarely complete. Such recovery of movement is, however, in a large proportion of cases only partial, and the side remains weakened. In such instances the gait of the patient is characteristic. In walking, he leans to the sound side and swings round the affected limb from the hip, the foot scraping the ground as it is raised and advanced. Besides this the evidence of the ' shock ' is felt more or less upon the system generally, the patient rarely (though occasionally) recovering his nervous stability. The paralysed parts retain their contractility when stimulated by electric currents, but they are apt to suffer in their nutrition from disuse and to assume an attitude of rigidity.

It is to be observed that in many instances the hemiplegia is only partial, and instead of the symptoms of complete paralysis above described there exist in varied combination only certain of them, their association depending on the extent and locality of the damage to the brain. Thus there may be impairment of speech and some amount of facial paralysis, while the arm and leg may be unaffected, or the paralysis may be present in one or both extremities of one side while the other symptoms are absent. Further, the paralysis may be incomplete throughout, and the whole of the side be weak, but not entirely deprived of motor power. To partial paralysis of this latter description the term PARESIS is applied.

Besides hemiplegia, various other forms of paralysis may arise from cerebral disease. Thus occasionally there is CROSSED PARALYSIS, one side of the face and the opposite side of the body being affected simultaneously. Or again, as is frequently observed in the case of tumors of the brain, the paralysis may be limited to the distribution of one or more of the cranial nerves, and may produce a combination of symptoms (such as squinting, drooping of the eyelid, and impairment or loss of vision) which may enable the seat of the disease to be accurately localised. The condition of DIPLEGIA, in which both sides are affected, sometimes occurs in infants, and is due generally to some inflammation of the brain occurring soon after birth.

Trembling palsy, PARALYSIS AGITANS, or SHAKING PARALYSIS, is a peculiar form of paralysis characterised chiefly by rhythmical tremors and rigidity of muscles. It is a chronic disease of advanced life and is due to degenerative

changes in the ganglia at the base of the cerebrum. The symptoms first show themselves chiefly by involuntary tremblings and stiffness of the muscles of the fingers, hand, arm, or leg, the tremors being worse on making efforts or under excitement. These tremors become more marked and more extensive with the advance of the disease. The peculiar stiffness of the muscles greatly impedes movement, as can be seen in the gait, the act of walking being performed in a peculiar tottering manner with the body bent forward. The trembling movements cease during sleep. An almost identical condition—known as the PARKINSONIAN SYNDROME or PARKINSONISM — occurs after encephalitis lethargica.

Functional paralysis includes other forms of paralysis which, being of cerebral origin, should be mentioned here, though they are not connected with any discoverable disease of the brain. It is possible, but not likely, that the condition is due to microscopic changes in the cells or nerve-fibres within the brain, as a result of which they become temporarily or permanently worn-out, and unable to originate or to conduct the nerve impulses upon which muscular action depends. These forms of paralysis are amenable to psychological treatment, the cause of the paralysis often being traceable to some deep-seated mental conflict having its origin in childhood. (*See* HYSTERIA, CRAMP, NEURASTHENIA.)

2. **PARALYSIS DUE TO DISEASE OF THE SPINAL CORD.**—Of paralysis from this cause, there are numerous varieties, depending on the nature, the site, and the extent of the disease. Frequently defects in muscular action, due to disease in the spinal cord, are not of a paralytic nature, and these must be carefully distinguished. For example, in disease of the posterior part of the cord, involving the sensory paths, the condition of '*ataxia*' is produced, and the patient, though sufficiently strong, cannot control his movements, as he is unconscious of the directions in which his limbs move till he sees the movements made. Or again, in disease of the lateral parts of the cord, involving the controlling motor paths from the brain, the condition of '*spasticity*' results, and when muscles contract they do so to an excessive degree, so that freedom of movement is impossible.

Paraplegia, paralysis of both lower extremities, including usually the lower portion of the trunk, and occasionally also the upper portion — indeed, all the parts below the seat of the disease in the spinal cord—is a form of paralysis which is a frequent result of injuries or

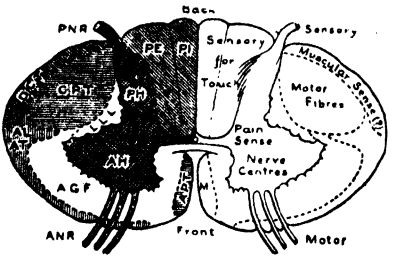


FIG. 358.—Diagram of a section of the spinal cord in the region of the neck. On one side the various nerve-tracts are shown, on the other the function of these is indicated. *PE, PI*, Tracts in posterior column of cord; *CPT*, crossed pyramidal tract; *DCT*, direct cerebellar tract; *LLL*, lateral limiting layer; *ALAT*, antero-lateral ascending tract; *AGF*, anterior ground fibres; *APT*, anterior pyramidal tract; *PH*, posterior horn, and *AH*, anterior horn of grey matter; *PNR*, posterior nerve root; *ANR*, anterior nerve root.

disease of the vertebral column; also of inflammation affecting the spinal cord (*see* MYELITIS), as well as of hæmorrhage or tumors involving its substance. When it is due to disease, this is generally situated in the lower portion of the cord. The symptoms necessarily vary in relation to the locality and the extent of the disease in the cord. Thus, if in the affected area the posterior part of the cord, including the posterior nerve roots, suffer, the function of sensation in the parts below is impaired because the cord is unable to transmit the sensory impressions from the surface of the body to the brain, and the condition of 'ataxia' affects the power of motion. If, on the other hand, the anterior portion of the cord and the anterior nerve roots be affected, the motor impulses from the brain cannot be conveyed to the muscles below the seat of the injury or disease, and consequently their power of movement is abolished. While, if the lateral portions of the cord be affected, a condition of 'spastic' paralysis is set up. In many forms of this complaint, particularly in the case of

injuries, the whole thickness of the cord is involved (transverse myelitis), and both sensory and motor functions are lost below the level at which the cord is affected. Further, the functions of the bladder and bowels are apt to suffer, and either spasm or, more frequently, paralysis of these organs is the result. The nutrition of the paralysed parts tends to become affected, and bed sores and wasting of the muscles are common. Occasionally, more especially in cases of injury, recovery takes place, but in general this is incomplete, the power of walking being more or less impaired. When the paralysis is due to pressure caused by a diseased spine, an operation designed to relieve this pressure is often completely successful, and entire power is restored, even after the paralysis has lasted for several months. On the other hand, the patient may linger on for years bedridden, and at last succumb to bed sores or to a septic affection of the paralysed bladder spreading up to the kidneys.

Infantile paralysis, or POLIOMYELITIS, is a form of spinal paralysis, most commonly confined to one limb, which occasionally occurs in children, and is caused by an inflammatory affection limited to the anterior portion of the grey matter of the spinal cord throughout a greater or less extent, and affects therefore the function of motion, leaving that of sensation unimpaired. This disease is most common during the earlier part of childhood (although a similar affection is also observed in adults).

The disease is an infectious disease caused by an ultra-microscopic virus, which affects merely this part of the nervous system. Large epidemics are fortunately not a feature of the disease in Great Britain.

The commencement may be insidious, or frequently there may be an acute febrile attack lasting for several days. In either case paralysis comes on, at first, in many cases, very extensive, involving both upper and lower extremities, but tending soon to become more limited and confined to one or other limb or even to a group of muscles. The affected muscles lose their electric contractility, and later waste. Hence limbs become shortened, shrivelled, and useless, and deformities such as club-foot may thus be readily produced. In many instances fortunately the disease is very limited, and the prospect of improvement is good in the muscles which show any reaction to faradic electricity. The paralysis is not progressive, and, when its limits have become clearly defined within a few days of the onset, it may be assumed that recovery, so far as other parts are concerned, will take place. In the paralysed parts considerable improvement but incomplete recovery of power is the rule.

There is complete absence of some of the more distressing of the symptoms of paraplegia, such as disturbances of the bladder and bowels or extensive bed sores, and in general the health of the child does not materially suffer.

Wasting palsy, or PROGRESSIVE MUSCULAR ATROPHY, or MOTOR NEURONE DISEASE, is a disease usually occurring in middle life. It is characterised by the gradual wasting of certain muscles or groups of muscles, loss of power in them, fibrillation (fine twitching of muscle fibres), alteration of tendon and skin reflexes. It is insidious in its onset, and usually first shows itself in the prominent muscular masses in the palm of the hand, especially the ball of the thumb, which becomes wasted and deficient in power. The other palmar muscles suffer in like manner, and as the disease advances the muscles of the arm, shoulders, and trunk become implicated if they have not themselves been the first to be attacked. The malady tends to spread symmetrically, involving the corresponding parts of both sides of the body in succession. It is slow in its progress, but, although it may occasionally undergo arrest, it tends to advance and involve more and more of the muscles of the body until the sufferer is reduced to a condition of extreme helplessness. Should some other ailment not be the cause of death, the fatal result may be due to the disease extending so as to involve the muscles of respiration.

Pathologically, progressive muscular atrophy is characterised by degeneration: (*a*) of the motor cells of Betz in the cerebral cortex, with corresponding degeneration of the pyramidal tracts; (*b*) of the anterior horn cells of the grey matter of the spinal cord, with corresponding degeneration of the peripheral

motor nerves and wasting of the muscles innervated by them; (*c*) of the nerve cells in the bulb of the brain from which the motor cranial nerves arise—hypoglossal, facial, trigeminal, oculomotor, spinal accessory, glossopharyngeal, vagus. There is diffuse atrophy of the white matter of the spinal cord, excepting the posterior, sensory columns.

From this it can be seen that spastic paralysis and profound wasting of muscle may be combined, as in amyotrophic lateral sclerosis (*q.v.*); that a purely spastic paralysis may occur when the degenerative process affects principally the motor cells of the cerebral cortex; and that the clinical picture will be that of a bulbar paralysis when the motor nuclei of cranial nerves degenerate. In bulbar paralysis, the muscles of facial expression, of mastication, of articulation, and of swallowing suffer progressive loss of power.

The cause of the nerve degeneration is not known, although in some cases it is a syphilitic infection.

Progressive muscular dystrophy, MYOPATHY, or PSEUDO-HYPERTROPHIC PARALYSIS, is another form of paralysis, in certain respects resembling progressive muscular atrophy, though in it the change occurs in the muscles themselves, not in the nervous system. (*See* MYOPATHY.)

3. **PERIPHERAL PARALYSIS,** or local paralysis of individual nerves, is of frequent occurrence. Only the most common and important examples of this condition can be briefly referred to.

Facial paralysis and BELL'S PALSY are the terms applied to paralysis involving the muscles of expression supplied by the seventh nerve. It is unilateral, and generally occurs as the result of exposure of one side of the head to a draught of cold air, which sets up inflammation of the nerve, but it may also be due to injury or disease either affecting the nerve near the surface or deeper in the bony canals through which it passes, or in the brain itself, involving the nerve at its origin. The paralysis is manifested by a marked change in the expression of the face, the patient being unable to move the muscles of one side in such acts as laughing, whistling, etc., or to close the eye on that side. The mouth is drawn to the sound side, while, although the muscles of mastication are not involved, the food in eating tends to lodge between the jaw and cheek on the palsied side. Occasionally, when the nerve is injured as it passes through the skull, the sense of taste is impaired. In the ordinary cases of this disease, such as those due to exposure, recovery usually takes place in about six weeks, the improvement being first shown in the power of closing the eye, which is soon followed by the disappearance of the other signs. When the paralysis proceeds from wounding of the nerve, disease of the temporal bone, or from tumors in the brain, it is more apt to be permanent, and is in many cases of serious import.

Lead palsy is a common form of local paralysis. It is due to the poisonous action of lead upon the system, and, like the other symptoms of lead-poisoning, affects chiefly workers in that metal. (*See* LEAD-POISONING.)

A form of peripheral paralysis, resembling the last, frequently results from chronic alcoholism. Other poisons also act similarly, as, for example, arsenic. (*See* NEURITIS.) Injury to a nerve may cause paralysis in the muscles which it should supply, and this may follow on wounds, severe bruises, or even long-continued pressure, as in crutch-palsy. (*See* DROP-WRIST, NERVE INJURIES.) The paralysis occurring after diphtheria, another example of the peripheral variety, has been already mentioned, and similar paralyses, for example of the foot, follow sometimes on other infectious diseases. (*See* DIPHTHERIA, DROP-FOOT.)

Treatment.—It is impossible in a brief notice like the present to enter at any length into the treatment of the different varieties of paralysis. Generally speaking, the treatment consists of measures which aim at supporting the patient's strength and maintaining his health while the nervous system is slowly restoring itself so far as may be. The conditions of the disease in any particular case can only be understood and appreciated by the medical expert, under whose direction alone treatment can be advantageously carried out.

An important point in the treatment is that, since paralysed muscles tend to undergo degenerative changes, their action should be maintained as long as

possible. With the view of improving the circulation in the muscles, and also in order to prevent stiffening of the joints, massage is very useful. In order to exercise the muscles, the faradic current, or failing it the interrupted galvanic current, may be applied daily.

When acute symptoms have ceased, but not before this period, the use of nervine tonics, such as strychnine, and, in certain cases, of substances which encourage tissue change, such as iodide of potassium and arsenic, is most important.

In the case of paraplegia there is a necessity for highly skilled nursing, since not only the patient's comfort but his life depends upon careful management, directed towards preventing bed sores (*see* BED SORES), and inflammation of the bladder (*see* CATHETERS) in cases where the act of urination is interfered with. A similar remark applies to bulbar palsy, in which special care is necessary in feeding the patient, owing to his difficulty in swallowing.

PARAMETRITIS (παρά, beside; μήτρα, the womb) means inflammation in the cellular tissue at the side of the womb.

PARAMNESIA is the term applied to a derangement of the memory in which words are used without a comprehension of their meaning; it is also applied to illusions of memory in which a person in good faith imagines and describes experiences which never occurred to him.

PARAMYOCLONUS (παρά, beside; μῦς, muscle; κλόνος, disturbance) is the name applied to an affection in which paroxysmal jerking contractions of the muscles of the limbs take place; it is sometimes due to organic disease of the nervous system, sometimes hysterical.

PARANOIA (παρά, aside; νοῦς, mind) is the term applied to a form of fixed delusional insanity, in which the delusions, usually of persecution, all centre round some perverted idea and have an important bearing upon the insane person's actions. In this form of insanity, heredity plays an important part, recovery is unlikely, and in marked cases restraint is often necessary to prevent criminal acts. Many paranoic persons, however, are able to go about freely and transact business, with which their delusions do not interfere, and are regarded simply as eccentric persons. (*See* INSANITY.)

PARAPHASIA.—Misplacement of or use of wrong words in speech as a result of a lesion in the 'speech region' of the brain.

PARAPHRENIA (παρά, aside; φρήν, mind) is a term applied to intellectual insanity in which the person, usually in middle life, is affected by extreme delusions, but, unlike persons suffering from dementia, retains a strong sense of personality and, unlike persons suffering from paranoia, has not got delusions forming a regular system and habitually influencing conduct. (*See* INSANITY.)

PARAPLEGIA (παραπληγία, paralysis crosswise) means paralysis of the lower limbs, accompanied generally by paralysis of bladder and rectum. (*See* PARALYSIS.)

PARASITES (παράσιτος, one who eats at another's table) are creatures that live upon or in the body of another creature, known as the 'host', being indebted to the latter for their nourishment, though contributing nothing to its welfare. The parasite may be comparatively harmless; or it may, by the

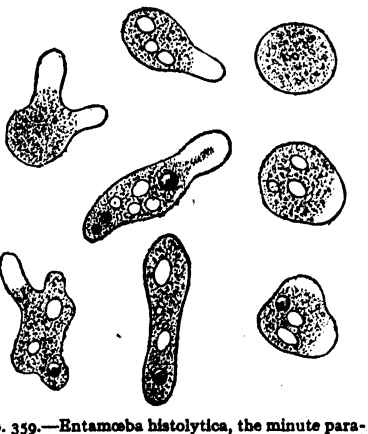


FIG. 359.—Entamœba histolytica, the minute parasite which is one cause of dysentery. Magnified by 330. (Thoma's *Pathology*.)

mere irritation of its presence or by interference with the bodily functions of the host, give rise to troublesome symptoms; or it may even, by destroying vital parts or forming poisonous substances, lead to the death of the host.

As regards human beings, there are numerous parasites belonging to both the vegetable and animal kingdom, of various sizes, and producing effects of all degrees of severity. In the vegetable kingdom are bacteria, and several minute fungi. (*See* BACTERIOLOGY.) At the bottom of the animal kingdom are the amœba, that produces dysentery, the parasites of malaria, that of kala-azar, and various trypanosomes which cause serious diseases in animals, and one of which is responsible for sleeping sickness among both black and white races in tropical Africa.

Apart from these, the following is a table and short account of the chief parasites which are apt to infest man, and the symptoms their presence occasions. It will be noticed that those parasites which live on the surface belong to the division of Arthropods, which are strong and capable of resisting much damage, while the internal parasites, infesting mainly the bowels, or burrowing in the deep cellular tissues, belong to the division of Worms.

Division : Arthropoda.
Class : Arachnoidea.
- Acarus scabiei
- Acarus folliculorum
  (mites).

Class : Insecta.
- Pediculus capitis
- Pediculus vestimentorum
- Pediculus pubis
  (lice).
- Pulex irritans (common flea).
- Pulex penetrans (jigger).

Division : Vermes (worms).
Class : Platyhelminthes (flat worms).
Order : Trematoda.
- Distoma hepaticum (liver-fluke).
- Schistosoma hæmatobium (Bilharzia).
- Schistosoma mansoni.
- Schistosoma japonicum.
- Paragonimus westermanni.

Order : Cestoda.
- Tænia mediocanellata
- Tænia solium
- Bothriocephalus latus
  (tape-worms).
- Tænia echinococcus (hydatid cyst).

Class : Nemathelminthes (round worms).
- Oxyuris vermicularis (thread- or seat-worm).
- Ascaris lumbricoides.
- Trichinella spiralis.
- Trichocephalus dispar (whip-worm).
- Ankylostoma duodenale (tunnel-worm).
- Filaria bancrofti.
- Filaria loa.
- Dracunculus medinensis (Guinea-worm).

External Parasites.—

ACARUS SCABIEI. — This is a minute mite just visible to the naked eye, provided with eight legs and numerous spines and hairs, and is the cause of scabies or itch. (*See* ITCH.) It burrows in the skin, in which it lays its eggs, and the movements of the minute animal set up the intolerable itching which gives the disease its name, and the consequent scratching, which produces various eczematous and pustular eruptions. The

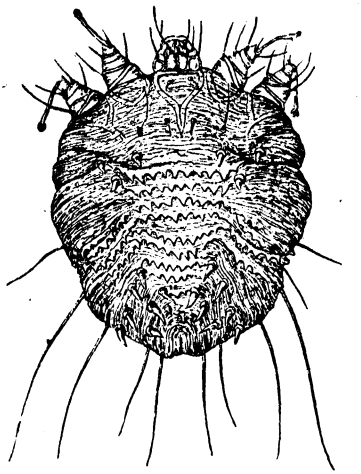


FIG. 360.—The female Acarus scabiei. Magnified by about 80. (Thoma's *Pathology*.)

female Acarus lays ten to fifteen eggs in her burrow and dies there, but the young hatch, escape, and make fresh burrows for themselves in about a fortnight, and so the disease gradually spreads. (*See* ITCH.)

ACARUS FOLLICULORUM or DEMODEX is still smaller, being only about one-hundredth of an inch long. It is found in the follicles of the hairs, especially of the minute hairs on the nose, in almost all persons. The blocking of the sebaceous glands which open into the hair follicles by masses of these animals is sometimes, though probably wrongly, given as the cause of blackheads and acne. The little 'worms' which can be squeezed out from the skin about the nose are not animals, though they each contain two to twenty of these mites, but consist of the sebaceous or fatty matter, which lies in the neck of the hair follicle and lubricates the hair.

PEDICULI (lice) are of three species, which vary in shape and size as well as in the area of the body they infest. They breed, as a rule, only on persons of uncleanly habits, but there are people, apparently of perfect cleanliness, upon whom they increase with amazing rapidity so soon as one has chanced to come upon the skin.

PEDICULUS CAPITIS is small and infests the back part of the head, seldom developing in numbers in front of the region of the ears. The eggs are visible as little white specks, called 'nits', attached to hairs, and the hair is often matted together by the exudation which irritation and scratching produce upon the scalp. The glands behind the ears and on the back of the neck become enlarged.

PEDICULUS VESTIMENTORUM is larger than the last mentioned, and affects the front of the chest, back of the shoulders, and upper arms, clinging to the clothes that cover these localities. It is got rid of and the itching is soothed by taking a bath containing 3 or 4 ounces of washing soda, and having the underclothing baked in a disinfecting oven.

PEDICULUS PUBIS is broader and shorter than the last two, and having three large claws upon each side is known as the 'crab-louse'. It is found on parts of the body covered by short hairs, the pubic region especially, and also the armpits, and even the eyebrows. It gives rise to great itching, and, since it holds fast to the hairs, is very difficult to dislodge.

(For all the above, *see also under* INSECTS IN RELATION TO DISEASE.)

PULEX IRRITANS (the flea) and **CIMEX LECTULARIUS** (the bed bug), though they attack man and draw his blood, are not true parasites, as they do not live upon his body. They may be destroyed by fumigating their habitat with sulphur, or spraying or scrubbing walls, floor, and bedstead with corrosive sublimate lotion or 5 per cent cresol. (*See* BED BUG.)

PULEX PENETRANS (the jigger, or sand-flea) is found in the West Indies, in tropical America, and in tropical Africa. It lies in the sand, and attacks the bare feet of all warm-blooded animals and of men, the female flea burying herself in the skin, especially at the root of the toes, and then swelling up with ova to the size of a pea. Abscesses and ulcers result, and may sometimes become serious. They are prevented by wearing boots, smearing the skin with some volatile oil, and by picking the jigger out with a needle as soon as its irritation is felt.

Internal Parasites.—

DISTOMA HEPATICUM, the liver-fluke, is very frequently present in the biliary passages of sheep, giving rise to 'liver-rot', but when present in man, which is seldom, these flukes are so few in number that beyond causing symptoms of jaundice and enlargement of the liver they produce little result.

SCHISTOSOMA HÆMATOBIUM, or BILHARZIA, is a parasite which infests the pelvic veins and deposits its eggs in the mucous membrane of the bladder so as to give rise to blood in the urine and cystitis. A closely allied species of worm, SCHISTOSOMA MANSONI, lays its ova in the mucous membrane of the rectum, producing tumor-like swellings of the mucous membrane of the bowel and a constant discharge of blood-stained mucus. These worms are half an inch, or thereabout, in length. The male is wider than the female, which lies

FIG. 361.—Ovum of Schistosoma hæmatobium (left) and of Schistosoma mansoni (right). Magnified by 150. (Thoma's *Pathology*.)

partly enclosed in a groove down the body of the former, and the ova are provided with a sharp spike, at or near one end. In the case of S. Hæmatobium, the spike is on the end, in S. Mansoni the spike is a little to one side. These worms are common in Egypt, Abyssinia, Cape Colony, Natal, and parts of North and West Africa; they have also been reported as present in Western Australia. The embryonic stages are passed in the body of fresh-water molluscs which live in canals and other expanses of water. These embryos find their way into the human body, either in drinking water or, more commonly, by burrowing through the skin of bathers. The bleeding from the

bladder is seldom serious, and the disease in this locality gradually dies out in the course of years, but the condition produced in the rectum is much more serious.

SCHISTOSOMA JAPONICUM, a species of worm closely resembling the two above mentioned, is the cause of a chronic disease of the intestine with enlargement of the liver and spleen and dropsy; it occurs in the Far East. The embryo goes through its development in a similar fresh-water mollusc. All these parasites are treated by intravenous injections of tartar emetic.

PARAGONIMUS WESTERMANNI, or DISTOMA RINGERI, is a parasite found in China, Japan, and the Philippines, which causes chronic cough and spitting of blood owing to the eggs of the parasite being laid in the lungs. The parasite is a species of fluke-worm and it may be found in various other organs, as well as the lungs, in which it produces the characteristic symptoms. The disease is carried by Japanese to other countries, and it is to be prevented by securing a pure water supply for drinking and bathing purposes. The expectoration of affected persons should be carefully destroyed, as in the case of consumption.

TÆNIÆ, or TAPE-WORMS, illustrate well the degeneration consequent upon a parasitic life. These animals exist solely to feed and to propagate their kind, discharging apparently no useful function in the economy of nature. Accordingly their shape is modified to present as large an absorbing surface as possible to the digested food passing down the intestine, so that they are flat, white, and long, like a piece of tape, as their name implies. Each consists of a 'head', the size of a small pin's head, provided with suckers, and sometimes with hooklets, for adhesion to the bowel-wall, and from this head segments are produced that gradually increase in size and develop ova the farther they recede from the head. The mature segments at the extremity of the worm are crammed full of ova, and are constantly splitting off to be discharged in the stools. When these mature segments, or 'proglottides', are discharged, they fall upon the ground, and the ova they contain are afterwards conveyed either by food or drink into the stomach of an 'intermediate host', which may be a pig, ox,

etc., in the case of different parasites. It is a notable fact that a parasite will not develop in any host save one of the proper species, and all through the

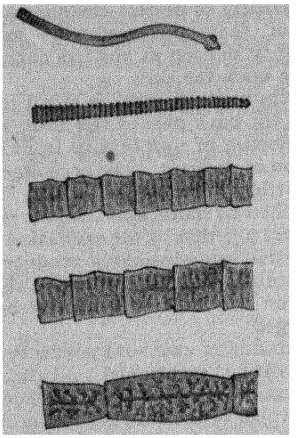


FIG. 362.—Tænia solium, five pieces at various distances from the head to the hinder end. Natural size. (Thoma's *Pathology*.)

animal kingdom different parasites are met in different animals. When the ova reach the stomach of the 'intermediate host' their capsule is dissolved, the embryos escape and find their way through the wall of stomach or intestine into the blood-vessels, by which they are carried to distant parts of the body. In the case of TÆNIA SOLIUM the inter-

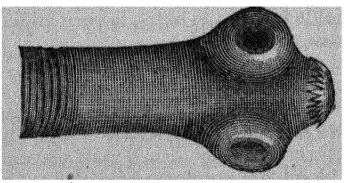


FIG. 363.—Head of Tænia solium. Magnified by 20. (Thoma's *Pathology*.)

mediate host is the pig, in the case of TÆNIA MEDIOCANELLATA it is the ox. In the muscles of these animals the embryos of the worm become encysted and remain so till they die, or till the animal's flesh happens to be eaten by the 'proper host', when they develop again into a new tape-worm in his intestine. The flesh of a pig thus infected shows plainly the encysted embryo (known as Cysticercus cellulosæ), and is called 'measly' pork. BOTHRIOCEPHALUS LA-

PARASITES

TUS is seldom met with, save in the north of Europe and Asia, and the intermediate hosts are several varieties of fish. In the case of TÆNIA ECHINOCOCCUS, relations

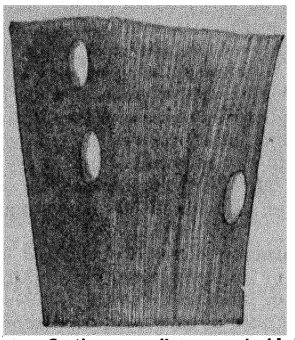


FIG. 364.—Cysticercus cellulosæ embedded in a muscle (the immature form of Tænia solium). Slightly reduced in size. (Thoma's *Pathology*.)

are reversed, and man plays the rôle of intermediate host, the host of the mature tape-worm being the dog, from which the human being derives the embryo worm by allowing the dog to lick his hands and face, or to contaminate his food. Although the worm in the dog is very small (having only three segments, as a rule), yet the encysted form in man,

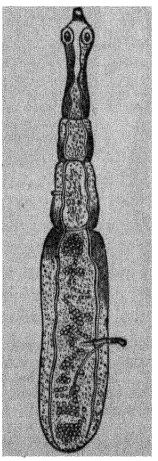


FIG. 365.—Tænia echinococcus. Magnified 12 times. (Thoma's *Pathology*.)

known as a ' hydatid cyst ', may reach a large size, situated in the liver, lungs, kidney, or brain.

The presence of tape-worms in the intestine does not long remain a matter of doubt. Generally, they give rise to voracious appetite, digestive disturbances such as diarrhœa, bloodlessness,

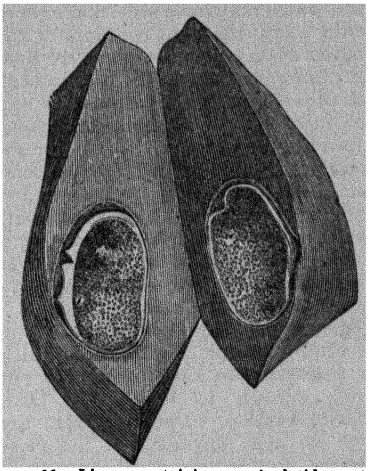


FIG. 366.—Liver containing a hydatid cyst, divided. Reduced to one-third. (Thoma's *Pathology*.)

and headache, and they may produce signs of grave general irritation, such as convulsions. Among certain peoples, however, such as the Abyssinians, where they are common, their presence is taken

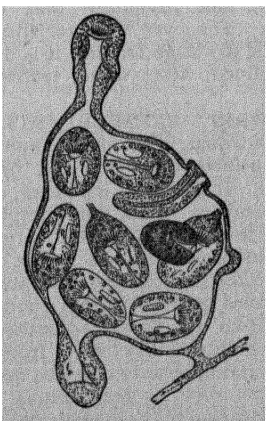


FIG. 367.—Brood-capsule from a hydatid cyst, containing numerous heads, some still connected with the wall of the capsule. Magnified by 40. (Thoma's *Pathology*.)

as a matter of course, and they give rise to no evil effects. Any doubt as to the presence of a tape-worm is set at rest when the host passes, as he does from

time to time, several feet of the mature segments.

Hydatid cysts often grow to a great size, budding off in their interior smaller cysts, which may have still smaller ones within them, the final contents of the smallest cysts being a salt, watery fluid and numerous 'heads' of echinococci, each provided with a circle of hooks, and each capable, under proper conditions, of forming a new worm. The symptoms produced by a hydatid cyst depend mainly upon the effects of its size and consequent pressure. Very small cysts in the brain may produce serious results, like those of a tumor, while in the liver a cyst may grow to the size of a man's head before causing much trouble.

Treatment of tape-worms consists in the administration of substances which are poisonous to the worm, but not strong enough to injure the host. Kousso, kamala, turpentine, etc., are given for this purpose, but the most effective drug is extract of the root of the common male fern, combined with starvation. (*See* FERN-ROOT.) Whatever remedy be adopted, the fragments of worm passed must be carefully examined to see that the head has been got rid of, for, if it be retained, the worm will probably grow again.

The treatment of hydatid cysts is surgical, and resembles that of an abscess. The cyst is either dissected out or, if too large for this, it is opened and drained, after which recovery is speedy.

OXYURIS VERMICULARIS, the THREAD-WORM, is the most common of all the intestinal parasites and the least harmful. It is about ½ inch long, white, and resembles, as its name implies, a little piece of thread. These worms live in considerable numbers in the lower bowel, affecting children particularly. They cause great irritation round the anus, often diarrhœa, sometimes in female children discharge from the vagina, and in weakly children nervous symptoms such as convulsions. The reflex irritation they occasion makes the child also pick his nose, and grind the teeth during sleep.

Treatment. — Out of many treatments, the two which seem to be most favoured are (1) administration of an enema of quassia infusion, and (2) enteric-coated capsules of gentian violet. The local irritation caused by the worms near the anus is allayed by weak white precipitate ointment.

ASCARIS LUMBRICOIDES, also known as the ROUND WORM, and the 'maw-worm', is rounded, of a pale-brownish colour, and may be 10 to 12 inches long, resembling an earth-worm very closely. These worms, two or three in number, may live in the small intestine, but one may wander into the stomach and be vomited up. They give rise to few symptoms beyond voracious appetite, and sometimes diarrhœa and colic.

Treatment is usually effected by 2 grains of santonin powder in children, 5 grains or more in an adult, followed by a large dose of castor oil, and repeated if necessary for several days. Other remedies used are oil of chenopodium, carbon tetrachloride, and tetrachlorethylene.

TRICHINELLA SPIRALIS is a minute worm, which is important because it produces the disease known as 'trichinosis'. The full-grown worm,

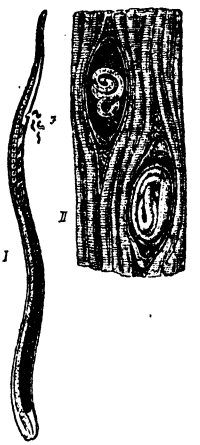


FIG. 368.—Trichinellæ. I, The mature worm found in the intestine, showing embryos escaping from it at *F*. Magnified by 25. II, Muscle containing the encysted form. Magnified by 50. (Schmeil's *Zoology*.)

which inhabits the intestine, is less than ¼ inch in length, and the embryos, to whose movements the disease is due, are much smaller. The disease is got by eating trichinosed meat, especially pork. When such a piece of meat is eaten, the embryos contained in it are set free, develop into full-grown

trichinellæ, and from each pair of these 1000 or more new embryos may arise in a few weeks. So soon as this new generation of embryos is produced they bore their way into the wall of the bowel, setting up sometimes severe irritation and diarrhœa, and thence wander all over the body, finally depositing themselves between the fibres of the voluntary muscles. During this migration, which lasts four or five weeks, they set up fever and pain in the limbs and muscles, often mistaken for rheumatism. Death may even result, but if the person survives to the end of four or five weeks, the trichinellæ, which are now encysted in the muscles, give no further trouble.

Treatment consists in preventive measures by the thorough inspection of meat in slaughter-houses, for even cooking, unless the meat be in slices, is not an efficient protection. Pigs should not be fed on unboiled garbage. Rats may be a source of sporadic outbreaks, for infected rats have been found near piggeries. The disease is now a rare one, thanks to sanitary inspection. The encysted trichinellæ are just visible as fine white specks.

TRICHOCEPHALUS DISPAR, also known as TRICHIURIS TRICHIURA and the WHIP-WORM, is very common in France. It is rarer in Britain. The worm inhabits the large intestine, and is said to be easily expelled by doses of thymol. It gives rise to little trouble unless it is present in great numbers.

ANKYLOSTOMA DUODENALE, also known as the TUNNEL-WORM, on account of the ravages it caused among the men at work on the St. Gotthard Tunnel, produces in persons affected by it great anæmia, debility, and cardiac weakness, sometimes leading to death. It is represented in the New World by NECATOR AMERICANUS, an allied species. These worms are about ½ inch in length and inhabit the upper part of the small intestine, often in great numbers; here they embed themselves in the mucous membrane lining the bowel. The disease produced by this worm is found in various tropical and subtropical regions, both in Asia and America. The disease caused is known as ankylostomiasis or hookworm disease. In certain parts of India it is so common that about 75 per cent of the population are said to be affected; it is also very common in Egypt. The worms embedded in the small intestine produce an enormous number of eggs which pass from the body in the stools; the embryos, finding their way into water, mud, or damp earth, develop rapidly and can maintain their vitality for weeks or months, if moisture be present. The embryos may gain access to the human host in polluted drinking-water, but they also penetrate the skin of the hands of workmen or the naked feet of Indian natives. Ultimately, through the blood-stream and the lungs, they gain access to the intestine where they develop. The disease is a very serious one, partly in consequence of the numbers of persons prevented from working by the debility it causes, and partly, because death in such debilitated persons is not uncommon.

As regards treatment, extract of male fern is sometimes used, but the most effective remedy is thymol, which, after the patient has been on liquid diet for a day, is administered in doses of 30 grains in capsules. Care must be taken not to administer alcohol, oil, or other substances which dissolve thymol, during the time it is being taken, because these may lead to its absorption, with dangerous collapse. The thymol is followed, a few hours afterwards, by a dose of magnesium sulphate.

In the prevention of this disease it is important to guard the water supply carefully from all chance of being contaminated by evacuations; drinking water should be boiled; ground known to be contaminated should be ploughed up, with the object of drying it. Common salt in the form of brine is an efficient disinfectant by killing the embryos.

FILARIÆ, or thread-like worms, are found only in tropical climates, such as India, South China, West Africa, and the southern United States and northern Australia. FILARIA BANCROFTI is a worm 3 or 4 inches in length, somewhat thicker than a hair, which is found in the loose tissues under the skin of various parts of the body. The parasite may exercise no injurious influence, but it sometimes causes blockage of the lymphatics, with resulting swelling of a limb, or other part in the neighbourhood. This may sometimes proceed to an enor-

mous size, especially in the case of the leg and the scrotum, and is then known as *elephantiasis arabum*. From time to time the embryos of these parasites, which are of microscopic size, find their way into the blood in great numbers. This sometimes occurs at night (*Filaria nocturna*), or during the day (*Filaria diurna*). From the blood, these minute filariæ may be drawn by a mosquito (*Culex fatigans*), and, after undergoing a stage of development in the mosquito, they may be transferred by its bite to another human being, in whom the parasite develops. In addition to elephantiasis, this parasite may be responsible for inflammation of joints, enlarged glands, inflammation in various internal organs, abscesses, and dropsy of various body cavities. In the prevention of the disease, measures are taken to keep mosquitoes from having access both to affected and to healthy persons.

Another filaria of similar size to the last named is FILARIA LOA, found in West Africa.

DRACUNCULUS MEDINENSIS, or the GUINEA-WORM, is found in West Africa, and also in Arabia, Persia, and Brazil; it may reach a length of 4 feet, and is found especially in the tissues under the skin of the limbs. Treatment consists in repeated douching of the part with cold water, by which, after a period of two to three weeks, the worm may be gradually extruded. Intravenous injections of tartar emetic also kill the worm and its embryos.

PARASITICIDE (*parasitus*, a parasite; *cædo*, I kill) is a general term applied to agents or substances destructive to parasites.

PARASYMPATHETIC is another name for the autonomic part of the nervous system. (*See* AUTONOMIC.)

PARASYPHILIS is a term applied to a diseased condition following and partly due to syphilis although not in itself syphilitic, *e.g.* locomotor ataxia, aneurysm, general paralysis.

PARATHORMONE is the name of the hormone secreted by the parathyroid gland (*q.v.*).

PARATHYROID is the name applied to four small glands which lie to the side of and behind the thyroid gland. These glands regulate the metabolism of calcium and of phosphorus. If for any reason there is a deficiency of the secretion of the parathyroid glands, the amount of calcium in the blood falls too low and the amount of phosphorus increases. The result is the condition known as tetany, in which there is great restlessness and spasm of muscles. The condition is checked by the injection of the parathyroid hormone — parathormone—which causes an increase in the amount of calcium in the blood. If there is over-activity of the parathyroids there will be an increase of calcium in the blood. This extra calcium is drawn from the bones, in which, as a consequence, thin cysts form and greatly weaken the bones, these breaking easily as a result. This cystic disease of bone has the elaborate title of GENERALISED OSTEITIS FIBROSA OF VON RECKLINGHAUSEN.

PARATYPHLITIS is a term applied to an inflammatory condition in the right lower corner of the abdomen in the tissues around the cæcum. It is sometimes caused by appendicitis.

PARATYPHOID FEVER is a continued fever which closely resembles mild attacks of typhoid and which is due to bacilli very nearly allied to the typhoid bacillus.

Causes.—There are two bacilli, the paratyphoid bacillus A and the paratyphoid bacillus B, the former being commoner in India, the latter elsewhere; these closely resemble the typhoid bacillus in appearance and some of its reactions, but inoculation against typhoid only does not afford protection against these, and a triple vaccine should be used for protective inoculation prepared from all three bacilli. The infection is usually conveyed by a 'carrier' case who has already had the disease, or it is due to water supply or food contaminated by flies or dust.

Symptoms resemble those found in a mild case of typhoid fever, infection with the bacillus A lasting about three weeks, and infection with bacillus B about a fortnight as a rule.

Treatment is the same as for typhoid fever. (*See* ENTERIC FEVER.)

PAREDRINE is one of the sympathomimetic amines. Its chemical descrip-

tion is β-4-hydroxyphenyl-isopropyl-amine. Like ephedrine, paredrine is active when taken by mouth. A dose of 40 mg. causes a rise in systolic and diastolic blood pressures, lasting two hours and with slowing of the pulse rate. Paredrine has little action on the central nervous system, or on the plain muscle of the bronchi and the intestine.

PAREGORIC, or COMPOUND TINCTURE OF CAMPHOR, is a preparation of opium much used for cough mixtures. It contains, in addition to opium, oil of anise, benzoic acid, and camphor. Scotch paregoric with a similar composition is about double the strength of this tincture and more stimulating.

PARENCHYMA (παρέγχυμα) is a term meaning originally all the soft tissues of internal organs except σάρξ, the muscular flesh, though now reserved for the secreting cells of the glandular organs.

PARENTERAL is the word applied to the administration of drugs by any route other than by the mouth or by the bowel. Parenteral methods of giving drugs includes injection under the skin or into muscle, inunction, and intrathecal injection.

PARESIS (πάρεσις, slackening) means a state of slight or temporary paralysis. (*See* PARALYSIS.)

PARIETAL (*parietes*, walls) is the term applied to anything pertaining to the wall of a cavity, *e.g.* parietal pleura, the part of the pleural membrane which lines the wall of the chest.

PARKINSON'S DISEASE is a name for Paralysis agitans. (*See* PARALYSIS.)

PAROLEINE (*see* PARAFFIN).

PARONYCHIA (παρά, beside; ὄνυξ, the nail) is the term applied to inflammation near the nail. (*See* WHITLOW.)

PAROTID GLAND (παρωτίς) is one of the salivary glands. It is situated just in front of the ear, and its duct runs forwards across the cheek to open into the interior of the mouth on a little projection opposite the second last tooth of the upper row. The parotid gland is generally the first of the salivary glands to become enlarged in mumps. (*See* MUMPS.)

PAROTITIS (παρωτίς, the parotid gland) is another name for mumps.

PAROVARIUM is the name of a rudimentary structure situated near the ovary, in which tumors sometimes arise.

PAROXYSM (παροξυσμός) means the return of some acute disease, supposed in the interval since its last occurrence to be in complete abeyance.

PARSLEY is the leaves and fruit of *Apium petroselinum*. It has a stimulant and diuretic action. Apiol is derived from the leaves. It should not be confused with *fool's parsley*, or lesser hemlock, *Æthusa cynapium*, which is highly poisonous.

PARTURITION (*parturio*, I bring forth). (*See* LABOUR.)

PARULIS (παρά, beside; οὖλον, gum) is another name for gumboil or abscess of the gum.

PASTEURISATION is a method of sterilising milk which is not open to some of the objections attending boiling. The boiling of milk gives it a taste and smell which are disagreeable to some persons. In many parts of the world pasteurisation has done away with milk-borne infections, of which the most serious is bovine tuberculosis, affecting the glands, bones, and joints of children. Other infections conveyed by milk are septic sore throat, scarlet fever, diphtheria, enteric fever (typhoid and paratyphoid), undulant fever, and food poisoning (*e.g.* from the toxins of the staphylococcus). The case, therefore, seems very clear for the compulsory pasteurisation of all milk. Pasteurisation destroys about 20 per cent of vitamin C, but it should be remembered that we do not rely upon milk to protect us from scurvy, but on fresh fruit and vegetables, such as oranges, lemons, currants, potatoes, and green vegetables.

HIGH-TEMPERATURE SHORT-TIME (H.T.S.T.) PASTEURISATION consists in heating the milk at a temperature not less than 162° F. for at least fifteen seconds.

LOW-TEMPERATURE PASTEURISATION, or 'HOLDER' PROCESS, consists in maintaining the milk for at least half

an hour at a temperature between 145° F. and 150° F. (63° to 65° Centigrade), followed by immediate cooling to a temperature of not more than 55° F. This has the effect of considerably reducing the number of bacteria contained in the milk and of preventing the diseases conveyed by milk referred to above. This procedure is sufficient for the sale of milk as 'pasteurised milk' in England.

PATELLA (*patella*, a small pan), also known as the knee-pan or knee-cap, is a flat bone shaped somewhat like an oyster-shell, lying in the tendon of the extensor muscle of the thigh, and protecting the knee-joint in front. (*See* BONES, KNEE, FRACTURES.)

PATHETIC NERVE is the fourth nerve arising from the brain and controlling the superior oblique muscle of the eye.

PATHOGENIC (πάθος, suffering; γενάω, I produce) means disease-producing, and is a term applied to bacteria, etc., capable of causing disease.

PATHOGNOMONIC (πάθος, suffering; γιγνώσκω, I recognise) is a term applied to signs or symptoms which are specially characteristic of certain diseases, and on whose presence or absence the diagnosis depends. Thus the discovery of the tubercle bacillus in the expectoration is said to be 'pathognomonic' of consumption.

PATHOLOGY (πάθος, suffering; λόγος, a discourse) is the science which deals with the causes of and changes produced in the body by disease.

PATULIN is the name given to a substance isolated from the mould *Penicillium patulinum*. Patulin (known also by the proprietary term 'tercinin') inhibits the growth of various Gram-positive and Gram-negative bacteria. It is toxic and hinders the phagocytic activity of white blood cells. The dramatic cure of one case by a nasal douche of a solution of patulin in 1943 led to its trial on a bigger scale in a Naval establishment, with very favourable results. But a trial of patulin in the Army at the same time showed it to be of little use as a 'cold cure'. Time will show whether patulin, or something like it, will indeed cure the common cold.

PECTIN (πηκτός, congealed) is a polysaccharid substance allied to starch, contained in fruits and plants and forming the basis of vegetable jelly. It has been used as a transfusion fluid in place of blood in cases of hæmorrhage and shock.

PECTORAL (*pectoralis*) means anything pertaining to the chest or a remedy used in treating chest troubles.

PECTORILOQUY (*pectus*, the chest; *loquor*, I speak) means the resonance of the voice, when spoken or whispered words can be clearly heard through the stethoscope. It is the sign of great consolidation or of a cavity in the lung.

PEDIATRICS (παῖς, child; ἰατρός, physician) means the branch of medicine dealing with diseases of children.

PEDICULOSIS CAPITIS (*see* INSECTS IN RELATION TO DISEASE, *under* LICE).

PEDICULUS (*see* PARASITES).

PELLAGRA (πέλλα, the skin; ἄγρα, seizure) is a chronic disease, showing a number of nervous, digestive, and skin symptoms which first make their appearance during the spring or autumn and recur year after year, improving to some extent during the winter months. It is chiefly confined to the poorer classes, especially agricultural labourers. Originally introduced into Italy and Spain about the middle of the eighteenth century, it was later found widely spread through Southern Europe, Portugal, south-west of France, Austrian Tyrol, etc., and has more recently been discovered in the British Isles, in various parts of Africa, India, Syria, and in the southern United States, Central and South America.

Cause.—The disease is most prevalent among field labourers wherever it occurs, and the inhabitants of towns are largely immune, even in districts where the disease is very common. It seldom attacks people in good circumstances who live on a generous diet. There is a marked connection between the disease

and the season of the year, the particular season at which it is worst varying in different localities but always being the same for any given place; in Europe, for example, the spring is the time of year in which it specially manifests itself. The disease is in no way contagious from person to person. It has been ascribed at different times to most varied causes, including poverty, insanitary dwellings, bad water, garlic, and maize, and to burning by exposure to the sun. Maize has been especially blamed for its production, the theory having been held that it was caused by some poisonous substance developed in this grain. It is now known that it is a vitamin-deficiency disease. It was found that in institutions where pellagra had been common the addition of meat, vegetables, fruit, and eggs to the diet prevented new cases from occurring and rapidly restored to health persons already suffering from pellagra. It was later found that most foods which were rich in vitamin B would cure pellagra, but when the purified preparation of anti-beri-beri vitamin B1 was tried, it was found that this was ineffective, and the pellagra-preventing factor was found to be in what was called vitamin B2. This was soon recognised to consist of more than one vitamin, and the pellagra-preventing factor was identified as nicotinic acid. Sufferers from pellagra probably lack more than one vitamin.

Symptoms.—The course of pellagra lasts many years, with digestive disturbances including loss of appetite and diarrhœa or constipation, headache, and irritability of temper. The skin symptoms consist at first of redness resembling severe sunburn on the parts of the body exposed to the sun, such as the hands, forearms, chest, neck, and face. The irritation usually lasts about a fortnight, is followed by desquamation, and the skin remains rough, thickened, and permanently brownish in colour. This brownish and roughened appearance on the hands is the most prominent feature of the disease, and from this the disease takes its name. Tremors, sleepiness, and weakness of the legs also appear. For several years the disease may recur in this manner every spring, the attacks gradually becoming more severe, the patient slowly growing emaciated and in some cases completely paralytic or demented.

Treatment.—The disease is prevented or cured by adding to the diet foods such as fresh meat, eggs, milk, liver and yeast extracts, and nicotinic acid, as well as by improvement of the general conditions of life.

PELVIS (*pelvis*, a basin) is that division of the skeleton which is made up of the haunch-bones, one on each side, and the sacrum and coccyx behind. It connects the lower limbs with the spine. Each haunch-bone is composed of three originally separate bones, in the adult pelvis firmly fused together; the ilium; the ischium, with a rounded part below, the 'tuberosity', upon which the body rests in sitting: and the pubis in front. The expanded parts of the iliac bones incompletely surround the lower part of the abdomen, known as the 'false pelvis', and are separated by a distinct line, known as the 'brim' or 'inlet', from the 'true pelvis' beneath. The true pelvis, as its name implies, is basin-shaped, and though in the dried state it has a wide 'outlet' beneath, yet in the

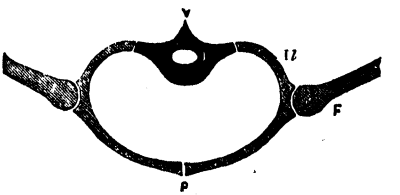


FIG. 369.—Diagram showing the relation of the pelvic bones to the spinal column and to the thigh-bone. *V*, Sacrum; *Il*, ilium; *P*, pubis; *F*, thigh-bone. (Turner's *Anatomy*.)

living body it is well closed and rounded off by ligaments and muscles so as to leave small openings only for the urinary and genital passages and for the rectum. This soft 'floor' of the pelvis is composed mainly of two muscles, the levators of the anus, while the deep notch, between the haunch-bone and sacrum behind, is closed in by a pair of strong sacro-sciatic ligaments.

The pelvis varies considerably in the two sexes. In the female it is shallower and the ilia are more widely separated, giving great breadth to the hips of the woman; the inlet is more circular and the outlet larger; while the angle beneath the pubic bones (subpubic angle),

which is an acute angle in the male, is obtuse in the female. All these points are of importance in connection with the subject of child-bearing.

The contents of the pelvis are the urinary bladder and rectum in both sexes, and in addition the male has the seminal vesicles and the prostate gland surrounding the neck of the bladder, while the female has the womb, ovaries, and their appendages.

In addition to the above differences for sex there are certain differences in the pelvis of different races, those of the lower races being, generally speaking, longer from before back and from above down than those of higher races, *i.e.* approximating more to the pelvis of lower animals.

PELVIS, DISEASES OF (*see* ABDOMEN, DISEASES OF, and also see under the headings of the various pelvic organs).

PELVIS OF THE KIDNEY, or RENAL PELVIS, is the cavity of the kidney, lined by mucous membrane, in which the ureter commences.

PEMPHIGUS (*πέμφιξ*, a bladder) is a skin eruption characterised by the appearance of large blebs.

PENICILLIN is the name given to an extract of the mould *Penicillium notatum* which has very high bacteriostatic properties. The purified product inhibits the growth of *Staphylococcus aureus*, *Streptococcus pyogenes*, and other bacteria in as high a dilution as 1 in 1,000,000. A more purified product (1943) inhibits the growth of *Staphylococcus aureus* in a dilution as high as 1 in 30,000,000. Serum, blood, and pus do not interfere with its action; it apparently has no toxic effect. Penicillin has already (1941) been given to a case of staphylococcal septicæmia with good results. Its manufacture on a wide scale in Great Britain and the U.S.A. is in progress (1943). It is the first chemotherapeutic remedy to be really effective against staphylococcal infections. It has been used with success against streptococcal and pneumococcal infections not yielding to the sulphonamide drugs, and is highly successful in the treatment of gonococcal infections. Altogether penicillin is one of the most remarkable medical discoveries of the first half of the twentieth century, discovered first by Professor Fleming of London, and worked out later by Professor Florey of Oxford. (*See also* GRAMICIDIN.)

PENIS (*penis*) is the organ down which in the male passes the urethra, the tube by which the contents of the urinary bladder and those of the seminal vesicles escape.

PENNYROYAL is a popular name for several plants such as *Mentha pulegium* (European pennyroyal) and *Hedeoma pulegioides* (American pennyroyal). These plants contain a volatile oil which is much used for rubbing into the skin to prevent the bites of midges and mosquitoes and to allay the itching caused by them.

PENTAMIDINE. — A proprietary term for diamidino-diphenoxypentane (*q.v.*).

PENTOSE is the name applied to a fruit sugar which contains 5 atoms of carbon and which does not ferment.

PENTOTHAL is the proprietary term for a barbiturate which in small doses is sedative, in medium hypnotic, and in large anæsthetic. Its chemical description is ethyl-(1-methylbutyl)-thiobarbituric acid. The sodium salt PENTOTHAL SODIUM is commonly used as a rapidly acting anæsthetic for short operations; it is injected into the veins.

PEPO is a substance made from the interior of pumpkin seeds, and used to expel tape-worms.

PEPPER is the unripe fruit of *Piper nigrum*, a vine of the East Indies, and possesses an active principle, piperin. It is used externally as a counter-irritant, and internally as a stimulant to digestion.

PEPPERMINT is the leaves and tops of *Mentha piperita*. It has an aromatic odour, due to the presence of an oil from which is obtained menthol, a camphor-like substance. (*See* MENTHOL.) Peppermint water is a useful remedy for flatulence and colic in infants. Oil of peppermint is used like the other volatile oils.

PEPSIN (*pepsinum*) is the name given to a ferment found in the gastric juice which digests proteins by converting them into albumose and finally into peptones. Pepsin is used in medicine in cases of weak digestion either to digest food before it is taken or more frequently to administer after meals. It is a light yellowish-brown or white powder prepared from the fresh mucous membrane of the stomach of pigs, sheep, or calves, and it can dissolve from 2500 to 5000 times its weight of hard-boiled white of egg. For the predigestion of food see PEPTONISED FOODS.

PEPTIC ULCER is the term commonly applied to innocent ulcers in the stomach and duodenum.

PEPTID is a term applied to a compound formed by the union of two or more amino-acids.

PEPTONE is a whitish soluble powder prepared from meat which has been peptonised either by the action of acids or by artificial digestion with pepsin or trypsin. It is used as a food, especially in the form of freshly peptonised milk, beef, etc., and it is also injected subcutaneously in the treatment of disease. (*See* PROTEIN THERAPY.)

PEPTONISED FOODS.—Pepsin and pancreatin are extracts made from the stomach and pancreas respectively of newly killed animals, and used by persons of weak digestion, or those recovering from a severe illness, or those devitalised by age, in order to assist in the digestion of the food by converting its insoluble proteids into peptones. They may be added to the food before it is taken into the stomach, being allowed to act upon it at a temperature a little above that of the body for a period of some minutes to several hours, or they may be given in solution, or as a powder in cachets, along with the food.

PEPSIN is extracted with weak alcohol from the stomach of the pig, and is then dried to a light yellow powder. For its administration see PEPSIN.

PANCREATIN contains four ferments (*see* DIGESTION), and is made by chopping up a pancreas finely and extracting it with weak alcohol or glycerin. Pancreatin has the advantages over pepsin that it acts more quickly, digests all kinds of food, does not require an acid to assist it, and does not unpleasantly change the taste of food unless allowed to act upon it too long. Pancreatic extract may be obtained in the form of powder or tablets (dose 3 to 10 grains), and is often used as liquor pancreaticus, of which one or two teaspoonfuls is taken for a dose. Beef-jelly, chicken-jelly, wheat flour, and other foods are sold, predigested to some extent by pancreatic extract, for the use of invalids.

Peptonised milk is made by taking a quarter of a pint of cold water, mixing with it a peptonising tablet or peptonising powder, adding this to a pint of fresh milk in a quart bottle, and finally placing the bottle in a pan of water just so hot that the hand can be immersed in it without pain. The bottle of milk is left in this bath according to the amount of digestion desired, but not longer than ten minutes. If the milk be not immediately used, it must be placed upon ice or brought quickly to the boil in order to stop the action of the peptonising ferment. It is often sufficient to administer one or two teaspoonfuls of liquor pancreaticus along with the milk, without any digestion outside the body.

Peptonised beef may be prepared as follows: A quarter of a pound of finely minced lean beef is mixed with half a pint of cold water, and cooked gently over the fire till it has boiled a few minutes. The liquor is then poured off, and the meat rubbed or beaten to a paste. The liquor and meat are placed next in a clean jar, and half a pint of cold water containing twenty grains of 'zymine' pancreatic extract (or a teaspoonful of liquor pancreaticus) and half a teaspoonful of bicarbonate of soda are added. The jar with its contents is covered and set aside in a warm place for three hours, and then boiled quickly to stop further peptonisation. The resulting liquid is seasoned with salt, and, if necessary, strained before use.

Other foods are peptonised in a similar manner. It is not well to use these artificially digested foods for too long a time, or the digestive glands become torpid from disuse.

PERCUSSION (*percutio*, I strike) is an aid to diagnosis practised by striking

the body with the fingers or with an instrument known as a 'plessor', in such a way as to make it give out a note. According to the degree of dulness or resonance of the note, an opinion can be formed as to the state of consolidation of air-containing organs, the presence of abnormal cavities in organs, and the dimensions of solid and air-containing organs, which happen to lie next one another. Still more valuable evidence is given by auscultation. (*See* AUSCULTATION.)

PERCUTANEOUS (*per*, through; *cutis*, skin) is a term applied to any method of administering remedies by passing them through the skin, as by rubbing in an ointment or carrying in drugs on the galvanic current.

PERFORATION is one of the serious dangers attaching to any ulcerated condition of the stomach or bowels. When a perforation from one of these hollow organs takes place into the peritoneal cavity, many bacteria, together with putrescible material, are poured into this cavity and there set up peritonitis. (*See* PERITONITIS.) The immediate signs that a perforation has taken place are usually a state of collapse, and increase of pain over the abdomen, together with, in some cases, the evidence of free fluid and gas in the peritoneal cavity.

PERI- (περί, around) is a prefix meaning around.

PERIARTERITIS NODOSA is a rare and fatal disease of unknown but probably infectious origin in which prolonged fever and obscure symptoms referable to any system of the body are associated with local areas of inflammation along the arteries giving rise to nodules in their walls.

PERICARDITIS means inflammation of the pericardium. (*See* HEART DISEASES.)

PERICARDIUM (περικάρδιος, near the heart) is the smooth membrane that surrounds the heart. (*See* HEART.)

PERIHEPATITIS (περί, around; ἧπαρ, liver) means inflammation of the peritoneal covering of the liver.

PERIMETRITIS (περί, around; μήτρα, the womb) means a localised inflammation of the peritoneum surrounding the womb.

PERINEPHRITIS (περί, around; νεφρός, the kidney) means inflammation in the cellular tissue round the kidney, often leading to formation of an abscess. (*See* ABSCESS, ACUTE.)

PERINEUM (περίνεος), or FORK, is the region situated between the opening of the bowel behind and of the genital organs in front. In the female it is apt to be lacerated in the act of childbirth.

PERIOD (*see* MENSTRUATION).

PERIOSTEUM (περιόστεος, round the bones) is the membrane surrounding a bone. The periosteum carries blood-vessels and nerves for the nutrition and

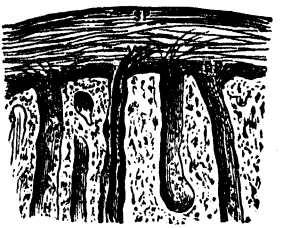


FIG. 370.—Surface of a growing bone. *SP*, Superficial fibrous layer of periosteum; *DP*, deep cellular layer next the bone; *V*, blood-vessel entering the bone; *HH*, Haversian canals. Magnified by about 200. (Turner's *Anatomy*.)

development of the bone. When it is irritated, an increased deposit of bone takes place beneath it, and, if it is destroyed, the bone may cease to grow and a portion may die and separate as a sequestrum. (*See* BONE.)

PERIOSTITIS means inflammation on the surface of a bone affecting the periosteum. (*See* BONE, DISEASES OF.)

PERIPHERAL NEURITIS (περιφέρεια, the outer part; νεῦρον, nerve) means inflammation of the nerves in the outlying parts of the body. (*See* NEURITIS.)

PERISTALSIS (περισταλτικός, compressing) is the term applied to the worm-like movement by which the stomach and bowels propel their contents. It consists of alternate waves of relaxation and contraction in successive

parts of the tube. When any obstruction to the movement of the contents exists, these contractions become more forcible and are liable to be accompanied by the severe form of pain known as colic.

PERITONEOSCOPY. — Viewing of the peritoneal cavity through a tube fitted with mirrors and light. The instrument (resembling a CYSTOSCOPE, *q.v.*) is entered just below the umbilicus. The peritoneal cavity is then inflated with air. This simple operation may obviate a more drastic one — for example, if peritoneoscopy shows 'deposits' of cancer in the peritoneum or the liver. In America colour photographs of the liver have been taken through the peritoneoscope.

PERITONEUM (*περιτόναιος*, a stretched membrane) is the membrane lining the abdominal cavity, and forming a covering for the organs contained in it. That part lining the walls of the abdomen is called the 'parietal' peritoneum, and that part covering the viscera is known as 'visceral' peritoneum. The two are continuous with one another at the back of the abdomen, and form a closed sac. One may understand its relation to the organs by conceiving them to have been pressed against the outside of this sac from behind, and each to have become wrapped up in the hinder part of the sac without being forced through to its interior, while the front wall of the sac remains quite smooth. The folds of peritoneum passing from one organ to another are thus very complicated, and receive special names in various parts. (*See* MESENTERY, OMENTUM.)

It is stated that the peritoneum forms a closed sac, but to this there is an exception in the female, the Fallopian tube on each side having an opening into the cavity at its end large enough to admit a bristle. There is, however, no large outlet for drainage of fluid, so that a small amount is always present to lubricate the membrane, while a large amount collects in conditions that are associated with dropsy. From this arises one great reason for the danger of inflammation affecting this membrane, since there is no escape from it for the pus and other products of inflammation, which accumulate and increase the state of irritation.

In structure the peritoneum consists of a dense, though thin and elastic,

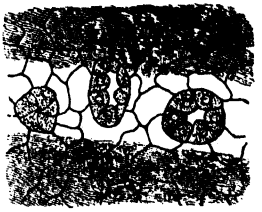


FIG. 371.—Cells lining the surface of the peritoneal cavity. Three minute stomata are shown. The clear band is a lymphatic vessel behind. (Turner's *Anatomy*.)

fibrous membrane covered, on its inner side, by a smooth glistening layer of plate-like epithelial cells. Here and there between the cells are minute openings (stomata), each of which communicates with a lymphatic vessel, so that the fluid in the cavity is constantly draining off into the general lymphatic circulation.

PERITONITIS means inflammation of the peritoneum or membrane investing the abdominal and pelvic cavities and their contained viscera. It may exist in an acute or a chronic form, and may be either localised in one part or generally diffused.

Inflammation of this membrane varies much as regards its causes, severity, and danger, according as it is acute or chronic. Though there are occasional intermediate cases, it may be said, roughly speaking, that the development of acute cases may be reckoned by days, that of chronic cases by months.

ACUTE PERITONITIS. — Causes. —Like inflammations of other parts, this is said to arise occasionally in consequence of a chill, being of rheumatic nature, but this cause is rare. Much more frequently it arises in consequence of the entrance of micro-organisms into the peritoneal cavity, which gain entrance through wounds from the exterior or pass out of some of the abdominal organs. The great danger which follows upon stabs and other penetrating wounds of the abdomen, and the fear which, prior to the days of antiseptic surgery, kept surgeons from operating upon this cavity, originate from the risk of peri-

tonitis. On the other hand, the danger may come from within, and all conditions which lead to perforation of the stomach, bowels, bile-ducts, bladder, and other hollow organs may produce it. Thus gastric ulcer, typhoid fever, gallstones, rupture of the bladder, strangulated hernia, and obstructions of the bowels may end in peritonitis. Again, abscesses and cysts developed in connection with various organs may burst and so produce it, appendicitis and abscesses of the ovary and Fallopian tubes being specially dangerous. Peritonitis may also arise within a few days after delivery, and this 'puerperal' form is a very fatal complication of childbirth.

The changes which take place in the peritoneum are similar to those undergone by other serous membranes when inflamed, viz. (1) congestion; (2) exudation of fibrin in greater or less abundance, at first greyish in colour and soft, thereafter yellow and becoming tough in consistence, causing the folds of intestine to adhere together, and so tending to limit the spread of the inflammation; (3) effusion of fluid, either clear, turbid, bloody, or purulent; (4) absorption more or less complete of the fluid and fibrin, or, in cases that proceed to a serious issue, the formation of grey or greenish-grey pus. Occasionally shreds or bands of unabsorbed fibrin remain, and become converted into fibrous tissue, thus producing adhesions which constitute a subsequent danger of strangulation of the bowel, though this risk follows more often upon recovery from the chronic form.

In some cases the peritonitis becomes *localised* by adhesions between neighbouring organs due to the deposit of fibrin upon their surface. This process takes place with great rapidity, and it makes a good deal of difference to the result of the disease whether it be thus shut in to one part of the abdomen or whether it spreads so rapidly, or is of so virulent a type, as quickly to become *general*.

The bacteria causing peritonitis are numerous, but among the most common are the bacillus coli communis, which is always a denizen of the intestine; streptococci, which produce the most virulent form of inflammation; and the gonococcus.

Symptoms.—The symptoms usually begin by a rigor, together with vomiting and pain in the abdomen of a peculiarly severe and sickening character, accompanied with extreme tenderness, so that the slightest pressure causes a great aggravation of suffering. The patient lies on the back with the knees drawn up, and the hands often rest upon the head, and it will be noticed that the breathing is rapid and shallow and performed by movements of the chest only, the abdominal muscles remaining rigid, unlike what takes place in healthy respiration. The abdomen becomes swollen by flatulent distension of the intestines, which increases the patient's distress. There is usually constipation. The skin is hot, and the temperature rises to 104° or 105° Fahr., although there may be perspiration; the pulse is small, hard, and wiry; the urine is scanty and high-coloured, and passed with pain. The patient's aspect is one of anxiety and suffering. These symptoms may subside in a day or two, but if they do not, the case is apt to go on rapidly to a fatal termination. In such an event, the pain and tenderness subside, the abdomen becomes more distended, hiccough and vomiting of brown or blood-coloured matter occur, the temperature falls, the face becomes pinched, cold, and clammy, the pulse exceedingly rapid and feeble, and death takes place from collapse, the patient's mental faculties generally remaining clear till the close. When the peritonitis is due to perforation, as may happen in the case of a gastric ulcer, or the ulcers of typhoid fever, the above-mentioned symptoms and the fatal collapse may all take place in from twelve to twenty-four hours. But usually the disease lasts four or five days, and the patient sometimes survives as long as a week. The puerperal form of this disease, which comes on within a day or two after parturition, is always very serious, and is often rapidly fatal. The symptoms are similar to those already described, but in addition there are generally superadded those of septicæmia. (*See* BLOOD-POISONING.)

Treatment.—The patient should lie recumbent on the back, with a pillow beneath the knees, so as to bend up the thighs, and a cage over the abdomen to support the weight of the bed-clothes.

Externally, either an ice-bag or hot laudanum fomentations retard the inflammation and give relief. The food must be fluid, stimulating, and easily digested, and, if vomiting comes on, it should be administered in the form of enemata by the bowel. In the later stages, when the stomach will not retain even water, large enemata of saline solution quench the distressing thirst. Some physicians administer small doses of Epsom salts in the early stages, in order to relieve the constipation which is present and diminish the congestion of the bowels. These doses are repeated at frequent intervals till the bowels move. In the later stages, opium is of great value, administered especially with the view of relieving the pain and also in order to diminish to some extent the inflammatory process. Sulphonamide drugs, both by mouth and locally in the peritoneal cavity, because of their action against *B. coli* and streptococci, are indicated.

The question of operation arises in every case of peritonitis. In cases due to perforation of the stomach or intestine which are discovered early, operation is always advisable, because there is a good prospect of freeing the abdomen from the septic material which has entered it, and, if no operation be performed, the patient will almost certainly die. Later in the course of the case, when the patient is much enfeebled, the question is more difficult to decide, and the decision must be made as to whether the patient has sufficient remaining strength to stand the shock of a severe operation, designed to cleanse the peritoneal cavity thoroughly. In cases where peritonitis has become 'localised' to a position of the abdomen the question arises whether the patient's small stock of vitality will be used to more advantage in combating the disease. The operation consists in making a large opening into the abdomen, carefully cleansing the outer surface of the bowels, attending to the original cause of the peritonitis, whether it be a perforation, obstruction, abscess, appendicitis, etc., and washing out the cavity with a large quantity of sterile salt solution, after which it is usual to insert drainage tubes.

CHRONIC PERITONITIS.—**Causes.**—This is, in the great majority of cases, tuberculous in origin and secondary to tuberculous disease of bones, joints, glands, or bowels. There is also a localised form of chronic peritonitis, which is non-tuberculous. This latter form is due to long-continued inflammation in an abdominal organ or to ulceration which threatens to perforate. This type of peritonitis is advantageous, because it produces great thickening and adhesions over the part in question, thus lessening the risk of perforation or of infection of the general peritoneal cavity, *e.g.* in appendicitis.

Symptoms.—The chief symptoms of tuberculous peritonitis are abdominal pain and distension, along with disturbance of the functions of the bowels, there being either constipation or diarrhœa, or each alternately. Along with these local manifestations, there exist the usual phenomena of tuberculous disease, viz. fever, with emaciation and loss of strength. The abdominal pain may, however, be so slight as only to reach a feeling of uncomfortable weight and fullness.

The simple localised form mentioned above is characterised mainly by recurring attacks of sharp pain, and often the thickening of the peritoneum is so great as to resemble and be mistaken for a tumor.

Treatment.—The same rules, as to diet and a healthy life, that govern the consumptive, apply in tuberculous peritonitis. (*See* CONSUMPTION.) The application of various counter-irritants to the abdomen is practised by some, and the daily rubbing of mercurial ointment into the abdomen has been highly recommended. Ointment containing tuberculin (Moro's ointment) is frequently used. Surgical intervention is often attended by a cure if the case does not recover within some months under this medical treatment. The usual operation consists in opening the abdomen, allowing the fluid to escape and air to enter the peritoneal cavity, and again closing the wound. This operative treatment seems to be oftener successful if fluid be present in considerable amount than if there be little or none in the cavity.

PERITONSILLAR ABSCESS is the term applied to an attack of tonsillitis which results in an abscess near the

tonsil, forming the condition known as 'quinsy'. It usually points and bursts through the soft palate.

PERITYPHLITIS (*περί*, around; *τυφλόν*, the cæcum) means inflammation round the region of the cæcum, that part of the large intestine situated in the lower right-hand corner of the abdomen from which the appendix vermiformis springs. The name is now little used, having been introduced before people came to recognise the fact that inflammations in this region usually originate in the appendix. (*See* APPENDICITIS.)

PERLÈCHE (*see* CHEILOSIS).

PERMANGANATE OF POTASSIUM is a crystalline substance of brilliant purple hue. Permanganate of sodium is red in colour, and is the chief ingredient in Condy's disinfectant fluid, having an action similar to that of the potassium salt. Potassium permanganate dissolved in water is of a brilliant purple colour, and has a powerful oxidising action, in exerting which it disintegrates alkaloidal poisons, foul and decomposing organic bodies, and kills low forms of life, such as bacteria. It is, therefore, a powerful antiseptic. It is non-volatile, and therefore has not the penetrating power of carbolic acid, and in exerting its oxidising power it is itself reduced, so that it gradually loses strength. *Green Condy's fluid* contains sodium manganate, which has a similar action.

Uses.—Permanganate of potassium is a cheap disinfectant, and is conveniently kept in a saturated solution (1 part of potassium permanganate to 20 parts of water). If this be diluted with water twenty-five times (1 in 500), that is, to a crimson tint, or in the proportion of about a tablespoonful of the strong solution to a tumblerful of water, it forms an excellent lotion for washing ulcers and suppurating wounds, and, diluted to a pale pink colour, makes a good gargle for an ulcerated throat. In the latter strength, it may be poured down drains, when it both purifies them and destroys the smell proceeding from them. A stronger solution (dark crimson or purple in colour) may be used with advantage to wash or steep the hands after they have touched a foul wound or a person suffering from infectious disease. If the hands become brown after its use, this discoloration may be removed by oxalic acid. As a hair-dye, potassium permanganate gives a rich chestnut-brown colour. As an antidote to poisoning by opium, strychnine, colchicum, oxalic acid, and toadstools (muscarine), potassium permanganate is most valuable if administered at once; 3 or 4 grains may be given well diluted in water. A pale pink solution of potassium permanganate is also a delicate test for the purity of drinking-water; a drop or two allowed to fall into a glass of water should tinge the latter pink, but, if the pink colour disappear, it indicates the presence of organic impurities.

PERNICIOUS ANÆMIA is a severe form of bloodlessness also known as ADDISONIAN ANÆMIA and ESSENTIAL ANÆMIA. (*See* ANÆMIA.)

PERONEAL (*περόνη*, the fibula) is the name given to the muscles, nerves, etc., on the outer or fibular side of the leg.

PEROXIDE OF HYDROGEN is a syrupy, colourless, odourless liquid which differs in chemical composition from water, by containing two atoms of oxygen (H_2O_2) to every one in water (H_2O). It has the property of readily giving up its extra oxygen and being reduced to water, and this renders it of great value in medicine for antiseptic, deodorant, and other purposes. It is most commonly employed as a solution in water of such a strength that any quantity will give off ten times its bulk of oxygen gas; this is known as 10-volume strength, or as liquor of hydrogen peroxide. It is also prepared twice this strength. When added to ether, the substance is more stable, and the mixture is known as ozonic ether. Volatile oils which have become oxidised contain a considerable quantity of peroxide of hydrogen, and to this substance the powers they possess of destroying foul odours is largely due.

Uses.—Externally to ulcers, and by sprays or swabs to cavities like the nose and throat, the watery solution of hydrogen peroxide is applied in order to act as an antiseptic, and also for the valuable

property possessed by the little bubbles of oxygen that it gives off in breaking up and causing the separation of discharges. It is used to remove surgical dressings that are very adherent. Internally it can be administered as an antiseptic in doses of ½ to 2 drams.

PERSEVERATION is the term for describing the senseless repetition of words or deeds by a person with a disordered mind.

PERSPIRATION, or SWEAT, is an excretion from the skin, produced by microscopic sweat-glands scattered over the surface. Perspiration takes place constantly by evaporation from the openings of the sweat-glands, and this

FIG. 372.—Vertical section through the skin showing a sweat-gland *s*, with its duct running up through the cuticle to the surface. For other letters see SKIN. (Turner's *Anatomy*.)

'insensible perspiration' amounts in twenty-four hours to considerably over a pint. Under certain circumstances, as when the skin is heated or the person exerts himself, drops of 'sensible perspiration' appear on the skin; to these the term 'sweat' is generally confined, and the amount of sweat secreted may become very large.

Sweat is a faintly acid, watery fluid containing less than 2 per cent of solids, made up mainly of salts and to a slight extent of fatty material, and including a small amount of urea (about 1 part per 1000), the substance which the kidneys excrete in large amount. When the action of the kidneys is defective, for example in Bright's disease, urea and other substances, which the kidneys normally excrete, pass out in great quantities through the skin. This action of the skin is so marked that in a case of uræmia crystals of urea may be deposited on the surface as the sweat evaporates.

The sweat-glands in man are situated in greatest numbers on the soles of the feet and palms of the hands, and with a magnifying glass their minute openings or pores can be seen in rows occupying the summit of each ridge in the skin. Perspiration is most abundant in these regions, though it also occurs all over the body. Different animals perspire in different regions; thus rabbits and rats do not sweat at all, oxen very little, pigs mostly on the snout, dogs and cats chiefly from the pads of the feet.

The chief object of perspiration is to regulate the amount of heat lost from the surface of the body and so maintain an even body-temperature. Accordingly muscular activity, which sets free a great deal of heat, is the chief cause of sweating, and external heat is another. The process is regulated by nerves, some of which are the nerves controlling the size of the blood-vessels (vaso-motor), and therefore the amount of blood in a part, while other nerves proceed to the sweat-glands (secretory) and directly influence secretion. These are presided over by centres in the spinal cord and medulla.

Abnormalities of perspiration.—LESSENED sweating under certain conditions may occur, as in the early stages of fever, in diabetes, and in some forms of Bright's disease. Certain persons are peculiar in the fact of being unable to sweat copiously after muscular exertion, or when exposed to heat, and such persons are often seriously affected by exposure to a hot sun or to the heat of an engine-room. (*See* SUNSTROKE.)

EXCESSIVE sweating may also take place in rheumatic fever, in the later stages of various other fevers, and above all in advanced consumption, where the night-sweats are often copious enough to drench the patient's night-clothes and bedding. In a slighter degree, persons

of feeble muscular power are apt to perspire very freely upon exertion or when exposed to heat. Rickets is another disease in which children perspire copiously when asleep, and in this disease the sweating is mainly about the head. Some persons have the peculiarity of sweating copiously over a localised area, as, for example, one side of the forehead, and this peculiarity is generally due to some nervous injury.

OFFENSIVE perspiration is not uncommon. In rheumatic conditions the sweat has a peculiar, sour smell. Dyspeptics too are frequently troubled by an unpleasant odour of the skin. But it is sweating of the feet or armpits that is most offensive of all, this condition being often due to decomposition of the skin secretions by bacteria.

COLOURED perspiration is a rare peculiarity, the sweat being tinged blue by indigo, or red by altered blood pigment.

Treatment.—LESSENED perspiration is treated when necessary by various drugs known as diaphoretics (*see* DIAPHORETICS), and by hot-air baths. (*See* BATHS, BRIGHT'S DISEASE.)

EXCESSIVE sweating is diminished by the proper treatment of the disease which causes it. In consumption, the night-sweats are accompanied by a feeling of great weakness, and the clammy garments are a source of great discomfort to the patient till they are removed. Sweating is checked to some extent by sponging the skin with vinegar in water, and by the administration of astringent drugs. Belladonna is a drug which has special power in checking the secretion of sweat, either applied to the skin as the liniment of belladonna or more effectively when the extract or other preparation is given by the mouth. Both the weakness and the cold sweats of phthisical patients are, however, mainly due to exhaustion of the nervous system, so that stimulating food, such as a bowl of beef-tea at night, or stimulating drugs, such as strychnine, have perhaps the greatest power in diminishing both exhaustion and sweating in the early morning.

OFFENSIVE perspiration can often be treated by frequent bathing and attention to the digestion. Sometimes, however, the unpleasant smell can only be banished by prolonged treatment. The feet, armpits, and other sources of perspiration should be washed daily with carbolic, coal-tar, or other mildly antiseptic soap, and thereafter dusted with boric acid powder or bathed with peroxide of hydrogen. The stockings must be frequently changed, and, in addition to washing, they should be disinfected by being wrung out of boric lotion or weak perchloride of mercury lotion immediately before drying. The shoes must also be treated by wiping them out with perchloride of mercury lotion now and then, because the bacteria responsible for the condition may survive on the damp leather. Shoes should be worn in preference to boots, so as to allow freer access of air to the feet, and for the same reason it is a good plan to wear cork soles. Sweating may also be considerably checked, if it is very copious, by rubbing the feet, armpits, etc., with liniment of belladonna or with spirit.

PERTUSSIS (*per-*, excessive; *tussis*, cough) is another name for whooping-cough. (*See* WHOOPING-COUGH.)

PERUVIAN BARK is another name for cinchona bark, from which quinine is derived.

PESSARIES (*πεσσός*) are instruments designed to support a displaced womb.

PEST (*pestis*) is an old name for plague. (*See* PLAGUE.)

PETECHIÆ (Ital. *petecchiæ*, fleabites) are small spots on the skin, of red or purple colour, resembling fleabites. They may be due to minute areas of inflammation, as in typhoid fever, or to small hæmorrhages in the skin, as in purpura.

PETHIDINE HYDROCHLORIDE.—The term officially recommended by the British Pharmacopœia Commission for the proprietary preparations 'DEMEROL' and 'DOLANTAL'. A synthetic analgesic and antispasmodic drug chemically described as the ethyl ester of 1-methyl-4-phenylpiperidine-4-carboxylic acid. Used in the treatment of painful and spasmodic conditions in place of morphine and atropine. It

was at first thought that the drug would have an advantage over morphine in not encouraging addiction, but this favourable view of the drug is not sustained by experience.

PETIT MAL (Fr.) means the lesser type of epileptic seizure. (*See* EPILEPSY.)

PETROLATUM is another name for vaseline. (*See* PARAFFIN.)

PHAGEDÆNA (φαγέδαινα, a devouring sore) means a process of ulceration of so severe a type that pieces of skin become gangrenous and slough off. It is due either to great weakness on the part of the person attacked, or to excessive virulence of the bacteria concerned.

PHAGOCYTOSIS (φαγεῖν, to eat; κύτος, a corpuscle) is the name applied to a process by which the attacks of

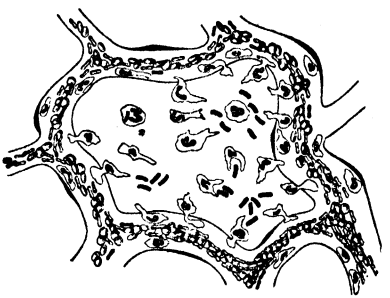


FIG. 373.—Diagram of a minute portion of the body surrounded by blood-vessels, and illustrating the invasion of the tissue by bacteria, the passage of white corpuscles through the walls of the vessels, and the ingestion by them of the bacteria. Circulation has come to a standstill in the vessels, which are full of red blood corpuscles.

bacteria upon the living body are repelled and the bacteria destroyed through the activity of the white corpuscles of the blood.

The first observations upon this point were made by Metchnikoff in the case of the Daphnia or water-flea. This little animal, which exists in large numbers in pools of stagnant water, may often be observed to devour the large spores of a species of fungus. Metchnikoff observed that these spores, perforating the intestine of the Daphnia, found their way into its body cavity and there multiplied. They were, however, attacked at once by the white corpuscles circulating in the creature's vessels, which surrounded and took into their substance these spores, apparently in time digesting them, so that they broke down and disappeared. In some cases, however, he found that the spores developed quickly, the white corpuscles appeared to be sluggish in attacking them, and the creature died.

Similar observations have been made in the case of other bacteria in higher animals. The processes which precede phagocytosis, viz. the slowing of the blood-stream in the part, collection of the white corpuscles on the walls of the vessels, their passage out of the vessels into the tissues (diapedesis), and their approach to the bacteria, are described under ABSCESS and INFLAMMATION. When bacteria are very virulent they seem to repel the white corpuscles instead of attracting them, and no phagocytosis takes place, but the bacteria develop unimpeded. (*See* OPSONINS.)

It should be stated that some hold that these white corpuscles do not devour and digest the living bacteria, but simply take up dead ones, just as they absorb particles of carbon, fragments of dead bone, and the like. These authorities suppose that the death of the bacteria is due to some chemical products formed by the body in response to the poisonous substances set free by the bacteria.

PHALANX (φάλαγξ) is the name given to any one of the small bones of the fingers and toes. The phalanges are fourteen in number in each hand and foot, the thumb and great toe possessing only two each, while each of the other fingers and toes has three.

PHANTASY (φαντασία, appearance), or FANTASY, is the term applied to an imaginary appearance or day dream.

PHARMACOLOGY (φάρμακον, drug; λόγος, discourse) is the part of medical science dealing with knowledge of the action of drugs.

PHARMACOPŒIA (φαρμακοποιέω, I prepare medicines) is an official publication dealing with the recognised drugs and giving their doses, preparations,

sources, and tests. Most countries have a pharmacopœia of their own. That for Great Britain and Ireland, for example, is issued under the supervision of the General Council on Medical Education. Many hospitals and medical schools have a small pharmacopœia of their own, giving the prescriptions most commonly dispensed in that particular hospital or school.

PHARMACY is the term applied to the art of preparing and compounding medicines, or to a place where this is carried out.

PHARYNGITIS means inflammation of the pharynx. (*See* THROAT, DISEASES OF, *and* CLERGYMAN'S SORE THROAT.)

PHARYNX (φάρυγξ) is another name for the throat. The term throat is

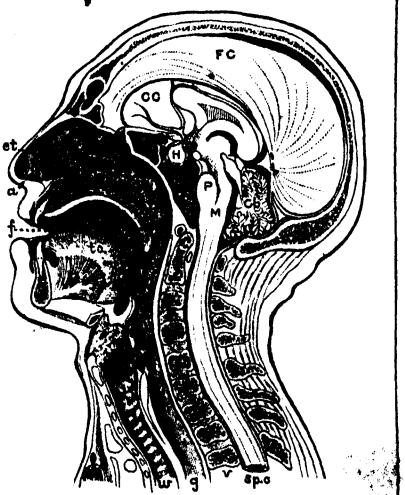


FIG. 374.—Vertical section through the middle of the head and neck. *a*, Is a heavy dotted line indicating the air passages; *f*, a lighter line shows the food passages. The two cross in the throat; *et*, Eustachian tube; *t*, tonsil; *to*, tongue; *g*, gullet; *l*, larynx; *w*, windpipe. For other letters see BRAIN. (After Braune.)

popularly applied to the region about the front of the neck generally, but in its strict sense it means the irregular cavity into which the nose and mouth open above, from which the larynx and gullet open below, and in which the channel for the air and that for the food cross one another. It extends from the base of the skull down to the 6th cervical vertebra, separated from the upper six vertebræ only by some loose fibrous tissue, and is about 5 inches long.

It is completely closed behind by a layer of muscles, and by mucous membrane, but in front it opens into the nose, mouth, and larynx in succession from above down. In its upper part, the Eustachian tubes open one on either side, and between them on the back wall grows a mass of glandular tissue known as the third tonsil, which, if enlarged, produces the condition known as 'adenoids'. (*See* NOSE, DISEASES OF.) The muscles which close in the sides and back of the pharynx are three in number on each side, and spring, one from the jaw-bone, the second from the hyoid-bone, the third from the side of the larynx, each of these 'constrictors' spreading out like a fan on the back of the pharynx. Two other small muscles run downwards on each side.

PHEMITONE is the *British Pharmacopœia* name for PROMINAL (*q.v.*).

PHENACETIN is a white crystalline coal-tar product. It is much used in fevers, influenza, headaches, and neuralgias of all kinds, on account of its power of reducing temperature and of deadening pain. It is often given in doses of 5 to 10 grains, along with sodium salicylate and citrate of caffeine. (*See* ANTIPYRIN.)

PHENAZONUM is another name for antipyrin.

PHENIODOL is a drug which is excreted by the liver into the bile passages and is opaque to X-rays. As it gets into the gall-bladder and is 'radio-opaque', an X-ray skiagraph will show whether the gall-bladder is normal or not—for example, whether gall-stones are present. The drug is taken by mouth. It is chemically described as β-(4-hydroxy-3: 5-diiodophenyl)-α-phenyl-propionic acid.

PHENOBARBITONE, or PHENOBARBITAL, is another name for luminal.

PHENOL is another name for carbolic acid. (*See* CARBOLIC ACID.)

PHENOL-PHTHALEIN is a substance much used as an indicator of reaction in

urine, gastric juice, etc., being colourless in acid media, brilliant red with alkalies, and varying in tint according to the acid concentration. It is given internally under the names of ' purgen ', ' laxen ', ' phenolax ', etc., in 1 to 5 grain doses for an aperient. Phenol-sulphone-phthalein is used to test the power of the kidneys; a measured quantity being injected into a muscle and the amount excreted in the urine during the next few hours carefully estimated by a colour scale. Phenoltetrachlorphthalein is a coal-tar derivative used as a diagnostic agent for the estimation of the functional power of the liver by intravenous injection.

PHENOTHIAZINE. — A yellowish crystalline compound with the chemical formula $C_6H_4S(NH)C_6H_4$, the parent substance of many thiazine dyes, including methylene blue. Much used in veterinary practice as an anthelmintic, especially against nematodes, it is also highly effective in the treatment of human threadworm infection. Unfortunately it is toxic, causing photosensitisation of the skin, toxic hepatitis, and hæmolytic anæmia. These risks appear out of proportion to the gravity of the condition treated.

PHIMOSIS (*φιμός*, a muzzle) is the name applied to a condition of great narrowing at the edge of the foreskin, for which the operation of circumcision is necessary.

PHLEBITIS (*φλέψ*, a vein) means inflammation of a vein. (*See* VEINS, DISEASES OF.)

PHLEBOLITH is the term applied to a small stone formed in a vein as a result of calcification of a thrombus.

PHLEBOTOMY (*φλέψ*, a vein; *τέμνω*, I cut) is an old name for the operation of blood-letting by opening a vein. (*See* BLOOD-LETTING.)

PHLEGM (*φλέγμα*, a slimy, inflammatory humour) is a popular name for mucus, particularly that secreted in the air passages. (*See* BRONCHITIS, EXPECTORANTS, MUCUS.)

PHLEGMASIA DOLENS (*φλεγμασία*, superficial inflammation; *dolens*, grievous) is another name for white leg. (*See* WHITE LEG.)

PHLEGMON (*φλεγμονή*, burning heat) is an old term for inflammation.

PHLYCTENULE (*φλύκταινα*, a blister) is a small inflammatory swelling situated on the conjunctiva or on the cornea in front of the eye. Phlyctenules are found especially in ill-nourished, weakly children, and cause a great deal of irritation, pain, running at the eyes and inability to face the light. (*See* EYE, DISEASES OF.)

PHOSPHATES are salts of phosphoric acid, and, as this substance is contained in many articles of food as well as in bone, the nuclei of cells, and the nervous system, phosphates are constantly excreted in the urine. In certain diseased conditions, such as gout, the amount of phosphates excreted rises above the 30 to 50 grains daily excreted in health, but it is only in diseased conditions of the urinary passages that these give rise to trouble. The continued use of an excess of food containing alkalies, such as green vegetables, and still more the presence in the urine of bacteria which lead to its decomposition, produce the necessary change from the natural mild acidity to alkalinity, and lead to the deposit of phosphates and to their collection into stones.

PHOSPHATURIA means the presence in the urine of a large amount of phosphates. It is treated by a stimulating diet and tonics.

PHOSPHORIC ACID, either as the dilute acid or in the form of phosphates, forms a constituent of many tonics. Phosphate of lime is much used in cases of debility and especially of bone disease. Sodium phosphate and effervescent sodium phosphate are much used as mild aperients, and acid sodium phosphate is used in cases of cystitis.

PHOSPHORUS BURNS.—These may happen in an air-raid from the use of phosphorus bombs. If particles of phosphorus settle on or become embedded in the skin, the resulting burn should be treated with a 2 per cent sodium bicarbonate solution, followed by application of a 2 per cent solution of copper sulphate. Fats and oils should not be employed.

PHOSPHORUS POISONING is very rare, and is produced only by the yellow, soluble form of phosphorus. Red phosphorus, from which safety matches are made, is harmless or nearly so. Red phosphorus is made from yellow by heating the latter to a high temperature in closed iron vessels. When taken internally, as when a child sucks the heads of matches, phosphorus acts first as an irritant poison, and, being thereafter absorbed, produces profound degenerative changes in the liver and other abdominal organs. There is also a chronic form of phosphorus poisoning, from which those who make matches tipped with yellow phosphorus suffer. This consists of profound debility, and the occurrence of disease in the lower jaw-bone (phossy jaw), which necroses and comes away in large fragments, over a period of months or years. It is now believed by some authorities that this disease in the bone is really a form of tuberculosis to which weak health predisposes the match-workers. Phosphorus is, however, given in minute doses as a medicine, having an action very similar to that of arsenic.

Symptoms.—When a child, for example, has taken a large dose it speedily suffers from pain, vomiting, colic, diarrhœa, and perhaps convulsions, and may die in a few hours. Or partial recovery may take place, and the sufferer survive for several days, later developing jaundice and blood-stained urine.

Treatment.—As phosphorus is absorbed slowly, washing out the stomach may succeed in removing the poison up to two hours after it has been swallowed. Copper sulphate, 1½-3 grains in water may be given every ten minutes until emesis occurs. Gastric lavage with 0·1 per cent potassium permanganate or with hydrogen peroxide solution may be tried instead. After emesis and gastric lavage two or four ounces of liquid paraffin and a big dose of a saline purge should be given. No oils, fats, or milk should be taken so long as any phosphorus remains in the gastro-intestinal tract, for phosphorus is soluble in fats. If damage to the liver is threatened then treatment with sodium bicarbonate, glucose, and insulin is indicated.

Chronic poisoning is prevented in match-works by free ventilation, cleanliness, and periodic examination of the teeth of the match-workers.

PHOTOPHOBIA (*φῶς*, light; *φόβος*, fear) means a condition in which a person shrinks from letting bright light fall upon the eye. It is a symptom of inflammation of the eye, and occurs especially when the iris is inflamed.

PHRENIC NERVE (*φρήν*, the diaphragm) is the nerve which chiefly supplies the diaphragm. It springs from the 3rd, 4th, and 5th cervical spinal nerves, and has a long course down the neck, and through the chest, where each nerve lies between the heart and corresponding lung, to the diaphragm.

Phrenicectomy is an operation performed to divide this nerve in the neck. For its object *see under* CONSUMPTION.

PHRENOLOGY (*φρήν*, mind; *λόγος*, discourse) is an old term applied to the study of the mind and character of individuals from the shape of the head. As the shape of the head has been shown to depend chiefly upon accidental characteristics, such as the size of the air spaces in the bones, and not upon development of special areas in the contained brain, this branch of science is now generally discredited.

PHTHIRIASIS (*φθείρ*, a louse) means the condition of eczema, matted hair, dirt, and enlarged glands that constitute a minor disease arising from the presence of lice. (*See* PARASITES.)

PHTHISIS (*φθίσις*) means wasting, and is the general term applied to that progressive enfeeblement and loss of weight that arise from tuberculous disease of all kinds, but especially from the disease as it affects the lungs. The term is also used, in a more limited sense, to designate that variety of tuberculous disease of the lungs in which rapid breaking down of the lung tissue takes place with the formation of a cavity. (*See* CONSUMPTION.)

It must be remembered that persons who have other diseases of the lungs, as for example potters and knife-grinders, whose lungs are injured by the irritating particles they have inhaled, and persons who have incompletely recovered from acute pneumonia, may suffer from

symptoms very much resembling those of consumption. (*See* PNEUMONIA.)

PHYLACOGEN (*see* VACCINES).

PHYSIOLOGY (*φυσιολογία*, an inquiring into nature) is the branch of medical science that deals with the healthy functions of different organs, and the changes that the whole body undergoes in the course of its activities. Further information is given under the heading of each organ, and information will also be found under DIET, DIGESTION, EXERCISE, etc.

PHYSOSTIGMA, or CALABAR BEAN, is a seed derived from *Physostigma venenosum*, a tree of West Africa. It is known also as the ordeal bean, because preparations derived from it are used by the natives of West Africa to decide the guilt or innocence of accused persons, the guilty being supposed to succumb to its action, while the innocent cape. Its action depends on the presence of two alkaloids, the one known as physostigmine or eserine, the other as calabarine, the former of these being much the more important.

Action.—In moderate doses the drug acts as a general stimulant to muscle-fibre, producing movement of the bowels and contraction of the pupils. In poisonous doses it brings on a general paralysis.

Uses.—It is occasionally an ingredient of aperient pills, but it is chiefly in ophthalmic practice that eserine is used, a solution being dropped in the eye when it is desired to contract the pupil—for example, in treatment of glaucoma.

PIA MATER (*pius*, tender; *mater*, a nourishing structure) is the membrane closely investing the brain and spinal cord, in which run blood-vessels for the nourishment of these organs. (*See* BRAIN, SPINAL CORD.)

PICA is a term which means an abnormal craving for unusual foods, and may be a sign of pregnancy.

PICRIC ACID, or TRINITROPHENOL, is produced by the action of nitric upon carbolic acid. It is used for preparing explosives, and so is employed in medicine only in solution. As it coagulates albumin without any further irritant action, it produces a soothing pellicle over any raw surface with which it is brought into contact.

PICROTOXIN is a bitter crystalline principle obtained from the fruit of *Cocculus indicus*, which has an action similar to that of strychnine, and is administered in small doses to check the night-sweats and relieve breathlessness in cases of consumption. Picrotoxin is a convulsive poison and as such has been used in the 'shock' treatment of schizophrenia. It is a valuable antidote in poisoning from barbiturate drugs.

PIGEON BREAST (*see* CHEST DEFORMITIES).

PIGMENT (*pigmentum*, paint) is the term applied to the colouring matter of various secretions, blood, etc.; also to any medicinal preparation of thick consistence intended for painting on the skin or mucous membranes.

PILES, or HÆMORRHOIDS, consist of a varicose and often inflamed condition of the veins about the lower end of the bowel, known as the 'hæmorrhoidal' veins.

Varieties.—It is usual to divide hæmorrhoids into 'external piles', 'internal piles', and 'mixed piles'. To understand this division, it is important to remember that at the margin of the anus the skin joins the mucous membrane of the bowel in a sharp line, and that the bowel is kept closed by two circular muscles, the external sphincter and internal sphincter. The external sphincter is a weak muscle situated immediately beneath the skin, while the internal sphincter is a stronger circular band extending up the bowel for an inch. External piles are found outside the bowel, and are covered by skin, being brown or dusky-purple in colour; internal piles are within the opening, covered by mucous membrane, and are bright red or cherry-coloured. Mixed piles are those situated just on the margin, and covered half by skin, half by mucous membrane. Even internal piles do not extend more than an inch up the bowel, corresponding to the position of the internal sphincter muscle.

Causes.—There is always a tendency for the veins in this situation to become

distended, partly because they are unprovided with valves, partly because they form the lowest part of the 'portal' system, and are very apt to become overfilled when there is the least interference with the circulation through the portal vein, and partly because the muscular arrangements for keeping the rectum closed interfere with the circulation through the hæmorrhoidal veins. Probably most people of middle life are troubled by this condition to some extent, especially men of sedentary habits who indulge in over-eating and are troubled by constipation, as well as women who have borne many children. Habitual constipation is perhaps the principal cause of the presence of piles, and sitting on a cold stone or damp seat, or even a general chill, may suffice from time to time to inflame them and bring on what is popularly known as 'an attack of piles'.

It must be remembered, however, that in a certain number of cases piles are merely a symptom of disease higher up on the portal system, causing interference with the circulation. They come on very frequently during pregnancy, passing off when this condition has terminated. They are very common in heart disease, liver complaints, such as cirrhosis or congestion, and any disease affecting the bowels.

Symptoms.—EXTERNAL PILES may be present for years and give no trouble whatever, beyond occasioning pain of a cutting or burning character now and then when a very costive motion is passed. When, in consequence of a chill or other cause, they become inflamed, they are very painful and tender from chafing against the thighs and clothing in walking, and from pressure upon the chair on which the person sits. The pile, or piles, in these circumstances become enlarged and red, and give off a thin blood-stained discharge. They may become so badly inflamed as to suppurate, and this sometimes results in a natural cure, or they may cure by filling with blood-clot and shrivelling up into hard little knots. Such an 'attack of piles' lasts generally a week or two, and then subsides till another chill is caught.

INTERNAL PILES may be slight, and may give no sign of their presence beyond occasional bleeding, which may vary from a mere streak, when the bowels are opened, to a discharge of several ounces of dark blood. They are apt to produce a constant discharge of mucus tinged with blood which soils the linen, but unless very severe are not, as a rule, painful. These discharges of blood may, when copious and frequent, cause anæmia and become a serious menace to the health, though they are never fatal. On the other hand, in plethoric overfed people they may be a very salutary thing, warding off gout and apoplexy, or relieving the heart when it is diseased. When internal piles are large they may come down with the movement of the bowels, and may then become inflamed and painful from time to time, just like external piles.

Treatment.—Constipation must, in the first place, be guarded against. While the use of violent and irritating purgatives, like aloes, should be avoided if possible, care must be taken, by regulation of the diet and other means, to secure soft motions. (*See* CONSTIPATION.) The diet should, as a rule, include plenty of fruit, vegetables, and butter, and should in all cases be of a simple nature. Above all articles of food, alcoholic beverages tend to produce and perpetuate piles, and should therefore in bad cases be entirely abandoned. Regular exercise is very necessary in order to carry off the blood to the limbs and so relieve the portal circulation. An occasional dose of some substance that stimulates the liver, such as blue-pill (*see* CHOLAGOGUES), is beneficial.

Locally, great care must be taken not to irritate the piles, and when they are inflamed they should be washed with water every time the bowels move. Bleeding and the tendency to inflammation may be controlled by applying a sponge full of very hot water, or by smearing on cocaine or adrenalin ointment, or by using a morphia suppository after the motion. In the case of internal piles which come down at stool it is very important that they should be returned within the bowel each time by gentle steady pressure with the fingers. If they are 'down' and inflamed, a hot bath followed by a cocaine and morphia suppository gives relief.

Generally these means suffice to keep

the piles from causing trouble or to cure them completely, but occasionally surgical means are had recourse to. The external piles are simply removed with scissors or with the cautery. Internal piles require, according to their size and position, to be ligatured, destroyed by clamp and cautery, or, when they extend all round the bowel, to be removed *en masse* along with the last inch of mucous membrane lining the bowel. Small masses of piles are sometimes treated by injecting them with carbolic acid through a hollow needle.

PILLS are small round masses containing active drugs held together by syrup, gum, glycerin, or adhesive vegetable extracts. The majority of pills have a purgative action. They are sometimes without coating, being merely rolled in French chalk, but often they are covered with sugar, gelatin, or gilt. Some pills, designed to act upon the bowels only, are coated with keratin or glutol, substances which are insoluble in the gastric juice.

PILOCARPINE (*see* JABORANDI).

PIMENTO, or ALLSPICE, is the dried fruit of *Pimenta officinalis*, a Central American shrub, from which oil of pimento, a volatile oil, is obtained. It is used in the form of aqua pimentæ, or water of allspice, in doses of a tablespoonful or more in cases of colic and to make up various medicines.

PIMPLES, technically known as papules, are small, raised, and inflamed areas on the skin. On the face the most common cause is acne. (*See* ACNE.) Boils commence as hard pimples. (*See* BOILS.) The eruption of smallpox and that of chicken-pox begin also with pimples. (*See also* SKIN DISEASES.)

PINE OIL is a nearly colourless oil with aromatic odour, distilled from the fresh needles of *Pinus silvestris*, the Scotch fir. Its action is similar to that of turpentine, and it is mainly used as an inhalation, prepared by adding a few drops to hot water.

PINEAL BODY is a small reddish structure situated on the upper part of the mid-brain. It is of unknown function, although a body resembling an imperfect third eye is found in its position in some of the lower vertebrate animals, as, for example, in the lizard Hatteria.

PINK DISEASE (*see* ERYTHROEDEMA).

PINK-EYE is the name given to an acute muco-purulent conjunctivitis caused by various germs and highly contagious from such things as towels.

PINT is a measure of quantity containing 16 fluid ounces (wine measure) or 20 fluid ounces (Imperial measure). (*See* WEIGHTS AND MEASURES.)

PIPERAZINE is a substance which is credited with the power of dissolving uric acid in large amount. For this purpose it is administered in cases of gout, and is also used to wash out the bladder with the hope of dissolving uratic stones when these are present. It is usually given in doses of 5 grains or thereabout thrice daily.

PIRQUET'S REACTION is the term applied to a test for tuberculosis. A blob of tuberculin is placed on a patch of scarified skin. The subsequent appearance of a raised reddened papule (positive test) shows that the person tested has been infected by the tubercle bacillus but not necessarily that he has active tuberculosis.

PITHIATISM (*πείθω*, I persuade) is a name applied to a group of disorders in which the patient is subject to cure by persuasion or suggestion, the term being used as an equivalent for hysteria. (*See* HYSTERIA.)

PITOCIN.—The fraction isolated from extract of the posterior pituitary lobe which stimulates the uterine muscle to contract.

PITRESSIN.—The fraction isolated from extract of the posterior pituitary lobe which stimulates intestinal activity, constricts blood-vessels, and inhibits the secretion of urine.

PITUITARY BODY is a small structure about the size of a pea, weighing less than one gram in man, attached to the base of the brain, and lying in a depression (sella turcica) in the sphenoid bone. It consists of four parts, the

anterior lobe, pars intermedia, pars tuberalis, and posterior lobe. The *anterior lobe* resembles the thyroid gland in structure; the *pars intermedia* is a thin layer of cells lying on the posterior lobe; the *pars tuberalis* is a cellular layer on the stalk, and the *posterior lobe*, composed mainly of cells similar to the neuroglial cells of the brain, is connected with the floor of the third ventricle of the brain by a funnel-shaped stalk, the *infundibulum*. The pituitary is the most important ductless gland in the body and in recent years an increasing number of functions has been attributed to it, especially to the anterior lobe. The pituitary seems to have a controlling effect on all the other ductless glands, which it does by the elaboration of hormones; these circulate in the blood and act upon the glands for which each is designed. There is, for example, the thyrotrophic hormone, which stimulates production of thyroid cells and activity. The adrenotrophic hormone stimulates the adrenal gland, and the gonadotrophic hormone the sex glands—ovaries and testes. As to the last mentioned, it is thought that one hormone stimulates the formation of the ovarian follicle, and another of the corpus luteum. In practice, the follicle-stimulating hormone (FSH) is obtained by the manufacturing chemist from the blood serum of pregnant mares. The luteinising hormone is extracted from the urine of pregnancy. It is produced by the chorionic tissue and is known as chorionic gonadotrophin: this not only stimulates the formation of the corpus luteum in the female; it also stimulates the interstitial cells of the testes to produce the sex hormone of the male. A hormone—prolactin—excites the mammary gland to secrete milk. Still other hormones are said to have been discovered in the anterior lobe of the pituitary—hormones which raise the blood sugar, act upon the pancreas and parathyroids, and control metabolism. Whatever the final verdict may be, there is no doubt of the enormous importance of the pituitary to a vast range of bodily activities. An extract of the posterior lobe—often known as pituitrin—has the effects of raising the blood-pressure by a constricting action on blood-vessels and of stimulating contraction of the pregnant uterus; these two effects are the result of separate principles in the gland.

Gigantism is the result of the overactivity of, or tumor formation of, the acidophil cells in the anterior lobe—the cells which control growth. If this overactivity occurs after growth has ceased a condition known as acromegaly arises, in which there is gross overgrowth of ears, nose, jaw, and hands and feet. Various disorders are the result of disturbed pituitary function: premature senility, extreme wasting, development of painful overgrowth of fat, various disturbances of growth and sexual development.

PITYRIASIS (*πίτυρον*, bran) is the name of a bran-like eruption on the skin, which is due to the growth of a microscopic fungus, and is characterised by large brown patches.

PIX is another name for tar.

PLACENTA (*placenta*, a cake) is the technical name for the afterbirth. (*See* AFTERBIRTH.)

PLAGUE, or BUBONIC PLAGUE, is the name of an infectious epidemic disease common to man and many of the lower animals. Its main characters are fever, swelling of the lymphatic glands, a rapid course, and a very high mortality, which has made it a much-dreaded scourge. In the Middle Ages it was known as the BLACK DEATH, which again and again ravaged Europe, though for the past century it has been almost confined to warm climates. The ancients referred to a disease which they called 'pestis', a term which possibly included several severe epidemic maladies; but, according to Hirsch, there is a recognisable description of an epidemic of what we know as plague infesting Libya, Egypt, and Syria between two and three centuries B.C. The first occurrence of the disease in Europe was the 'plague of Justinian', which swept through the Roman Empire in A.D. 542, devastating cities and country as it spread. Since that time it has periodically invaded Europe from the east, and spread westward, though with lessening severity in successive epidemics. The last occasion on which England was seriously invaded was at the time of the 'Great Plague' in 1664–65, when 70,000 people

died in London out of the total population of 460,000. In Glasgow a small outbreak occurred in 1900, which was quickly suppressed. The disease had not invaded America till recent years, when it broke out in Brazil, the Argentine Republic, San Francisco, and Mexico. Still more recently, it has broken out in Mauritius, South Africa, and Australia.

Causes.—The disease is probably always present (endemic) in certain localities, such as in the south-west of China, among the hill people of India, and in East Africa. From these homes it spreads outwards at intervals, sometimes creeping from village to village, at other times being disseminated widely along trade-routes.

The bacillus (*Pasteurella pestis*) which is the immediate cause was discovered by Kitasato, a Japanese scientist, in 1892. (*See* BACTERIOLOGY.) It is found in the enlarged lymphatic glands and in all the secretions and discharges, as well as in the blood of some cases. The proof that it is the cause is quite complete. The bacillus has repeatedly been made to produce plague in animals, and in 1898, through some accident at a laboratory in Vienna, where plague bacilli were being studied, far from any possible infection by plague-stricken people, several persons contracted plague and died.

Plague occurs first as an epizoötic in rats—especially in the black rat, *Rattus rattus*. The infection is then conveyed to man by the rat flea. The plague bacilli multiply in the gastro-intestinal tract of the flea, which may remain infectious for as long as six weeks. In pneumonic plague the bacillus may pass from man to man as a 'droplet infection'.

The rat is not the only rodent which serves as a 'reservoir' for *Pasteurella pestis*. In Argentina, for example, it has been found in wild guinea-pigs. In the U.S.A. between the Rocky Mountains and the West Coast plague is widespread among ground squirrels, wood rats, and prairie dogs. Between 1900 and 1941 rodent plague has spread through ten of the Western States of the U.S.A. This carries with it the risk of starting plague in any city with a large rat population. In South Africa, too, plague is prevalent in rodents, and human cases have cropped up from time to time. In England the last outbreak was in Suffolk in 1910.

Symptoms.—A graphic description of the symptoms of the disease is given by Defoe in his *Story of the Great Plague*, through which he lived as a child in London in 1664–65.

After infection, an incubation period, varying from two to eight days, elapses, and then the disease sets in suddenly with fever, headache, great lassitude, and aching of the limbs. The temperature soon rises to 103° Fahr., or more, the skin is hot and dry, the tongue furred, while thirst, prostration, and a feeling of utter weakness assail the sufferer. His features become drawn, his eyes sunken, and he sinks into a state of stupor or passes sometimes into wild delirium. There is often also sickness and vomiting.

In over two-thirds of all cases there are swollen glands, known as 'bubos', from which the malady has received the name of *bubonic plague*. These are situated most commonly in the groins, less frequently in the armpits, and give sometimes the first sign that the person has contracted the plague. There are also hæmorrhages under the skin in many cases, which sometimes produce black gangrenous patches that lead to large ulcers, and hence the old name of 'black death'. In favourable cases the fever abates at about the end of a week, the strength gradually returns, and the bubos soften, burst, and discharge foul-smelling pus.

There is a rapidly fatal form, associated with great weakness, in which the bacteria enter the blood, and the person dies on the second or third day, sometimes even in a few hours, before the bubos have time to form (*septicæmic plague*).

In other cases the lungs especially become affected, and pneumonia comes on, with death on the fourth or fifth day. This is said to be both the most infectious and the most fatal form of the disease (*pneumonic plague*).

In all epidemics, especially at the beginning and end of the epidemic, slight cases occur, in which the persons continue to go about, the bubos being almost the only sign of the malady. The matter from the bubos of such slight cases is, nevertheless, infectious,

and these cases are therefore specially dangerous to other people.

The death-rate varies in different epidemics from 60 to 95 per cent of those who contract the disease, persons who are healthy and well-fed standing a better chance than the poor and weak.

Treatment. — Preventive treatment is all-important in this disease. The quarantine system has been adopted on the continent of Europe, and consists in detaining ships which have arrived from an infected port till any persons on board who may have contracted plague shall have had time to show the disease. Thus no one is allowed to land till ten days (eight days being the maximum incubation period) have elapsed since the ship left port, or since the last plague patient died on board. Any persons who have had plague and recovered are isolated for at least one month. The strictest quarantine is apt to be ineffective, and measures directed against the spread of plague are far more efficient. Clothes, skins, and soft merchandise which have been in contact with the plague-stricken preserve the bacilli, and consequently their infectiousness, for several months. Such articles must therefore be either destroyed or disinfected. Houses or huts in which plague has occurred should either be carefully disinfected, or, if valueless, burned to the ground. The inhabitants of a plague-infected village or district are not allowed to migrate, carrying infection with them, to other localities, but all who have been in contact with a plague-stricken person should be isolated as ' contacts ' or ' suspects ' in special houses or camps.

In time of plague, or when plague is approaching, a war of extermination should be waged against rats and other rodents which are responsible for spreading the disease. The bodies should also be carefully examined, because it is found that rat-plague in a given district or house is followed later by plague among the human inhabitants. Various devices are adopted against the rats on ships. Thus the ships are generally moored a little way distant from the quay, the hawsers are rendered ' rat-proof ' by slipping hollow metal cones round them, and sulphurous acid gas or hydrocyanic acid is pumped into the holds under closed hatches to kill vermin which may be among the merchandise.

Personal protection is gained by good feeding, and by living in bright well-ventilated rooms or out-of-doors. The wearing of high boots and special clothing impervious to fleas is important for those who go into the neighbourhood of plague cases. The use of antiseptics for the hands and of disinfectant mouth-washes is important for those nursing the plague-stricken, and special precautions must be taken to seal up any small wounds on the hands, etc., and so guard against inoculation.

The Annual Report of the Eastern Bureau of the Health Organisation of the League of Nations for 1940 attributed the notable decline from plague mortality in Java to the building of one and a half million houses between 1911 and 1938, and the mass inoculation of thousands of people with a living non-virulent vaccine of *P. pestis*.

Serum is still used in treatment, and the various sulphonamide drugs are being tried out.

PLASMA is the name applied to the fluid portion of the blood composed of serum and fibrinogen, the material which produces clotting. When the plasma is clotted, the thinner fluid separating from the clot is the serum.

PLASMA TRANSFUSION has been a new development since the beginning of the war in 1939. Plasma, the fluid part of blood from which the cells have been separated, may be dried and in powder form kept indefinitely; when wanted it is reconstituted by adding distilled water. In powder form it can be transported easily and over big distances. Transfusion of plasma is especially useful in the treatment of shock.

PLASMODIUM is the general term applied to minute protoplasmic cells, and particularly to those which cause malaria and allied diseases. (*See* MALARIA.)

PLASMON is a term applied to a flour-like food consisting of the protein materials of milk.

PLASMOQUINE, or PLASMOCHIN, is a synthetic preparation of quinoline used in the treatment of malaria. The *British Pharmacopœia* term for this useful drug is PAMAQUIN. Plasmo-

quine acts more powerfully on the gametocytes of the malarial parasite than on the schizonts; this is the reverse of the action of quinine; the two together therefore make an effective combination against malaria. Plasmoquine is very useful as a malarial prophylactic.

PLASTERS (*see* ADHESIVE PLASTERS).

PLASTIC SURGERY is that part of surgery which is concerned with the re-formation and restoration of parts of the body which are damaged, lost, or deformed.

PLASTRON is the term applied to the skeleton on the front of the chest consisting of the breast bone and attached rib cartilages.

PLATING is a term used in connection with bacteriological investigation to mean the cultivation of bacteria on flat plates containing nutrient material. The term is also applied in surgery to the method of securing union of fractured bones by screwing to the sides of the fragments narrow metal plates, which hold them firmly together whilst union is taking place.

PLETHORA (πληθώρα) means a condition of fullness of the blood-vessels in a particular part or in the whole body. Persons who consume much more food and drink than that necessary for the work they do, and who tend to the development of acidity, gout, apoplexy, and other diseases of allied nature, are commonly classed as 'plethoric'. The term is applied to a condition in which the volume of the blood is increased above normal; there may or may not be an increase in the total number of red blood corpuscles.

PLETHYSMOGRAPH is an apparatus for estimating changes in the size of any part placed in the apparatus; in this way changes in the volume of blood in a part can be measured.

PLEURA, or PLEURAL MEMBRANE (πλευρά, a rib), is the name of the membrane which, on either side of the chest, forms a covering for one lung. The two pleuræ are distinct, though they touch one another for a short distance behind the breast-bone. (*See* LUNGS.)

PLEURISY, or PLEURITIS, means inflammation of the pleura or serous membrane investing the lung and lining the inner surface of the ribs. It is a common form of chest complaint, and may be either acute or chronic, the latter being usually tuberculous in origin.

The changes which take place are as follows: (1) Inflammatory congestion and infiltration of the pleura, which may spread to the tissues of the lung on the one hand, and to those of the chest wall on the other. (2) Exudation of fibrin on the pleural surfaces. This exudation is of variable consistence, sometimes composed of thin and easily separated pellicles, or showing itself in the form of a membrane. It is of greyish-yellow colour, and, microscopically, consists mainly of coagulated fibrin along with epithelial cells and red and white blood corpuscles. Its presence causes roughening of the two pleural surfaces by material which may later break up or may become organised by the development of new blood-vessels and formation of fibrous tissue. This by forming permanent adhesions may obliterate the pleural sac throughout a greater or less space, and interfere to some extent with the free play of the lungs. (3) Effusion of fluid into the pleural cavity. This fluid may vary in its characters. Most commonly it is clear or slightly turbid, of yellowish-green colour, sero-fibrinous, and containing flocculi of fibrin. In cases where the pleurisy complicates some severe form of disease, *e.g.* the acute infectious maladies, it is deeply coloured, bile-stained, sero-purulent, purulent, or bloody, occasionally containing bubbles of air from decomposition. The amount may vary from an almost inappreciable quantity to a gallon or more. When large in quantity, it may fill the pleural sac to distension, bulge out the thoracic wall externally, and compress more or less completely the lung, which may in such cases have all its air displaced and be reduced to a mere fraction of its natural bulk lying squeezed up upon its own root. Other organs, such as the heart and liver, may in consequence of the presence of the fluid be shifted away from their normal position. In favourable cases the fluid is absorbed more or less completely and the pleural surfaces may unite by adhesions; or, all traces

of inflammatory products having disappeared, the pleura may be restored to its normal condition. When the fluid is not speedily absorbed, it may remain long in the cavity and compress the lung to such a degree as to render it incapable of re-expansion as the effusion passes slowly away. The consequence is that the chest wall falls in, the ribs become approximated, the shoulder is lowered, the spine becomes curved and internal organs permanently displaced, while the affected side scarcely moves in respiration. Sometimes the unabsorbed fluid becomes purulent, and an *empyema* is the result. In such a case the matter seeks outlet in some direction, and it may point as an abscess upon the chest or abdominal wall, or, on the other hand, burst into the lung and be discharged by the mouth, if it is not evacuated by surgical means.

Many cases of pleurisy are associated with only a little effusion, the inflammation consisting chiefly in exudation of fibrin. To this form the term *dry pleurisy* is applied. Further, pleurisy may be limited to a very small area, or, on the contrary, may affect, throughout a greater or less extent, the pleural surfaces of both lungs.

Causes.—Pleurisy frequently arises from exposure to cold, being then probably of rheumatic nature; hence it is more common in the colder weather; but besides this, various other causes may produce it. Thus it is often associated with other forms of inflammatory disease within the chest, more particularly pneumonia, bronchitis, and phthisis, and also occasionally accompanies pericarditis. Again, it is apt to occur as a secondary disease in certain constitutional states, *e.g.* the infectious fevers, rheumatism, gout, Bright's disease, diabetes, etc. Further, wounds or injuries of the thoracic walls are apt to set up pleurisy, and the rupture of a phthisical cavity in the lungs causing the escape of air and matter into the pleura has a similar effect. The connection of pleurisy with consumption is now recognised as a most important one. Very often it happens that an attack of pleurisy, which apparently has passed off, returns and is eventually followed by consumption, it may be after several years. Many of these cases are undoubtedly due to the presence of the tubercle bacillus in the pleural cavity.

Symptoms.—The symptoms of pleurisy vary, being generally well-marked, but sometimes obscure.

DRY PLEURISY.—In the case of dry pleurisy, which is, on the whole, the milder form, the chief symptom is a sharp pain in the side, felt especially in breathing. Fever may or may not be present. There is slight dry cough; the breathing is quicker than natural, and is shallow and of catching character. If much pain is present, the body leans somewhat to the affected side, to relax the tension on the intercostal muscles and their covering, which are even tender to touch. On listening to the chest with the stethoscope the physician recognises sooner or later 'friction', a superficial rough rubbing sound, occurring only with respiration and ceasing when the breath is held. It is due to the coming together during respiration of the two pleural surfaces which are roughened by the exuded fibrin. The patient may himself be aware of this rubbing sensation, and its vibration or 'fremitus' may be felt by the hand laid upon the thoracic wall during breathing. This form of pleurisy may be limited or may extend over the greater part of one or both sides. It is a frequent complication of phthisis in all its stages. In general it disappears in a short time, and complete recovery takes place; or, on the other hand, extensive adhesions may form between the surfaces of the pleura covering the ribs and the lung, preventing uniform expansion of the lung in respiration, and leading to emphysema. Although not of itself attended with danger, dry pleurisy is sometimes preliminary to more serious lung disease, and is therefore to be regarded with some degree of anxiety.

PLEURISY WITH EFFUSION is usually more severe than dry pleurisy, and, although it may in some cases develop insidiously, it is in general ushered in sharply by shivering and fever, like other acute inflammatory diseases. Pain is felt in the side or breast, of a severe cutting or stabbing character, referred usually to the neighbourhood of the nipple, but it may be also at some distance from the affected part, such as through the middle of the body or in the abdominal or iliac regions. This

transference of the pain occasionally leads to errors in diagnosis, the patient being supposed to be the subject of appendicitis, gastric ulcer, or some other serious abdominal condition. The pain is greatest at the outset, and tends to abate as the effusion takes place. A dry cough is almost always present, which is particularly distressing, owing to the increased pain the effort excites. The breathing is painful and difficult, tending to become shorter and shallower as the disease advances, and the lung on the affected side becomes compressed. The patient at first lies most easily on the sound side, but as the effusion increases he finds his most comfortable position on his back or on the affected side. When there is very copious effusion and, as is apt to happen, great congestion of the other lung, or disease affecting it, the patient's breathing may be so embarrassed that he cannot lie down.

In most instances the termination is favourable, the acute symptoms subsiding, and the fluid (if not drawn off) gradually or rapidly becoming absorbed, sometimes after re-accumulation. On the other hand, it may remain long without undergoing much change, and thus a condition of *chronic pleurisy* becomes established. Such cases are to be viewed with suspicion, particularly in those who are predisposed to phthisis, of which it is sometimes the precursor.

Pleurisy may exist in a *latent form*, the patient going about for weeks with a large accumulation of fluid in his thorax, the ordinary acute symptoms never having been present in any marked degree. In some cases the pleurisy is on the under surface of the lung. This condition, known as *diaphragmatic pleurisy*, gives few signs on examination and is liable, when the symptoms are severe, to be mistaken for some acute inflammation of the abdomen.

The chief dangers in pleurisy are the occurrence of a large and rapid effusion, particularly if both sides be affected, causing much embarrassment to the breathing, and tendency to collapse; the formation of an *empyema* (often marked by recurring rigors and hectic symptoms); severe collateral congestion of the other lung; imperfect recovery, and the supervention of phthisis.

Acute pleurisy is often merely an accompaniment of the severer condition of lobar pneumonia, the disease really being a *pleuro-pneumonia*.

Treatment.—The treatment varies greatly with the form and severity of the attack. In the early inflammatory stage, one of the chief symptoms calling for treatment is the pain, which may be soothed by opiates in the form of morphia or Dover's powder, along with the application to the chest of hot poultices or fomentations. Instead of these, an ice-bag is often applied to the side, and this has the effect of almost immediately soothing the acute pain. Another plan consists in the fixing, as far as possible, of one side of the chest by means of overlapping cross strips of adhesive plaster.

Cases of simple dry pleurisy usually soon yield to such treatment, aided, if need be, by the application of blisters or iodine to the chest as the condition is subsiding.

In the case of pleurisy with effusion, in addition to these measures, blistering and the internal use of saline purgatives and diuretics appear to be often of service in diminishing the amount of the fluid in the pleural cavity. In cases of extensive accumulation, when other means fail to reduce or remove the fluid in a short time, the only hope of preventing such compression of the lung as will impair its function lies in the performance of aspiration. (*See* ASPIRATION.) All the more necessary does the operation become if the accumulated fluid is interfering with the function of other organs, such as the heart, or is attended with marked embarrassment of the breathing. The chest is punctured in the lateral or posterior regions, and most physicians prefer to draw off not more than 30 ounces or thereabout at one time and to repeat the operation if necessary. In general, the operation is unattended with danger, although not entirely exempt from such risks as sudden fainting. In many instances, not only is the removal of distressing symptoms speedy and complete, but the lung is relieved from pressure in time to enable it to resume its normal expansion. When there is any evidence that the fluid is purulent, the operation should be performed early. In such cases it is sometimes necessar-

to establish for a time a drainage of the pleural cavity by introducing a drainage tube through an opening in the lower part of the side, a portion of a rib being usually removed to admit the tube. The pleural cavity is then for some weeks irrigated through the opening at regular intervals, and treated exactly as any other large abscess cavity. (*See* EMPYEMA.)

The convalescence from pleurisy requires care, and the expansion of the lung may be assisted by suitable breathing exercises (*see* CHEST EXPANSION), or by connecting two wash-bottles in such a way that a quantity of fluid can be blown over from one to the other repeatedly. The latter exercise is graduated by blowing the fluid from one bottle to the other an increasing number of times on each successive day.

After an attack of pleurisy, and particularly after a second attack, the person should submit himself from time to time to medical examination, in order to make sure that phthisis does not develop in the lung. He will thus be enabled, if this serious disease should show itself, to commence its treatment at an early stage, when a cure may be expected.

PLEURODYNIA (*πλευρά*, rib; *ὀδύνη*, pain) means a painful condition of the chest-wall. It may be due to rheumatism of the intercostal muscles or to neuralgia of the intercostal nerves, or, when of the sharp nature, popularly known as a 'stitch in the side', to cramp.

PLEURO-PNEUMONIA means a combination of pleurisy with pneumonia. Acute pneumonia is practically always accompanied by a certain amount of pleurisy, to which the pain experienced in pneumonia is mainly due. The epidemic disease known as pleuro-pneumonia, which is so fatal to horned cattle, does not affect man.

PLEXIMETER (*πλῆξις*, stroke; *μέτρον*, measure) is the name applied to a small plate of ivory or similar material laid upon the skin to be struck in percussion. The small hammer used to strike it is called a plexor or plessor.

PLEXUS (*plexus*, braid) is the name applied to a network of nerves or vessels, *e.g.* the brachial and sacral plexuses of nerves and the choroid plexus of veins within the brain.

PLICA (*plica*, fold) is the term applied to various folded structures in the body.

PLICATION is a term applied in surgery to an operation for taking tucks in the walls of a hollow organ, such as the cæcum, in order to reduce it in size.

PLOMBIÈRES DOUCHE is a term applied to lavage of the lower bowel by means of a soft rubber tube which is inserted into the rectum to a distance of 3 to 6 inches. Several pints of fluid are slowly allowed to run in by gravity, the patient reclining on the left side with the hips raised, and later turning on the back so that the fluid may penetrate throughout the large intestine. The fluid is retained as long as possible and returned by the ordinary movement of the bowels. Various fluids, but especially normal saline solution, are used for this purpose. The treatment is particularly useful in mild types of dysentery and colitis.

PLUMBISM (*plumbum*, lead) is another name for lead poisoning (*See* LEAD POISONING.)

PLUMMER'S PILL is another name for compound calomel pill, which is a favourite remedy for rheumatism accompanied by constipation. It contains calomel, antimony, and guaiacum.

PLURIGLANDULAR (*plures*, several; *glandulæ*, glands) means derived from several glands.

PNEUMOCONIOSIS (*πνεύμων*, the lung; *κόνις*, dust) is the general name applied to a chronic form of inflammation of the lungs which is liable to affect workmen who constantly inhale irritating particles at work. The disease produced may be of the nature of chronic interstitial pneumonia, but is very liable to result in true phthisis from the engrafting of the tubercle bacillus upon the diseased lung. Some of the trades most liable to suffer are those of stonemasons, potters, steel-grinders, ganister-workers, colour-grinders, and less often coal-miners, millers, and workers in cotton, flax, or wool mills. (*See* CONSUMPTION, PNEUMONIA, TRADE DISEASES.)

PNEUMOGASTRIC (πνεύμων, lung; γαστήρ, stomach), or VAGUS (*vagus*, wandering), nerve is the tenth cranial nerve. Unlike the other cranial nerves, which are concerned with the special senses, or distributed to the skin and muscles of the head and neck, this nerve, as its names imply, strays downwards into the chest and abdomen, supplying branches to the throat, lungs, heart, stomach, etc., and forming an important connecting link between the brain and the sympathetic nervous system.

PNEUMONIA (πνεύμων, lung), or inflammation of the substance of the lungs, manifests itself in several forms which differ from each other in their nature, causes, and results, viz.: (1) *acute lobar* or *croupous pneumonia*, the most common form of the disease, in which the inflammation affects a limited area, usually a lobe or lobes of the lung, and runs a rapid course; (2) *catarrhal pneumonia, broncho-pneumonia*, or *lobular pneumonia*, which occurs as a result of bronchitis, and is more diffuse in its distribution and longer in duration than the former; (3) *interstitial pneumonia* or cirrhosis of the lung, a more chronic form of inflammation, which affects chiefly the framework or fibrous tissue of the lung and is closely allied to phthisis.

In addition to these three principal types, pneumonia may arise as a part of several other diseases of which it forms a very serious complication; for example, it may occur in the course of typhoid fever, woolsorters' disease, plague, etc., in each case being caused by the special bacteria associated with the disease in question. Pneumonia may also supervene in a person suffering from serious cardiac trouble or in old and devitalised persons, coming on gradually as the result of lying for a long time on the back with resultant congestion of the lower and back portions of the lungs. This type of pneumonia is known as *hypostatic pneumonia*, but is essentially of the same nature as catarrhal pneumonia.

ACUTE LOBAR PNEUMONIA, or CROUPOUS PNEUMONIA. — This is the disease commonly known as inflammation of the lungs. It derives its name from its pathological characters, which are well marked. The changes that take place in the lung are chiefly as follows: (1) *Congestion*, or engorgement, is the first stage, the blood-vessels being distended and the lung more voluminous, heavier than normal, and of dark red colour. Its air-cells still contain air. The inflammation may pass off without proceeding further and the symptoms then abate after two or three days' duration. (2) *Red hepatisation* is so called from the resemblance that it gives the lung to liver tissue. In this stage, which follows upon the congestion, there is poured into the air-cells of the affected part of the lung an exudation consisting of blood plasma together with epithelial cells and red and white blood corpuscles, the whole forming a viscid mass which occupies both the air-sacs and the finer bronchi, and which quickly coagulates, causing the lung to become firmly consolidated. In this condition the air-cells of the lung are completely emptied of air and each filled with a small plug of the solid clot. The lung substance is now much heavier and would sink in water. The appearance of a section of the lung at this stage is similar to that of red granite, and on microscopic inspection the material in each air-cell is seen to be a felted network of fibrin containing entangled in its meshes a large number of corpuscles from the blood and of cells cast off from the lining surface of the air-vesicles. To this exudation, consisting mainly of fibrin, the term 'croupous' is due. (3) *Grey hepatisation.*—This stage in mild cases may also be omitted, and the attack may come to an early conclusion at the end of five or six days' illness. In this stage the lung retains its solid liver-like consistence, but the colour of a cut section is now grey, not unlike the appearance of grey granite, from the entrance into the exudate of many white corpuscles from the blood. A marked development of this stage, in which softening and liquefaction of the lung tissue may take place, is found in very serious cases, which either end in death or are liable to leave profound changes in the lung after the patient has recovered from the acute stage of the disease. (4) *Resolution* is the final stage which occurs in all cases that run a satisfactory course. The exudation now undergoes a process of liquefaction, the cells in it break up by a process of fatty degeneration, and the material is

either completely reabsorbed into the blood-vessels or to a certain extent is expectorated, and thus in a comparatively short period, varying from some hours to two or three days, the air-cells get rid of their morbid contents. Air again enters them and they resume their normal function. This is the manner of termination in the great majority of cases of acute lobar pneumonia, but it sometimes happens that this favourable result is not attained, and that further changes take place in the inflamed lung in the form of suppuration ending in abscess or gangrene. In such cases there usually exists some serious constitutional cause which contributes to give an unfavourable termination to the course of the disease, such, for example, as pre-existing diabetes or Bright's disease, or even the presence of old and partially healed tuberculosis in the lung. In occasional cases the pneumonia may become chronic, the lung never completely clearing up but continuing to discharge small quantities of pus which are brought up in expectoration, and to undergo a gradual fibrous change (*interstitial pneumonia*).

Acute lobar pneumonia is commonly limited to a portion of one lung, the commonest part being the lower lobe on one or other side. The inflamed area is sharply marked off by the deep fissure of the lung, which prevents spread of the disease to the other lobe. Occasionally the pneumonia spreads throughout the whole of one lung, or it may affect both lungs, when it is called *double pneumonia* and is a serious and often fatal condition. The apex of the lung is sometimes the only part affected (*apical pneumonia*), and this type seems especially to affect drunkards, in whom pneumonia is a very fatal malady. The right lung is considerably more frequently affected by pneumonia than the left lung.

Causes.—Exposure to cold or wet seems to be generally the exciting cause of an attack of pneumonia, though other conditions are of great importance (*see* LUNGS, DISEASES OF). Often the person affected is run down in health, fatigued, or mentally depressed, although the disease, particularly when associated with influenza, frequently attacks the most robust people with rapidly fatal effect.

The *Diplococcus pneumoniæ* or *pneumococcus* is the specific infecting micro-organism in about 95 per cent of all cases of lobar pneumonia. Some thirty 'types' of pneumococcus are now recognised. In Great Britain types I and II are said to be the infecting cause of between half and two-thirds of cases of lobar pneumonia. Type II infection is more severe than type I, and type III more severe than both. In the U.S.A. specific antisera were available against the various types isolated and were being used effectively in treatment at about the time of the discovery of sulphapyridine (M & B 693). Dramatic as have been the results achieved by sulphapyridine, it is possible there is still room also for serum treatment. The death-rate from pneumonia is still high in the first five years of life and after the age of 45.

The disease may occur at any age, but is most common during the active years of life from 20 to 50. Among the aged the other type of pneumonia, *bronchopneumonia*, is much more common. During the prime of life the disease affects men much more commonly than women, probably in consequence of their greater exposure at work. It appears to be a more serious disease among the darker races than in white men. There is a distinct tendency for pneumonia to be more prevalent during the late winter and early spring months, February, March, and April, but it is not specially associated with very low temperatures, and pneumonia, when it occurs in northern latitudes, appears to run a distinctly milder course than in the temperate zone. From time to time pneumonia occurs in epidemics and appears to be transmitted direct from person to person, so that several people living in one house may be successively affected. This infectious type of the disease is, however, not common.

Symptoms.—The symptoms of acute lobar pneumonia are generally well marked from the beginning. After an incubation period of two to six days, the attack usually commences with shivering (or in young children with a convulsion), and this is speedily followed by pain in the chest and sometimes by vomiting. The temperature almost at once rises to 101° or even 104° F., the

PNEUMONIA

pulse is quickened, and the breathing is rapid, shallow, and sometimes laboured. Occasionally the development is less abrupt, and the patient, although not feeling well, may remain at work for two or three days after the onset. The lips are dark and the face has a dusky bright red blood, and this is by no means a bad sign. The temperature may abate a little after the initial rise, but usually continues between 103° and 105° for about a week, when it falls with considerable suddenness (crisis) to normal. The crisis generally takes

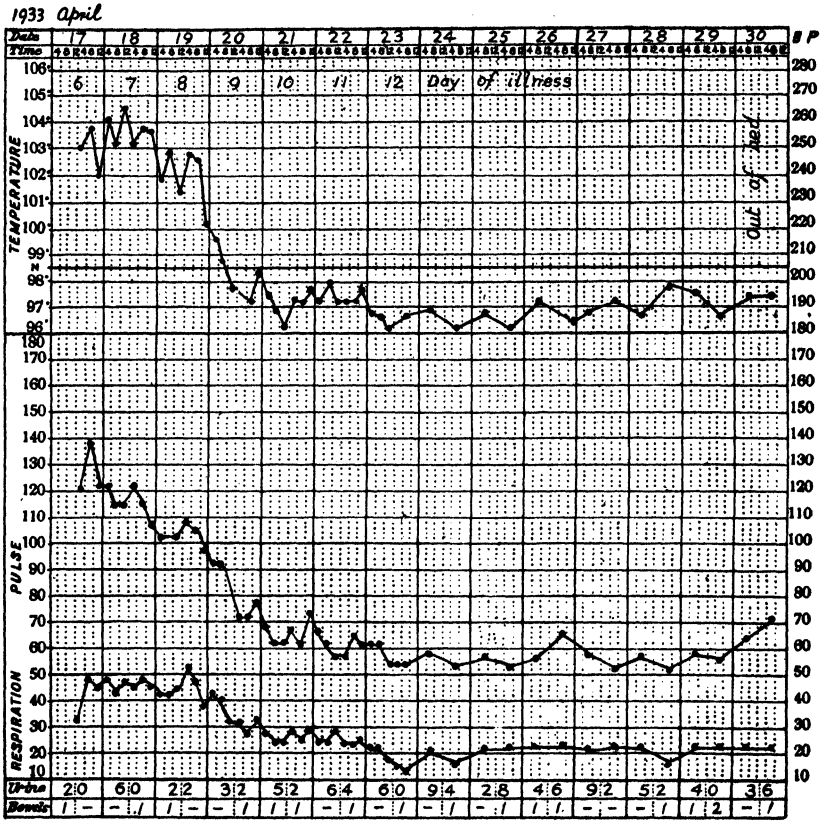


FIG. 375.—Chart from a case of lobar pneumonia. It shows the rapid fall of temperature (crisis) on the 8th day of illness, accompanied by a fall in the rate of pulse and followed by a fall in the rate of respiration. The patient remained in bed, as is usual, for 10 days after the crisis. The record was made four-hourly till the 12th day, and later twice daily.

flush. Cough is an early symptom, at first frequent, hacking, and accompanied by only a little clear, tough expectoration, but later bringing up a copious, rusty-brown material which is generally very tenacious, sticking to the sputum-dish even when the latter is turned upside down ('rusty sputum'). Occasionally the expectoration contains

place between the seventh and tenth day of the illness, most commonly about the eighth. After the sudden fall there is usually a slight reactionary rise to 99° or 100°, but the normal level in favourable cases is afterwards maintained. In occasional cases the temperature falls more slowly and takes two or three days gradually to subside

to normal. The pulse rate remains quick so long as the temperature is elevated, but it should fall proportionally to the temperature at the time of crisis. The respiration rate, which is during the course of the illness quickened out of proportion to the pulse, shows almost corresponding diminution at the time of crisis. Thus it is common at the crisis for the pulse rate to drop from about 120 to 80, and the respirations at the same time to diminish from about 36 per minute to 24 or less. At the time of crisis chemical changes also occur, and large quantities of urates and chlorides, which were previously retained, appear in the urine. At the same time the skin, which was previously dry and hot, perspires freely. Pain, which is an almost constant feature at the beginning of pneumonia due to the accompanying pleurisy, tends to abate as the disease advances. It is specially felt on coughing or drawing deep breaths. Pain is usually felt in the side, but may be referred by the patient to the pit of the stomach or even to the lower part of the abdomen. In the latter case the symptom is apt to lead to a mistaken diagnosis of some acute abdominal disorder. Although the breathing is rapid, the patient is not usually breathless unless a large area of the lungs is affected, and he lies on the back or on the affected side. Sleeplessness is often a troublesome feature of the disease, and tends to exhaust the patient unless it is relieved by hypnotics or other means. Delirium is occasionally present, but so long as it is mild affords no cause for anxiety. An eruption of herpes is frequently noticed about the lips.

Certain physical signs are usually present during different stages of the disease. Diminished movement of the affected side is noticeable, the healthy side of the chest performing most of the respiratory function. On percussion over the affected area a dull note is obtained, which becomes particularly marked if fluid has collected in the pleural cavity. On auscultation over the affected area, the breathing is usually harsh and high pitched (tubular breathing), but it sometimes shows no deviation from the normal, especially in cases where the deeper parts of the lung only are affected. Accompanying the breathing in the early stages of the disease, crackling sounds known as crepitations are commonly heard. These disappear during the period in which the lung remains solid, but reappear (redux crepitations) when resolution begins to take place. All these physical signs disappear with remarkable rapidity in about two days after the crisis has taken place. A moderate increase in the number of the white blood corpuscles is a favourable sign, the case having too little power of reaction if the corpuscles do not increase, and an increase to too large an extent in the later stages being a sign that suppuration is taking place.

In unfavourable cases, death may take place either from the extent of the inflammatory action, especially if the pneumonia is double, from exhaustion due to excessive fever, sleeplessness, and similar causes, or from failure of the heart's action in cases where a great amount of general poisoning is present, or again from the disease assuming from the first a low adynamic form with delirium and great prostration. Such cases are found in persons worn out in strength, in the aged, and in persons already suffering from alcoholism or chronic conditions like Bright's disease and diabetes. Some of the unfavourable signs are extremely rapid and shallow breathing with accompanying lividity, delirium of wildly excited type in which the patient becomes excited by struggling, persisting sleeplessness, a rapid and feeble pulse indicating impending heart-failure, excessive sweating, and the occurrence of complications such as pericarditis. Death may also take place at a later stage from the development of empyema, abscess, or gangrene of the lung. In a small number of cases, recovery may be imperfect, the disease gradually passing into a chronic interstitial pneumonia.

Treatment. — Treatment in acute pneumonia has undergone great changes with the course of time. Sixty to eighty years ago blood-letting was a general procedure and the whole treatment was conducted on lowering, or as it was then called, 'anti-phlogistic' principles. It was shown that, while this form of treatment was satisfactory in some cases, many patients were prejudicially

affected. Then it was generally held that in the great majority of cases very little active interference was required, the disease tending to run its course as a fever, and requiring the attention of a good nurse rather than the physician's skill. Good nursing is all-important, but the advent of the new drugs—sulphanilamide, sulphapyridine (M & B 693), sulphathiazole, etc.—since 1935 has given the physician a powerful weapon against pneumonia, and the outlook for the patient has now greatly improved.

Pain and difficulty of breathing may be relieved by the application of hot fomentations, poultices, or ice-bags to the affected side. Some physicians adopt as a general practice the stimulation of the patient's powers of resistance from the commencement of the disease by small doses of appropriate vaccine; others attempt to conserve the power of the heart by early administration of digitalis and other cardiac stimulants; cough is relieved by expectorants, of which those containing carbonate of ammonia are specially useful. Any tendency to excessive fever may often be held in check by quinine and other antipyretic drugs, or more effectively by sponging with tepid water or by the bath. Cases in which the disease is extensive in the lungs or in which the heart is feeble and the blood in consequence not properly oxygenated, as shown by blueness of the face and lips, obtain great relief and benefit from the inhalation of oxygen. As regards feeding, the digestive powers being much reduced, the patient should be fed with milk, soups, and other light forms of nourishment frequently administered. In the later period of the disease, stimulants may be required either in the form of spirits, champagne, or other forms of alcohol, or it may be necessary to administer cardiac stimulants such as digitalis, respiratory stimulants such as strychnine, or preparations which raise the blood-pressure such as pituitrin. Sleeplessness is sometimes relieved by sponging the body with tepid water, or, if more troublesome, by paraldehyde or chloral, or, if delirium be also present, by morphia. Anti-pneumococcic sera against numerous types have been extensively, and apparently successfully, used in the U.S.A. But now, both there and here, the prime agent in treatment is the drug sulphapyridine (M & B 693), the introduction of which has lowered the mortality from the disease. It may turn out to be that in some cases the best treatment is a combination of sulphapyridine and serum.

After the acute symptoms disappear, the patient must remain in bed for some time, not sitting up before at least ten days have elapsed after the crisis and not going about until a convalescence of three weeks has taken place. Counter-irritation of the chest by tincture of iodine is often employed to promote the absorption of the inflammatory products in the lung. The occurrence of empyema, which, when it takes place, is indicated by hectic rise of temperature every day, sometimes follows or prevents the crisis and requires aspiration or surgical drainage of the pleural cavity. After recovery is complete, the health for some time should be watched with great care because a recurrence of acute pneumonia is liable to take place.

BRONCHO-PNEUMONIA, BRONCHIAL PNEUMONIA, CATARRHAL, or LOBULAR PNEUMONIA, differs from acute lobar pneumonia in several important points. In the former, inflammation is more diffuse, and tends to affect small patches or lobules of lung tissue here and there, rather than one or more lobes. If the condition becomes extreme, the affected parts may join so that the whole lung is affected, but there are still certain important differences. The condition usually begins with the symptoms of bronchitis, which gradually spreads from the larger to the finer bronchial tubes and ultimately to the minute air-vesicles or cells. At first the affected patches are dense with a bluish-red appearance tending to become grey or yellow. Under the microscope the air-vesicles and finer bronchial tubes are seen to be full of cells which have been cast off from the membrane lining the tubes and air-vesicles, but there is no fibrinous exudation such as is present in croupous pneumonia. In favourable cases, resolution takes place after a longer or shorter interval by fatty degeneration, liquefaction, and absorption of the cells. At the same time, a large amount of the material filling the

lungs is gradually expectorated by the patient. On the other hand, when the illness is prolonged, degenerative changes may take place in the lung tissue, small abscesses may form, and a condition of chronic interstitial pneu-

often following upon some previous acute illness in which the bronchi are inflamed, such as measles or whooping-cough. It also tends particularly to affect old people in a more chronic form as the result of bronchitis, and it forms

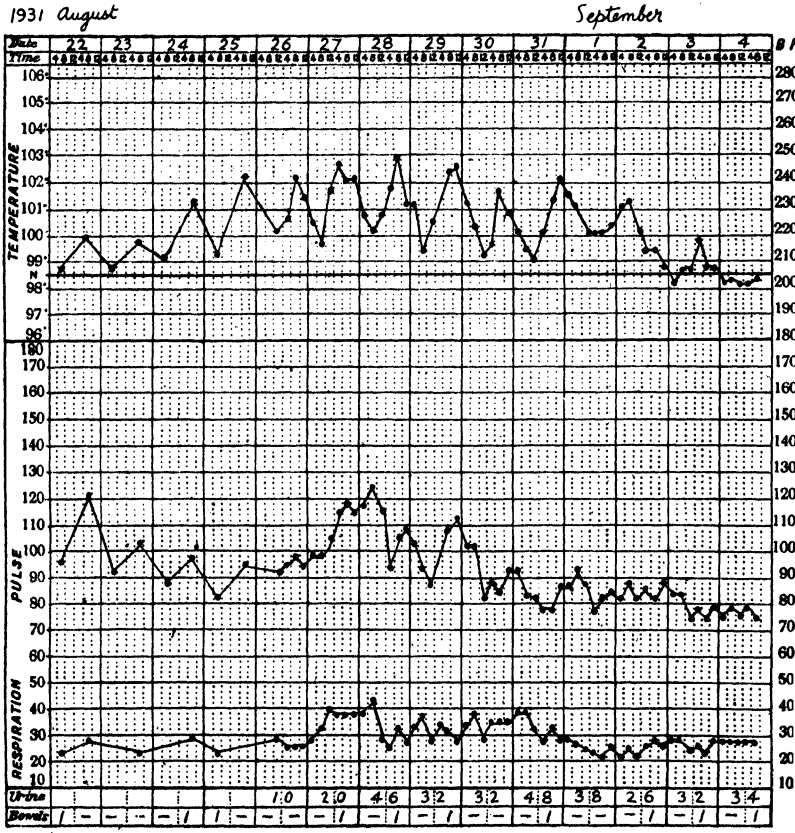


FIG. 376.—Chart from a case of broncho-pneumonia. It shows the gradual fall of temperature and of pulse and respiration rates, as the patient's condition improved. The record for the first 4 days was made twice daily by a district nurse, and four-hourly after admission to hospital.

monia is then developed. In the great majority of instances catarrhal pneumonia occurs as an accompaniment or sequel of bronchitis, either from the inflammation passing from the finer bronchi to the air-vesicles or from its affecting portions of the lung which have undergone collapse through obstruction of their bronchial tubes by secretion. It occurs most frequently in children, one of the chief causes of death among the aged. (*See* BRONCHITIS.)

Symptoms.—The symptoms of bronchial pneumonia in its more acute form are the occurrence, during an attack of bronchitis, of a sudden and marked rising of temperature together with quickened pulse and increased difficulty of breathing. The cough becomes short and painful unless the child or aged

person is too feeble to bring up expectoration, when the cough becomes of a suffocative type, which forms a very bad sign. Vomiting sometimes occurs in children and is a salutary symptom because it aids in freeing the lungs from the accumulating secretion. In a marked case of bronchial pneumonia the dusky red colour of the lips, cheeks, and ears is also present as noticed in acute lobar pneumonia, due to defective oxygenation of the blood.

Physical signs of a somewhat vague character are found over the chest. The note obtained by percussion is duller at some points than at others; the breathing is harsh with the signs of bronchitis, which is also present, and here and there breathing may be tubular with fine crackling sounds (crepitations).

The illness does not end by a crisis as in the case of lobar pneumonia, but the temperature tends for an indefinite period, it may be of several weeks, to remit and rise again with a gradual fall to normal.

Bronchial pneumonia must be regarded as a condition of serious import. It is apt to run rapidly to a fatal termination in weakly persons, the inflammation spreading and the lungs filling up with secretion. After its occurrence there is a considerable tendency to the development of interstitial pneumonia or of tuberculosis. On the other hand, a favourable result is frequent if the condition is recognised in time to admit of efficient treatment.

Treatment.—The treatment is essentially that for the more severe forms of bronchitis (*see* BRONCHITIS), where, in addition to expectorants intended to help the freeing of the chest from secretion, various stimulants and good nourishment are of great importance. The administration of ipecacuanha tincture in large doses, sufficient to cause the patient to vomit, often produces marked benefit by freeing the chest from its load of accumulated secretion in cases where coughing is difficult. The access of fresh air in bronchial pneumonia following whooping-cough, measles, and similar diseases is of great importance, the patient at the same time being protected by light warm applications, such as a gamgee-tissue jacket on the front and back of the chest. Administration of oxygen is of great value in cases showing duskiness of the lips and face. Sulphanilamide and sulphapyridine (M & B 693) are important drugs in treatment. The posture of the patient in bed is a matter of importance; whilst in the case of lobar pneumonia the patient obtains most relief from lying on his back or on the affected side, in bronchial pneumonia with an excessive amount of secretion the patient is usually most comfortable and breathes most easily when kept constantly in a half-sitting posture with the shoulders raised high by pillows placed behind the back.

Convalescence is often prolonged, and special care is required in the case of children, in view of the tendency of the disease to be followed by tuberculosis.

CHRONIC INTERSTITIAL PNEUMONIA, or CIRRHOSIS OF THE LUNG, is a slow inflammatory change affecting chiefly one portion of the lung texture, viz. its fibrous framework.

The changes produced in the lung by this disease are marked chiefly by the growth of fibrous tissue around the walls of the bronchi and vessels, which proceeds to such an extent as to invade and obliterate the air-cells. The lung, which is at first enlarged, becomes shrunken, dense in texture, and solid, any unaffected portions being emphysematous; the bronchi are dilated, the pleura thickened, and the lung substance often deeply pigmented, especially in cases which have been caused by the inhalation of irritating dust. The lung also shows a tendency to break down, either from an early stage in cases which have followed acute pneumonia, or later from a suppurative process or from dilatation of the bronchial tubes. In any case, cavities are formed similar to those produced by phthisis.

This condition is usually present to a greater or less degree in almost all chronic diseases of the lungs and bronchi, but it is specially apt to arise in an extensive form from pre-existing catarrhal pneumonia, and usually occurs in connection with occupations which necessitate the habitual inhalation of particles of dust, such as those of potters, knife-grinders, flax-dressers, stone-masons, millers, etc. It is specially liable to affect workers exposed to silica dust, and workers in the South African gold mines.

Symptoms are very similar to those

of chronic phthisis (*see* CONSUMPTION), especially increasing difficulty of breathing, particularly on exertion, cough, either dry or with expectoration, which is sometimes copious and fetid. In the case of coal-miners, the sputum is black from containing carbonaceous matter.

The deficient expansion of the affected side is very evident, retraction of the side becomes manifest, and the heart and liver may be displaced. Ultimately the condition, both as regards physical signs and symptoms, takes the characters of the later stages of phthisis, with increasing emaciation and death. The malady is usually of long duration, many cases remaining for years in a stationary condition, and even undergoing temporary improvement in mild weather, but the tendency is on the whole downward.

Treatment is conducted on similar principles to those applicable in the case of phthisis. Should the malady be connected with a particular occupation, the disease might be averted or at least greatly modified by early withdrawal from such source of irritation. Cases in which there is much expectoration of purulent material are frequently treated by administration of a vaccine with a view to lessening the septic processes which are aggravating the condition and devitalising the patient. Various inhalations are also of considerable use for the same purpose. (*See* INHALATIONS.)

PNEUMOTHERAPY is a term applied to the treatment of disease by rarefied or condensed air.

PNEUMOTHORAX (πνεῦμα, air; θώραξ, the chest) means a collection of air in the pleural cavity, into which it has gained entrance by a wound in the lung or in the chest-wall. When air enters the chest the lung immediately collapses towards the centre of the chest, but, air being very quickly absorbed from the pleural cavity, the lung expands again in a short time. (*See* LUNGS, DISEASES AND INJURIES OF.)

Artificial pneumothorax is an operation by which in a case of phthisis or of bronchiectasis air may be run into the pleural cavity so as to cause collapse of one lung, which rests it and allows cavities in it to heal up.

PODAGRA is another name for gout affecting the foot. (*See* GOUT.)

PODOPHYLLIN is a resin derived from the root of *Podophyllum peltatum*, a plant of the United States and Canada. It is a mildly acting purgative in small doses, and is generally combined with euonymin, iridin, and other vegetable extracts which stimulate the liver.

POIKILOCYTE (ποικίλος, manifold; κύτος, cell) is the name applied to a malformed red blood corpuscle found in the blood in various types of anæmia.

POISON IVY, or POISON OAK, is the name given to a poisonous species of sumac, *Rhus toxicodendron*. The leaves or juice when applied to the skin cause severe inflammation and symptoms of internal irritant poisoning. Some persons are very susceptible to this, and a kind of nettle rash may be produced by mere approach to the plant. A fluid extract and tincture are sometimes used in minute doses for treating rheumatism in persons not susceptible to the poisonous action. Symptoms of poisoning, when they appear, are treated by careful avoidance of the plant and by administration of soothing remedies externally and internally.

POISON REGULATIONS. — New rules for dealing with poisons which are used for medicinal purposes and in various trades were introduced in Britain in May 1936. These rules do not apply to poisonous substances which enter into the composition of adhesives, builders' materials, distempers, explosives, glazes, matches, inks, motor fuels, paints, rubber and similar articles employed in various trades. They apply chiefly to poisonous substances which have a medicinal use in order to prevent dangers that might arise from their careless, excessive or improper use. The list of these poisons is divided into two parts; part I of the list includes poisons which may be sold only by a registered pharmacist; part II includes a certain number of poisons used in connection chiefly with agriculture and with some other trades which may be obtained from other sellers licensed by local authorities to deal in these poisons.

The poisons in part I of the list, which

may be sold only by a registered pharmacist and only to a person who is known to him as a proper person to have such a substance in his possession and who signs a book for the purchase, comprise some 97 poisons or groups of poisons and include the following frequently used medicines. Powerful alkaloids such as aconitine, atropine, cocaine, codeine, colchicine, diamorphine, emetine, ephedrine, alkaloids of ergot, gelsemine, hyoscine, pilocarpine, lobeline, morphine and other opium alkaloids, strychnine; also acetanilide, amidopyrine, amyl nitrite, antimonial salts, arsenical substances, barbituric derivatives such as veronal, luminal and many other soporifics, barium salts (excluding barium sulphate), cannabis, cantharidin, chloral, chloroform, creosote of wood, croton oil, digitalis, glandular preparations including pituitary, suprarenal, thyroid extracts and insulin, glyceryl trinitrate (nitroglycerin), hydrocyanic acid and cyanides, lead acetate, mercurial salts, nux vomica, opium, phenols (including carbolic acid, cresol, etc., if the preparation contains 60 per cent or over of phenol), phosphorus, picric acid, strophanthus, sulphonal.

In this list, morphine, cocaine, ecgonine, diamorphine (commonly known as heroin), extracts and tinctures of cannabis (Indian hemp), and most of the preparations of opium are scheduled under the Dangerous Drugs Act, and may be dispensed only upon a prescription of a medical practitioner written in a specified form. (*See* DANGEROUS DRUGS.)

In this part of the list there are also three commonly used groups of drugs: amidopyrine and its salts, barbituric derivatives (including a large number of substances such as veronal, luminal and many other soporifics and analgesics), and sulphonal, together with a few seldom used substances, which are subject to the following stringent regulations in regard to their sale. They may be sold only in accordance with a prescription given by a qualified medical practitioner, registered dentist or registered veterinary surgeon; the prescription must contain the date and the address and signature of the person giving it, as well as the name and address of the person for whose treatment it is given, or, if the prescription is given by a veterinary surgeon, of the person to whom the medicine is to be delivered; if given by a dentist it must bear the words 'For dental treatment only', and if by a veterinary surgeon. 'For animal treatment only'; it must also indicate the total amount of the medicine to be supplied and the dose to be taken; the prescription may be dispensed only once unless it contains a direction that it may be dispensed a certain number of times or at stated intervals.

The bottle or container of the substances in part I of the list must in general be labelled 'Poison', but there are certain modifications of this. For example, in the case of insulin and active principles of the pituitary and thyroid glands, instead of the word 'Poison', the label must bear 'Caution. It is dangerous to take this preparation except under medical supervision.' In the case of animal medicines the label must read 'Poison. For animal treatment only.' In the case of hair dyes the label must read 'Caution. This preparation may cause serious inflammation of the skin in certain persons and should be used only in accordance with expert advice,' and in the case of potassium or sodium hydroxide the container must be labelled 'Caution. This substance is caustic.'

In the case of hospitals and similar institutions there are special provisions that medicines supplied to out-patients must be supplied only on a prescription, that a record must be kept in such a way that the particulars of its supply can be readily traced, and that the bottle must be labelled sufficiently to identify the institution from which it was supplied. In the case of in-patients, the medicines must be supplied upon a written order signed by a medical practitioner, registered dentist or by a sister or nurse in charge, and substances included in the list of poisons must be stored in a cupboard reserved solely for poisons.

The poisons in part II of the list, which may be supplied by a dealer licensed by the local authority, on the signing of a book or order, include some 16 substances or groups of substances, of which most are used for sheep dips, insecticides and disinfectants. They

are as follows. Ammonia, certain arsenical substances, certain barium salts, formaldehyde, hydrochloric acid, hydrofluoric acid and its salts, mercuric chloride and iodide, nicotine, nitric acid, nitrobenzene, phenols (if the preparation contains less than 60 per cent of phenols), phenylene and toluene diamines, potassium and sodium hydroxides (caustic potash and soda), potassium quadroxalate, sulphuric acid.

POISONS.—It is difficult to give a concise definition of the word poison, because substances which are injurious by their mechanical action, such as steel filings or powdered glass, cannot be classed as such; nor is boiling water a poison; nor can a substance be regarded as a poison if it owes its effect to some bodily peculiarity—as, for example, a draught of cold water taken by an overheated person. The following definition is, however, given by Guy: 'A poison is any substance or matter (solid, liquid, or gaseous) which, when applied to the body outwardly, or in any way introduced into it, can destroy life by its own inherent qualities, without acting mechanically, and irrespective of temperature.' Even this definition is not quite satisfactory, because many substances are poisonous in large quantities, harmless in smaller amounts, *e.g.* saltpetre, tartaric acid, Epsom salts. Further, substances which are generally poisons may by habit lose their deadly effect, as in the case of arsenic and opium. (*See* OPIUM.) Again, different persons and animals vary widely in susceptibility to poisons, the old adage that 'one man's meat is another man's poison' being literally true. Many herbivorous animals, like the cow, feed upon the deadly nightshade with impunity, and pigeons are almost entirely unaffected by opium.

Varieties.—Many substances which are poisonous are valuable remedies when used in small quantities or properly applied externally. Others are common household substances or garden plants, and very many have important uses in the arts. Under the heading of poisons must be included bacteria and the harmful substances which their growth produces, such as the poisons found in decomposing meat. (*See* BACTERIOLOGY, PTOMAINE POISONING, and other headings.) The injuries inflicted by insects, snakes, and other animals which introduce some poison into the body are considered under BITES.

Leaving these out of account, we may classify poisons either according to their source or to their mode of action. Classified according to their source they are —*animal*, like cantharides; *vegetable*, like monk's-hood or deadly nightshade; *mineral*, like sulphuric acid or perchloride of mercury; and *aerial*, like carbon monoxide gas. By this classification, however, substances with the most diverse actions are included in each group. A more practical arrangement is made, according to the mode of action, into:

Corrosives, which burn and destroy the parts with which they come in contact.
Irritants, which have generally an irritant action upon the stomach and bowels.
Narcotics, which affect the brain and spinal cord, causing a stuporous state.
Narcotico-irritants, which produce first of all an irritative effect upon the stomach or upon the nervous system, and finally act as narcotics.

The two last-mentioned groups are by some authorities placed together as *narcotics*.

(1) CORROSIVES go so far as to corrode, ulcerate, or even perforate the organs with which they come in contact. The chief corrosives are the strong mineral acids, like sulphuric, nitric, hydrochloric; the alkalies, like caustic soda or potash, their carbonates, and ammonia; and certain strong salts, like corrosive sublimate and pernitrate of mercury.

(2) IRRITANTS include vegetable acids and some acid salts, such as tartaric acid; white arsenic (arsenious acid), yellow arsenic (orpiment), acetate of lead (sugar of lead), sulphate of copper (blue vitriol), subacetate of copper (verdigris), arsenite of copper (Scheele's green), tartarated antimony (tartar emetic), chloride of antimony (butter of antimony), chloride of zinc (Burnett's disinfectant), nitrate of silver (lunar caustic), bichromate of potassium, sulphate of iron (green vitriol or copperas); also the leaves, roots, berries, or resins of many plants taken in large amount, such as colocynth, savin, gamboge, aloes, croton oil, elaterium.

(3) NARCOTICS are mostly drawn from the vegetable kingdom. Few poisons

TABLE OF COMMON POISONS AND THEIR TREATMENT

Poison	*Treatment*
Acids— Hydrochloric Nitric Sulphuric	Give lime-water, magnesia, chalk, whitening, or bicarbonate of soda in water; then albumin water, oil, or barley water.
Aconite	Lay patient down; give stimulants and digitalis; wash out stomach with permanganate of potassium.
Alcohol	Wash out stomach; cold douches; give apomorphine.
Alkalies— Caustic soda Caustic potash Ammonia	Give vinegar in water; then linseed or olive oil.
Arsenic	Give emetic; then magnesia or hydrated oxide of iron, prepared by mixing solution of perchloride of iron with solution of ammonia in equal parts, straining through a handkerchief, and stirring up the precipitate in water; then albumin water or barley water; wash out stomach and give laudanum.
Belladonna and atropine	Give emetic; wash out stomach with permanganate of potassium; morphine or pilocarpine as antidote; artificial respiration.
Camphor	Give emetic, then a stimulant.
Carbolic acid, Cresol, Lysol, etc.	Give magnesium sulphate or Glauber's salt, then albumin water or milk; wash out stomach.
Chloral	Give emetic, then strychnine and stimulants; artificial respiration.
Cocaine	Give stimulants; amyl nitrite as antidote; artificial respiration.
Corrosive sublimate (mercuric chloride)	Give albumin water or milk; wash out stomach.
Cyanide of potassium and prussic acid	Hot and cold sponges to heart; ammonia by inhalation; artificial respiration.
Digitalis (foxglove)	Give emetics; wash out stomach with permanganate of potassium.
Ether	Wash out stomach; cold douches.
Iodine	Give flour or other form of starch in water; wash out stomach.
Lead Acetate (sugar of lead)	Give magnesium sulphate or Glauber's salt; wash out stomach; then give albumin water or barley water.
Laudanum— Morphine Opium, etc.	Give emetic; wash out stomach with permanganate of potassium; give strong coffee; keep patient awake; artificial respiration.
Lysol	(*See* CARBOLIC ACID above.)
Mushrooms— Fungi	Give emetic; hypodermic injections of atropine and strychnine.
Oxalic acid and binoxalate of potassium (salts of sorrel)	Give magnesia, chalk, or whitening (*not* bicarbonate nor carbonate of soda); wash out stomach; give albumin water or milk.
Phosphorus (matches, etc.)	Give sulphate of copper as emetic; wash out stomach with potassium permanganate; give albumin water: avoid oils.
Ptomaines (bad meat)	Give emetic at once, or later castor oil; brandy.
Silver nitrate (lunar caustic)	Give salt in water; wash out stomach; give albumin water or milk.
Strychnine	Wash out stomach with permanganate of potassium; give chloral.
Tobacco	Give strong coffee or strychnine.
Turpentine	Give emetics, then magnesium sulphate and albumin water or milk.
Zinc chloride	Wash out stomach; then give albumin water or milk.

have a purely narcotic action, most producing also sickness, delirium, or other signs of irritation. The simple narcotics include opium and its preparations, prussic acid (hydrocyanic acid), cyanide of potassium, alcohol, ether, chloral, chloroform. Most poisonous gases also belong to this group, the chief among them being carbonic acid, carbon monoxide (*see* COAL-GAS POISONING), water gas, sulphuretted hydrogen, sulphide of ammonium, and other sewer gases. The amount of these which is necessary in the air in order to produce serious symptoms, or even to cause death if breathed for long, is very small. (*See* ASPHYXIA.)

(4) NARCOTICO-IRRITANTS form a very large group in which the individuals cause varied symptoms of irritation, such as delirium and excitement, convulsions, or sickness and vomiting. The group includes carbolic acid, oxalic acid, binoxalate of potash (salts of sorrel), nux vomica with strychnine, meadow saffron (*Colchicum autumnale*), white hellebore (*Veratrum album*), foxglove (*Digitalis purpurea*), monk's-hood (*Aconitum napellus*), henbane (*Hyoscyamus niger*), deadly nightshade (*Atropa belladonna*), black or garden nightshade (*Solanum nigrum*), woody nightshade or bitter-sweet (*Solanum dulcamara*), potato tops and seeds (*Solanum tuberosum*), tobacco (*Nicotiana tabacum*), Indian tobacco (*Lobelia inflata*), thorn apple (*Datura stramonium*), spotted hemlock (*Conium maculatum*), water hemlock or cowbane (*Cicuta virosa*), hemlock-water dropwort (*Œnanthe crocata*), five-leaved water hemlock (*Phellandrium aquaticum*), fool's parsley (*Æthusa cynapium*), yew leaves and berries (*Taxus baccata*), laburnum seeds and bark (*Cytisus laburnum*), and many species of poisonous fungi. (*See* FUNGUS POISONING.)

Symptoms. — The symptoms of poisoning, which come on soon after a meal, or at least after some substance has been swallowed, are of great importance, because the treatment varies according to the type of poison taken, as shown by the symptoms.

CORROSIVE POISONS produce immediate pain and swelling of the lips, mouth, and throat, which also show signs of discoloration, depending on the poison taken. If the dose be large, there may be speedy collapse and death.

IRRITANT POISONS produce vomiting, purging, and abdominal pain. In the case of the milder irritants, the results may be deferred for a few hours, particularly when a full meal has been taken along with the poison. Later, in very serious cases, collapse and insensibility come on.

NARCOTICS produce giddiness, headache, interference with sight, stupor, preceded occasionally by convulsions, followed by deepening insensibility ending in coma and death. No pain is produced by these. For the means by which narcotic poisoning is distinguished from apoplexy, or alcoholic intoxication, see OPIUM.

NARCOTICO-IRRITANTS produce at first the symptoms of the irritant poisons, vomiting, abdominal pain, and in many cases purging. Later, delirium or convulsions appear, ending in stupor and death.

Further details as to the symptoms and treatment connected with the more important poisons will be found under the headings of these poisons.

Treatment. — When a CORROSIVE POISON has been taken, one should first of all administer the chemical antidote to the poison, if there be one; and thereafter soothing substances should be given to allay the irritation in the mouth, throat, and stomach. The following corrosive poisons have such chemical antidotes. When acids have been taken, give a dilute alkali, such as lime-water, magnesia, chalk, whitening, or even plaster scraped from the walls and mixed with water. When caustic alkalies have been taken, give weak acids, such as copious draughts of vinegar in water or lemon juice in water. When corrosive sublimate is the poison, white of egg in water or milk combines with it to form a harmless substance.

After the poison has been neutralised, milk, white of egg in water, or other bland fluid may be given to mitigate the irritation it has caused.

In the case of the IRRITANT POISONS, draughts of water or milk to dilute the poison, together with an emetic consisting of a tablespoonful of mustard in water, or of 20 grains of sulphate of zinc in water, should be given as soon as possible. Still better is it to wash out the stomach with the stomach tube at the earliest possible moment.

The following irritant poisons have chemical antidotes, which may be given before the stomach is emptied. When oxalic acid or salts of sorrel has been taken, give chalk or magnesia, which forms in the stomach the harmless oxalate of lime. If lunar caustic should have been swallowed, common salt in water neutralises it by forming the inert chloride of silver. When sugar of lead has been swallowed, Epsom salts is an efficient antidote, producing the insoluble sulphate of lead in the stomach. Carbolic acid also has for an antidote Epsom salts. Arsenic is neutralised by a solution of hydrated peroxide of iron, when this is obtainable.

In the case of NARCOTIC AND NARCOTICO-IRRITANT poisons, an emetic administered at once is beneficial, and it is the usual practice for a medical man to wash out the stomach with a weak solution of permanganate of potassium, when he sees the case. Permanganate of potassium has the power of destroying many of these vegetable poisons which are of an alkaloidal nature. Many of these poisons, whose deadliness depends upon active principles, can be neutralised to some extent by other drugs. (*See* ANTIDOTES.)

WHEN THE POISON IS UNKNOWN, but the fact of poisoning suspected, the safest course is to administer tepid water and with it mustard, sulphate of zinc, or other emetic (*see* EMETICS), in order to expel the contents of the stomach, thereafter administering a drink of milk. Above all things is it necessary to keep all vomited matters and the remains of food that the poisoned person has been taking till the arrival of a medical man.

POLICLINIC (πόλις, city; κλίνη, bed) is the name applied to a hospital or clinic belonging to a city. POLYCLINIC (πολύς, many; κλίνη, bed) is the term applied to a clinic where diseases of all kinds are studied and treated.

POLIOMYELITIS (πολιός, grey; μυελός, marrow) means inflammation in the grey matter of the spinal cord, as occurs, for example, in infantile paralysis. (*See* PARALYSIS.)

POLIOSIS means premature greying of the hair.

POLITZER'S BAG is an india-rubber bag with nozzle intended for inflation of the middle ears by blowing air up one nostril while the other is closed.

POLLANTIN is the name given to an antitoxic serum used for the prevention of hay fever in persons who are liable to this disease.

POLLEX is a Latin term for thumb.

POLYCHROMASIA and POLYCHROMATOPHILIA (πολύς, many; χρῶμα, colour; φιλέω, I love) are terms applied to an abnormal reaction of the red blood corpuscles in severe anæmia in which they show an affinity for all sorts of stains in place of the normal affinity for acid stains only.

POLYCYTHÆMIA (πολύς, many; κύτος, cell; αἷμα, blood) is the name applied to excess in the number of red corpuscles in the blood.

POLYDIPSIA (πολύς, much; δίψα, thirst) means excessive thirst, which is a symptom of diabetes and some other diseases.

POLYGRAPH (πολύς, many; γράφω, I write) is the term applied to an instrument for making simultaneous tracings of the pulse in two different parts of the circulation at one time.

POLYMORPH (πολύς, many; μορφή, form) is a name applied to certain white corpuscles of the blood which have a nucleus of peculiar and varied shape. These form between 70 and 75 per cent of all the white corpuscles.

POLYNEURITIS (πολύς, many; νεῦρον, nerve) means an inflammatory condition of nerves in various parts of the body. (*See* NEURITIS.)

POLYPHARMACY (πολύς, many; φάρμακον, drug) is a term applied to the administration of too many drugs in one prescription.

POLYPUS (πολύπους, many-footed) is a general name applied to tumors which are attached by a stalk to the surface from which they spring. The term refers only to the shape of the growth and has nothing to do with its structure or nature. Most polypi are of a simple nature, though malignant polypi are also found. The usual structure of a polypus is that of a fine fibrous core covered with epithelium resembling that of the surrounding surface. The

sites in which polypi are most usually found are the interior of the nose, the outer meatus of the ear, and the interior of the womb, bladder, or bowels.

Their removal is generally easy, as they are simply twisted off, or cut off,

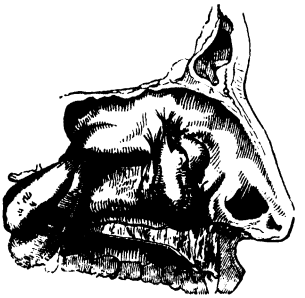


FIG. 377.—Polypi growing in the interior of the nose, each from a narrow stalk. (Miller's *Surgery*.)

by some form of snare or ligature; those which are situated in the interior of the bladder or bowels, and whose presence is usually recognised by the presence of blood in the urine or stools, may require a more serious operation to reach the organ into which they project.

POLYTHELIA is the term applied to the condition in which extra or 'supernumerary' nipples appear along a line between the armpit and the groin.

POLYURIA (*πολύς*, much; *οὖρον*, urine) means the passage of an amount of urine considerably in excess of the fifty ounces or thereabout which is the usual daily quantity. It is a symptom of diabetes, certain forms of Bright's disease, and some nervous diseases.

POMEGRANATE ROOT, derived from *Punica granatum*, is used either in the form of a decoction prepared from the bark, or of an alkaloid, pelletierine, extracted from it. The chief use of the drug is to expel tape-worm, and the mode of use is similar to that of the root of male-fern. (*See* FERN.)

PONS VAROLII is the bridge of the brain, mainly composed of strands of white nerve-fibres which unite various parts of the brain. (*See* BRAIN.)

POPLITEAL SPACE (*poples*, the ham), or HAM, is the name given to the region behind the knee. The muscles attached to the bones immediately above and below the knee bound a diamond-shaped space through which pass the main artery and vein of the limb (known in this part of their course as the popliteal artery and vein), the internal and external popliteal nerves (which continue the great sciatic nerve from the thigh down to the leg), the external saphenous vein, as well as several small nerves and lymphatic vessels. The muscles, which bound the upper angle of the space and which are attached to the leg bones by strong prominent tendons, are known as the 'hamstrings'. The lower angle of the space lies between the two heads of the gastrocnemius muscle, which makes up the main bulk of the calf of the leg.

POPPY as used in medicine is of two species, *Papaver somniferum*, the white opium-poppy, and *Papaver rhœas*, the red corn-poppy. The former is treated of under OPIUM. The corn-poppy is chiefly used as a colouring agent, the syrup made from it having a brilliant crimson colour.

PORENCEPHALIA (*πόρος*, hole; *ἐγκέφαλος*, brain) is a term applied to the presence of cavities in the surface of the brain due to an arrest of development or to birth hæmorrhage. The condition is generally associated with serious mental defect.

POROPLASTIC is the name of a thick kind of felt which is easily moulded into splints when softened by hot water and used for surgical purposes.

PORRIGO is a general term applied to diseases of the skin covering the head, such as ring-worm.

PORTAL VEIN (*porta*, an entrance, is the vein which carries to the liver blood that has been circulating in many of the abdominal organs. It is peculiar among the veins of the body in that it ends by breaking up into a capillary network instead of carrying the blood directly to the heart, a peculiarity which it shares only with certain small vessels in the kidneys. The portal system begins below in the hæmorrhoidal plexus of veins round the lower end of the rectum, and from this point, along the whole length of the intestines, the blood is collected into an inferior mesenteric vein upon the left, and a superior mesenteric vein upon the right side. The inferior mesenteric vein empties into the

splenic vein, and the latter, uniting with the superior mesenteric vein immediately above the pancreas, forms the portal vein. The portal vein is joined by veins from the stomach and gall-bladder, and finally divides into two branches which sink into the right and left lobes of the liver. (For their further course see LIVER.)

The organs from which the portal vein collects the blood are the large and small intestines, the stomach, spleen, pancreas, and gall-bladder.

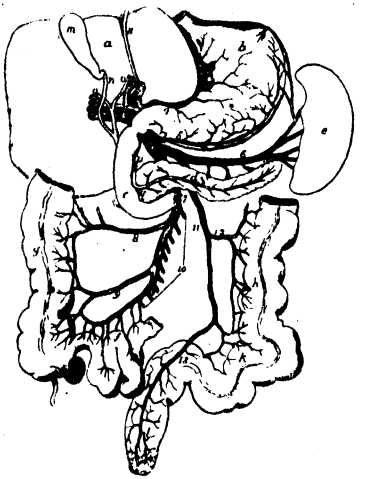


FIG. 378.—Diagram showing the organs from which blood is collected by the portal vein to be discharged into the liver. 1, Portal vein dividing into 2 and 3, its right and left branches; 4, gastric vein; 5, right gastro-epiploic vein; 6, splenic vein; 7, superior mesenteric vein; 8 and 9, right and middle colic veins; 10, intestinal veins; 11, inferior mesenteric vein; 12, left colic vein; 13, superior hæmorrhoidal vein; *a*, liver; *b*, stomach; *c*, duodenum; *d*, pancreas; *e*, spleen; *f*, part of small intestine; *g*, *h*, *k*, *l*, large intestine; *m*, gall-bladder; *n*, cystic ducts; *o*, *o*, hepatic ducts; *p*, where bile duct and pancreatic duct enter the duodenum; *q*, the pancreatic duct; *r*, hepatic artery; *s*, round ligament. (Turner's *Anatomy*.)

POSOLOGY (πόσος, how much; λόγος, discourse) means the science or system of dosage in regard to medicines.

POST- is a prefix signifying after or behind.

POST-MORTEM EXAMINATION (*see* AUTOPSY).

POST-PARTUM is the term applied to anything happening immediately after child-birth—for example, Post-partum hæmorrhage.

POTASH, or POTASSA, is the popular name for potassium carbonate. Hydrated oxide of potassium is usually known as caustic potash, and its solution as liquor potassæ. Potash is obtained by burning wood, washing the ashes with water, and evaporating the solution to dryness. The remainder contains 60 to 80 per cent of carbonate of potassium, which is used to obtain most of the other salts of potassium.

POTASSIUM is a metal which, on account of its great affinity for other substances, is not found in a pure state in nature. Its salts are used to a great extent in medicine, but as their action depends in general not on their metallic radicle but upon the acid with which it is combined, their uses vary greatly and are described elsewhere. Thus for the uses of potassium bromide see BROMIDES, for those of potassium iodide see IODIDES, for those of potassium permanganate see PERMANGANATE OF POTASSIUM, for those of the bicarbonate, citrate, and tartrate of potassium see CITRIC ACID, and for those of nitrate of potassium see NITRE.

All salts of potassium have a depressing effect upon the nervous system and upon the heart's action.

The solid tissues of plants and animals contain a considerable amount of potassium salts, but the fluids of the body, such as the blood, contain sodium salts, and require a constant supply of these for the maintenance of health. Hence the craving which cattle display at times for common salt (sodium chloride), and the necessity for adding this to the human dietary.

Potassium chlorate, in addition to the general actions exerted by potassium salts, has a specially soothing action upon inflamed mucous membranes, and it is very generally used for a gargle in sore throat of every description.

POTT'S DISEASE is a name frequently applied to the angular curvature of the spine which results from tuberculous disease. (*See* SPINAL DISEASES.) The disease is named after Percival Pott, a famous English surgeon (1713–1788), who first described the condition.

POTT'S FRACTURE is a fracture near

the lower end of the fibula, named after Percival Pott, who suffered from this fracture and was the first to describe it. (*See* FRACTURES.) It is very often mistaken for a simple sprain of the ankle.

POULTICES (*see also* FOMENTATIONS) are soft moist applications to the surface of the body, generally used hot. They soften the parts with which they come in contact, soothe irritated nerve-endings, relax spasmodically contracted muscle-fibres, and, after being applied for some time, dilate the vessels of the part they cover and increase the circulation through it. These applications are consequently used in all stages of inflammation to soothe pain and promote resolution, or in the late stages, when pus is forming, to aid the rapid formation of an abscess. (*See* ABSCESS.)

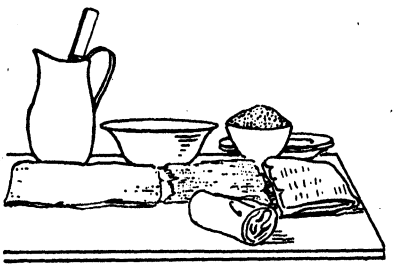


FIG. 379.—Requisites for linseed meal poultice.

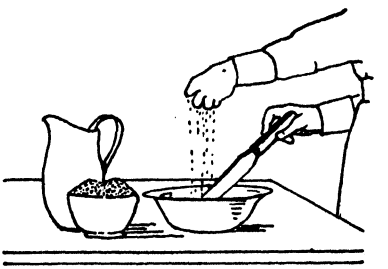


FIG. 380.—Adding the meal to boiling water in basin.

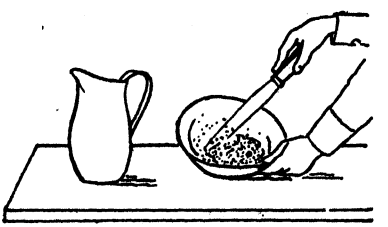


FIG. 381.—Meal and water mixed to a stiff hot mass.

Poultices should on no account be applied to open wounds, for their warmth and moisture greatly favour the growth of bacteria.

Variety and uses.—LINSEED POULTICE made from crushed linseed is one of the most commonly used, and is applied hot in cases of inflammation, as above stated. OATMEAL POULTICE is used in precisely the same conditions. MUSTARD POULTICE is used where it is desired to combine a counter-irritant action with the warmth of a poultice. BREAD POULTICE and STARCH POULTICE are used at the body temperature, generally in order to remove the crusts of skin eruptions or soften a hardened surface. CHARCOAL POULTICE was formerly much used to diminish the smell from foul ulcers, but now readier antiseptics are employed.

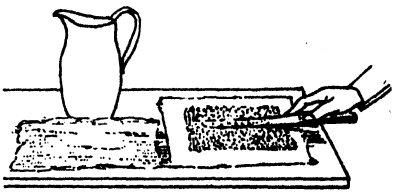


FIG. 382.—The poultice mass spread thickly on a piece of cotton cloth.

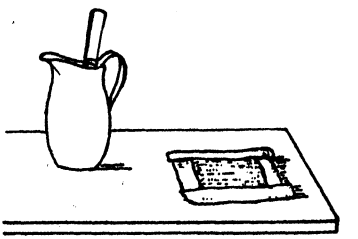


FIG. 383.—Muslin laid on surface of poultice and edges of cotton cloth turned over.

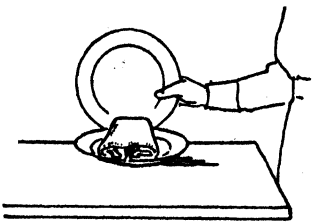


FIG. 384.—Poultice rolled up and laid between two hot plates ready for application.

Hot fomentations for acute pain are used of late years in preference to the more cumbersome and less cleanly poultices.

Method of application. — LINSEED POULTICE should be made of freshly crushed linseed, as the meal soon grows rancid if kept. About half a pint of boiling water is poured into a small basin, which has already been warmed, and the linseed is slowly added to it, stirring all the while. Enough meal (about 4 ounces) is added to make a mass sufficiently thick to adhere together, and still thin enough to spread. This may be judged by the mass being sufficiently coherent to allow a spoon or spatula to stand upright in it. A linen, or better a flannel, rag is laid by the basin and the hot linseed quickly spread on it with a spatula or table-knife. It may be covered with a piece of thin muslin, or the linseed may be applied directly to the skin. On the outer surface of the poultice a piece of macintosh or oil-silk should be placed, and outside of this a thick piece of cotton-wool to retain the warmth. The whole is fixed in place by a flannel bandage or binder. Such poultices become cold in two hours or more and should then be renewed, but the cold poultice should not be taken off till the new one is ready to lay on. Great care should be taken in changing the poultice that the patient is not exposed to chill.

MUSTARD POULTICE is made by mixing 2½ ounces of linseed with half a pint of boiling water as above, adding to it 2½ ounces of mustard flour which has already been mixed with lukewarm water, and stirring the two together. This poultice mass is spread and applied in the same way as the linseed poultice, but must not be left on longer than twenty minutes to half an hour. There must be a piece of muslin upon the surface in order to keep the mustard from adhering to the skin. The patient's sensations form the best guide as to the length of time over which such a poultice should be left on. The place of this poultice is now to a great extent taken by mustard leaves, which simply require to be wetted and applied.

BREAD POULTICE is made by breaking up stale bread in a basin, pouring boiling water over the crumbs sufficient to soak them, allowing to cool, draining off superfluous moisture, spreading on a cloth, and covering with muslin.

STARCH POULTICE.—Add a teaspoonful of powdered boric acid to four table spoonfuls of cold-water starch, mix with a little cold water, then pour in a pint of boiling water, and stir till thickened; let stand till cold; spread the cold starch *thickly* on pieces of cotton, cover with muslin, and apply to the part, changing the poultices every few hours and wiping the skin gently each time the poultices are re-applied.

CHARCOAL POULTICE is made by preparing a bread poultice and sprinkling it with dry powdered charcoal.

KAOLIN POULTICE is a paste which is applied by heating the pot containing it in a pan of boiling water, and spreading thickly on lint.

POWDERS form the simplest method in which drugs are prescribed. The dose of a powder is usually somewhere between 5 and 60 grains, very powerful drugs being made up with inert substances like sugar, gum, or ginger in order to give them sufficient bulk. The best-known powders are Dover's powder (compound ipecacuanha powder), containing opium, Gregory's powder (compound rhubarb powder), grey powder (mercury with chalk), James's powder (antimonial powder), and Seidlitz powder (effervescent tartarated soda powder).

Method of use.—If the powder be small and tasteless, a little water is poured out into a teaspoon, the powder shaken out on the surface of the water and swallowed. If it be large and nauseous, the best plan is to envelop it in a rice-paper. A little water is placed in the bottom of a saucer and the circular rice-paper laid upon it, when it quickly softens. The powder is shaken out upon the centre of the rice-paper, and the edges of the latter are quickly turned over it with a teaspoon. The soft mass is then pushed on to the spoon and is easily swallowed, being thus untasted.

PRE- is a prefix meaning before.

PRECORDIAL REGION (*præcordia*, the membrane covering the heart) is the area on the centre and towards the left side of the chest, lying in front of the heart. It is often the seat of pain or oppression in heart disease.

PREFRONTAL LOBOTOMY (*see* LEUCOTOMY).

PREGNANCY, PECULIARITIES OF

PREGNANCY, PECULIARITIES OF.—This state is a natural one, although it sets up great changes, not only in the womb, but throughout the whole body. Most of these changes subside quickly after delivery is accomplished, and though a few minor alterations persist throughout life, the mother returns to her normal state within about one month after the child is born.

Duration of pregnancy.—It is generally accepted that pregnancy lasts about 273 days from the end of the last menstrual period. In exceptional cases there may be considerable variation, but it is generally agreed that the shortest duration of a normal pregnancy is 240 days and the longest duration 313 days. The cause of these variations is not understood, and the longest period of gestation that has ever been admitted in the Law Courts in Great Britain is 331 days. For the purpose of calculating the probable date of confinement, it is usual to take the first day of the last period that occurred, to allow seven days for the duration of this and then to add 273 days for the duration of gestation, making in all 280 days from the beginning of the last menstruation. The actual date can be estimated roughly by adding seven days and then counting forwards nine calendar months; for example, supposing the last menstrual period began on 3rd October, adding seven days makes the 10th October, and nine months forwards from this gives the date of probable confinement as the 10th of July. It is usual to say that this day is the middle of the week in which the confinement may be expected.

Signs of pregnancy.—(*a*) The stoppage of the menstrual flow is the sign which first attracts attention. This symptom may, however, be due to many other causes, such as bloodlessness (*see* MENSTRUATION), but if it occurs quite suddenly it may usually be counted upon as an important sign. It is a popular mistake to suppose that pregnancy cannot occur in a woman while she is suckling a previous child, for this does occur even while the menses are in abeyance. (*b*) Swelling of the breasts is another important sign, appearing even in the second or third month of pregnancy. A thin fluid, known as colostrum, can, even at this early stage, be pressed from the nipples. At the same time the veins on the breasts become enlarged and visible, and the pigmented ring round the nipple (areola) becomes much darker than before, as well as showing small nodules (Montgomery's tubercles) round its edge. (*c*) Sickness in the mornings immediately on rising is also a very frequent sign, occurring in about two-thirds of all women, though it may be absent, and even if present may be due simply to dyspepsia and weakness. When the sickness is marked it is, however, a valuable sign, because it appears very early in the course of pregnancy, during the second month, and lasts usually about a couple of months. (*d*) 'Quickening', or the fluttering sensation felt by the mother in consequence of the child's rapid movements, is a very important sign, though it does not usually occur till some time during the fifth month of pregnancy or even later. It is the first sign of life felt by the mother, though it is a popular error to suppose that the child only then begins to live. (*e*) Enlargement of the abdomen is a pronounced sign, though for the first three months the enlargement is not apparent. It must not be forgotten, however, that enlargement may be due to other causes, such as tumors, dropsy, and even constipation or increasing development of fat. It is not an uncommon mistake for an elderly childless woman to delude herself with the hope that she is about to bear a child, when the abdomen is enlarging simply for the last-named reason. This condition is known as pseudo-cyesis or false pregnancy. (*f*) The only absolutely certain sign of pregnancy is obtained when the medical attendant hears the beating of the fœtal heart by auscultation over the lower part of the abdomen. The heart-sounds are rapid, much resembling the ticking of a watch, and are heard in general from the middle of the fifth month onwards. (*g*) There are various minor signs which are sometimes present, sometimes absent, some of which are noticeable by the mother, others appreciable only by the medical attendant. Such are the occurrence of varicose veins, mucous discharge from the vagina, changes in the neck of the womb, etc.

Hygiene of pregnancy.—It is unnecessary for a healthy woman to make

any great change in her ordinary mode of life during pregnancy. Her diet must be good, but should be simple and moderate. Alcoholic liquors should in all cases be abandoned during pregnancy. A pregnant woman should drink at least one pint of milk a day, on account, among other things, of the calcium it contains. Cheese should also be taken for its calcium. (The fœtus in the uterus needs calcium for its bones.) Iron-containing foods are also important for the development of the fœtus's red blood corpuscles. Iron is present in such foods as eggs, green leafy vegetables (especially spinach and watercress), and in liver and meat. Vitamins are also of great importance to the pregnant woman, and these are present in such foods as eggs, milk, cheese, butter, wholemeal bread, brown bread, fresh vegetables and fruit (especially oranges, lemons, currants, potatoes, and tomatoes), and fat fish, such as herring and salmon; in the winter months cod-liver oil or halibut-liver oil may well be taken in addition. Constipation should be avoided by a suitable diet containing vegetables, fruit, and the like, or by mild aperients. The skin should be kept in good condition by regular bathing. Moderate exercise should be taken every day and late hours avoided. The dress should be easy, and it is often advisable for women who have borne several children to wear a binder or special belt.

Special ailments. The misfortune which specially attaches to the condition of pregnancy is miscarriage (*see* MISCARRIAGE), which is not, however, liable to occur in perfectly healthy persons. Digestive disturbances are particularly common. Thus the natural morning sickness may become very troublesome, or even dangerous, and require special treatment. Constipation or diarrhœa is often a trouble, but either of them is treated much as under ordinary circumstances. Varicose veins in the legs, piles, swelling of the feet, and cramps in the legs are all liable to be caused in the later months by pressure of the increasing womb upon the large vessels and nerves within the pelvis. These, however, are not bad signs, and must simply be tolerated till after the child is born, when they quickly improve. Varicose veins, if very severe, should be supported by elastic stockings or by bandaging the legs, and cramps may be relieved by the usual means. (*See* CRAMP.) Irritability of the bladder, showing itself by frequency of making water, is also a temporary inconvenience similarly due to pressure.

More serious symptoms occasionally arise, such as those of kidney disease, various nervous disorders, and especially the condition known as eclampsia, in which convulsions come on. Displacements of the womb, which have existed prior to pregnancy, may also give trouble if attention be not paid to them, and it may be necessary for the subject of such displacements to wear a pessary during the earlier months.

PREGNANCY TEST.—A test for pregnancy in its early stages, devised by Zondek and Aschheim, depends upon the fact that in the first few months of pregnancy the pituitary gland (anterior part) forms a greatly increased secretion of which the excess is discharged in the urine. A small quantity of urine passed by the woman whom it is desired to test is sent to a laboratory, where a few drops are injected on several successive days into a young and immature female mouse or other small animal. The animal is killed a few days later, and if the person whose urine is being tested is pregnant, it is found that the ovaries and neighbouring organs of the immature mouse have been stimulated into a state of full maturity; but if the urine has come from a non-pregnant person, the young mouse's ovaries remain unchanged. The test is highly accurate.

PREGNANDIOL, $C_{21}H_{36}O_2$, is the excretion product of the hormone PROGESTERONE, manufactured by the corpus luteum of the ovary. Pregnandiol is excreted in the urine during the second half of the menstrual period, and its excretion rises steadily throughout pregnancy.

PREGNENINOLONE (*see* ETHISTERONE).

PREMATURE BIRTH (*see* BIRTH, MISCARRIAGE).

PRESBYOPIA (πρέσβυς, an old man; ὤψ the eye) is the general term used to

indicate the changes that take place naturally in the eye with the advance of age, and quite apart from any disease. The chief of these changes consists in decreasing elasticity of the lens, so that it becomes increasingly difficult to use the eyes for near work. At the age of forty this change has proceeded so far that the lens can just manage to accommodate itself for vision of objects at ten inches or thereabout, the distance which is most convenient for reading or other close work. After the age of about forty-five, therefore, much work must be done at an uncomfortable distance, or glasses must be worn in order to aid the natural lens. Persons who, during youth, have a slight degree of short-sight, may in old age not require any glasses for near work.

PRESCRIPTION (*præscriptio*, an order) means the written direction given by the doctor to the chemist for the compounding of medicine suitable to a patient's case. The prescription contains as a rule the names of some preparations from the pharmacopœia, a list of approved remedies published by the government of each country. Sometimes the prescription consists of only one such formula, or it may contain the names of proprietary medicines or of simple substances not included in this official list.

In Britain it is still customary to write prescriptions in Latin, a usage which has come down from mediæval times, and which had a parallel in ancient Greece, where the practitioners at Athens are said to have written their prescriptions in the Doric dialect. The quaintest part of this traditionary usage lies in the ℞ which heads every prescription, and which was at first probably the Eye of the god Horus, a charm used by the ancient Egyptians, and later the sign of the planet Jupiter. It now stands for the initial of the word *recipe* meaning 'take', and commences the directions to the dispenser. The practice of writing in Latin, and of using the symbols ℥ (minim), ʒ (dram), ʒ (ounce), has little to recommend it, and in France was once prohibited by law, while elsewhere it is also falling into disuse. One advantage that it possesses is that, the number of Latin terms being limited, they form an understood convention between doctor and chemist, so that a certain amount of precision is gained. Secondly, it is sometimes desirable that a patient should not be able to control the drugs or quantities that he is receiving, and this is gained by the use of the unfamiliar signs.

For chemical and physiological reasons as well as for convenience, drugs are administered in a more or less dilute form so calculated that the amount to be taken can be measured by some domestic utensil. Thus:

A drop (roughly)	= 1 minim (℥i.)
A teaspoonful	= 1 fluid dram (ʒi.)
A dessertspoonful	= 2 fluid drams (ʒii.)
A tablespoonful	= 4 fluid drams (ʒiv.) or
(small)	½ ounce (ʒss.)
A wineglassful	= 2½ fluid ounces (ʒii.ss.)
A tumblerful	= 10 fluid ounces (ʒx.)

PRESENTATION means the appearance in labour of some particular part of the child's body at the mouth of the womb. This is normally a head presentation in 96 per cent of cases, but in a certain number the breech may present, or the face, or foot, or even a part of the trunk in cases of cross-birth.

PRESSOR is the term applied to anything that increases the activity of a function, for example, a pressor nerve or pressor drug.

PRESSURE (*see* BLOOD-PRESSURE).

PRICKLY HEAT is a troublesome skin condition affecting Europeans in tropical climates. It consists in the appearance of numbers of minute vesicles, produced by blocking of the outlet of the sweat or sebaceous glands in the skin, and accompanied by intolerable itching.

Causes. — Nearly every European suffers from prickly heat during the early years of residence in the tropics, when the hot season comes round. It is due probably to the cells on the surface of the skin becoming sodden by the constant perspiration, and so swelling and blocking the outlets of the minute gland-ducts. Anything that leads to perspiration, such as hot drinks, hot soup, close rooms, or warm clothing, aggravates the condition.

Symptoms.—The surface is covered by minute vesicles which cause extreme itching and pricking. The scratching

which this entails often leads to the formation of boils and pustules, but the condition is not in itself a dangerous one. The extreme discomfort, and the loss of sleep arising from it, may, however be a serious matter for invalids.

Treatment.—The most important point is to avoid, so far as possible, all causes of perspiration, such as warm drinks, rough underclothing, and violent exercise. Common soap should not be used in the bath, and each time after bathing, the skin should be dusted with an astringent and antiseptic dusting powder, such as one composed of boric acid, zinc oxide, and starch in equal parts.

As a preventive, rubbing the body over after the bath with the juice of a lemon has been recommended, while as a cure, painting the patches with iodine solution, or with corrosive sublimate lotion (1 in 1000) has been advocated. Calamine lotion or carbolic acid lotion relieves the itching temporarily.

PRIMIPARA (*prima*, first, and *pario*, I bear) is the term applied to a woman who has given birth or is giving birth to her first child.

PRO- is a prefix meaning forwards.

PROBE (*probo*, I test) is the name of a slender, flexible instrument usually made of metal designed for introduction into a wound or cavity either to explore its depth and direction, to discover the presence of foreign bodies, or to introduce medicinal substances.

PROCAINE is another name for novocain.

PROCIDENTIA is another term for prolapse.

PROCTITIS (πρωκτός, the anus) means inflammation situated about the rectum or anus.

PRODROMATA (πρόδρομος, running before) is a term applied to the earliest symptoms of a disease, or those which give warning of its presence. For example, vomiting and headache may be prodromata of scarlet fever.

PROFLAVINE is a valuable antiseptic. Its chemical description is 2 : 8—diaminoacridine sulphate. In a 0·1 per cent solution in isotonic saline it is one of the best antiseptics in brain surgery: most other antiseptics—for example, acriflavine—have a damaging effect on the brain.

PROGERIA (πρό, before; γῆρας, old age) is a term for premature old age. When the physical appearances of old age occur in children the condition is believed to be due to disease of the pituitary gland.

PROGESTERONE, $C_{21}H_{30}O_2$, is the hormone of the corpus luteum. After the escape of the ovum from the ruptured follicle, the corpus luteum secretes progesterone, which stimulates the growth and secretion of the endometrial glands during the fourteen days before menstruation. In the event of pregnancy, the secretion of progesterone continues until parturition. (*See also* PREGNANDIOL, MENSTRUATION.)

PROGLOTTIS is a term applied to the joint of a tape-worm.

PROGNOSIS (πρόγνωσις) is the term applied to a forecast as to the probable result of an attack of disease, particularly with regard to the prospect of recovery, based upon the nature and symptoms of the case.

PROGRESSIVE MUSCULAR ATROPHY (*see* PARALYSIS).

PROLACTIN is the name of the pituitary hormone which initiates lactation. The development of the breasts during pregnancy is ascribed to the action of œstrogens (*q.v.*). Prolactin starts them secreting. If lactation does not occur or fails, it may be started by injection of prolactin.

PROLAPSE (*prolabor*, I sink down) means slipping down of some organ or structure. The term is applied chiefly to downward displacements of the rectum and womb. When the lower end of the bowel prolapses each time the bowels move—a fairly frequent occurrence in children—it should be carefully sponged with cold water, replaced, and, if necessary, retained in place by a soft pad and bandage attached to a waist-belt. The condition tends to pass off as the child grows older. Prolapse which affects the

womb may, in the earlier stages, cause protrusion of a fold of the bowel or bladder through the vagina, and in the later stages the womb itself may protrude to the exterior. The condition, which affects elderly women, is mainly due to injuries caused by childbirth. It may often be remedied by wearing a suitably shaped pessary, or by an operation designed to unite the torn parts.

PROMANIDE, or PROMIN.—The former is the British and the latter the American proprietary term for a sulphonamide drug which has been successfully used in the treatment of superficial tuberculous infections; it has also been employed in the treatment of malaria.

PROMINAL is the proprietary term for a barbiturate used in epilepsy, and more effective in controlling fits than is luminal. The *British Pharmacopœia* name for prominal is PHEMITONE. Its chemical description is N-methyl-5-phenyl-5-ethylbarbituric acid.

PRONTOSIL (*see* SULPHANILAMIDE).

PROPAMIDINE.—An 'antiseptic' applied in the form of a jelly or a cream in the treatment of wounds and burns. It is chemically described as 4 : 4′-diamidinophenoxypropane dihydrochloride. The action of propamidine is bacteriostatic, an action it retains in the presence of pus; it does not prevent phagocytosis. It has been used in the local treatment of wounds, and is effective against the staphylococcus and highly effective against the streptococcus. As a 1 per cent solution it has been injected into infected joints and empyema cavities.

PROPHYLAXIS (*προφύλαξ*, an advanced guard) means treatment adopted with the view of warding off disease.

PROSTATE GLAND is a structure which lies at the neck of the bladder in men and surrounds that part of the urethra lying within the pelvis. This gland is of importance, especially because in late life it is apt to increase in size and change in shape in such a way as to obstruct the exit of water from the bladder. Accordingly, great difficulty in making water occurs, and the regular use of a catheter to draw it off may become a necessity. (*See* CATHETERS.) Inflammation of the bladder is very apt to be finally produced if great care be not taken in the purification and use of this instrument. (*See* BLADDER, DISEASES OF.) An enlarged gland may have to be removed by operation. Attempts have been made to treat prostatic enlargement by injections of the male sex hormone—testosterone.

PROSTHESIS (*πρός*, to; *θέσις*, placing) means replacing of an absent part by an artificial one, *e.g.* eye, leg, or denture.

PROSTIGMIN is an artificial substance chemically allied to physostigmine, which on injection produces contraction of muscles of more prolonged character than that caused by physostigmine. It is used chiefly as a remedy for myasthenia.

PROTARGOL is a preparation of silver with powerful astringent and antiseptic action. It is used in acute inflammations of mucous membranes as a lotion of strength 1 in 400 to 1 in 200.

PROTEIN, or PROTEID, is the term applied to members of a group of non-crystallisable nitrogenous substances widely distributed in the animal and vegetable kingdoms and forming the characteristic materials of their tissues and fluids. They are essentially combinations of amino-acids. They mostly dissolve in water and are coagulated by heat and various chemical substances. Typical examples of protein substances are white of egg and gelatin. (*See* ALBUMINS.)

PROTEIN SHOCK is a method of treatment by intramuscular or intravenous injection of protein material in large amount. Its object is to cause a reaction accompanied by moderate rise of temperature which produces stimulation of the general chemical processes of the body and of its absorptive and healing powers. Various protein substances are used for this purpose including 5 per cent peptone solution, sterilised milk, and bacterial vaccines in large doses. Somewhat similar effects are produced by injection of certain metallic salts. This method is used in

treatment of chronic diseases such as disseminated sclerosis and rheumatoid arthritis.

PROTEIN THERAPY.—This is a method of treatment by injection of small quantities of protein substances in the case of persons suffering from diseases due to their excessive sensitiveness to similar substances. Diseases in which this form of treatment appears to be specially useful include asthma, hay fever, nettle-rash, and similar skin affections, and some associated diseases of nervous origin, such as migraine, periodic vomiting, and periodic diarrhœa. In some cases these disorders are caused by taking as food various forms of meat, fish, eggs, etc., certain cereals, fruits, and vegetables, or even by inhalation of the dust or emanations from the fur and feathers of cats, rabbits, fowls, horses, etc., and especially the pollens of certain grasses and ragweeds. The offending material can frequently be discovered by steeping some of these substances in water and afterwards inoculating a drop of the substance into the skin of the arm by means of a scratch. If the person is ' sensitive ' to the substance under trial, a red area develops round the scratch in the course of a few minutes followed later by a definite wheal. Such an inoculation produces no effect on an ' insensitive ' person.

The patient who has been found sensitive to a particular animal or vegetable protein can either refrain from taking this in food or otherwise coming into contact with it, or he can be ' desensitised ' by receiving gradually increasing doses of the protein in question.

PROTO- (*πρῶτος*, first) is a prefix signifying first.

PROTOCOL is a term applied to a written statement of the history and treatment of a particular case, especially one made for medico-legal purposes.

PROTOPLASM (*πρῶτος*, first; *πλάσμα*, form) is a viscid, translucent, glue-like material containing fine granules and composed mainly of proteins, which makes up the essential material of plant and animal cells and has the properties of life.

PROUD FLESH is the popular name given to the unhealthy granulations which sometimes arise from an ulcer which is inflamed and is not healing properly, or from the margins of a sinus. It is checked by applying to it some astringent like nitrate of silver solution or copper sulphate.

PROXIMAL is a term of comparison applied to structures which are nearer the centre of the body or the median line as opposed to more ' distal ' structures.

PRUNE PASTE (*see* SENNA).

PRURIGO (*prurigo*) is the name of a chronic skin disease in which small whitish pimples develop in the skin accompanied by intense itching. The condition may either be permanent or may come and go, especially in children in association with teething.

PRURITUS (*prurio*, I itch) is another name for itching.

PRUSSIC ACID POISONING.—Prussic or hydrocyanic acid is a very deadly poison with a sweet smell and pleasant taste, paralysing every part of the nervous system with which it comes in contact. In its dilute state it is a valuable remedy for irritable conditions of internal mucous membranes, such as that of the stomach, and for irritable skin diseases, being used in small doses to check vomiting or cough, and applied in lotions to relieve itching. It exerts this curative action by numbing the sensory nerves with which it is brought in contact.

As a poison it acts with great rapidity, and, since cyanide of potassium is much used in the processes of electroplating and photography, and is almost as deadly in its effects as the acid, persons using the cyanide should be acquainted with the treatment which may be of avail to save life in a case of poisoning.

Symptoms.—After a large dose, the poison is very rapidly diffused through the body, and only a few minutes or seconds elapse before the symptoms appear. These are slowness of breathing, slowness and irregularity of the heart's action, and blueness of the face and lips. In a few minutes, insensibility with gradual stoppage of breathing and of the heart's action come on, preceded in some cases by convulsions.

Treatment. — The suddenness and character of the symptoms and the sweet smell of prussic acid on the breath make the cause evident. An emetic may be given, but as a rule there is no time for this. Inhalation of the fumes of ammonia is recommended, as also the application of faradic electricity over the region of the heart or the alternate application of hot and cold sponges to the front of the chest in order to stimulate the heart and respiration, combined with the employment of artificial respiration and friction to the limbs. (*See* DROWNING, RECOVERY FROM.)

PSAMMOMA (ψάμμος, sand) is the name given to a small hard tumor of the brain containing calcareous matter.

PSEUDO- (ψευδής, false) is a prefix put to the names of certain well-defined diseases to indicate other conditions whose symptoms closely resemble those of one of the diseases in question, though the real nature of the two maladies is quite different. For example, pseudo-angina means a form of dyspepsia in which the symptoms closely resemble those of the severe disease known as angina pectoris.

PSEUDOCRISIS is the term applied to a sudden abatement of febrile symptoms which is merely temporary, the symptoms subsequently returning.

PSEUDOCYESIS (ψευδής, false; κύησις, pregnancy) means spurious or false pregnancy which may be produced by the presence of a tumor or simply by flatulence occurring especially about the time of the menopause.

PSEUDOHYPERTROPHIC PARALYSIS is a condition in which certain muscles enlarge owing to a fatty and fibrous degeneration, giving a false appearance of increased strength. (*See* MUSCLES, DISEASES OF.)

PSILOSIS (ψιλός, bare) is another name for sprue.

PSITTACOSIS (ψιττακός, a parrot) is a contagious infection of parrots sometimes communicated to man and caused by a filter-passer.

PSOAS (ψόα, the loin) is the name of a powerful muscle which arises from the front of the vertebral column in the lumbar region, and passes down, round the pelvis and through the groin, to be attached to the inner side of the thigh-bone not far from its upper end. The act of sitting up from a recumbent posture, or that of bending the thigh on the abdomen, is mainly accomplished by the contraction of this muscle. Disease of the spine in the lumbar region is very apt to produce an abscess which lies within the sheath of this muscle and makes its way down to the front of the thigh, where it threatens to burst. Such an abscess is known as a 'psoas abscess'. (*See* ABSCESS, CHRONIC.)

PSORIASIS (ψώρα, scurf) is a disease of the skin in which raised, rough, reddened areas appear, covered with fine silvery scales. This eruption consists of a chronic inflammatory process in the true skin, the papillæ of which become considerably lengthened and more vascular than usual, together with changes in the cuticle which cause a defect in the horny formation that naturally takes place on the surface. (*See* SKIN.)

Causes.—The condition generally appears for the first time in childhood or youth, afterwards disappearing and reappearing from time to time. It is very often a family disease occurring in different generations of one stock, and is often associated with gout or rheumatism. In some persons, psoriasis appears repeatedly at a particular season of the year, especially in the spring and autumn, but it is not infectious. Depressing influences seem to have something to do with its appearance, and people who are liable to it are troubled by its reappearance at any time when the general health is below par.

Symptoms.—The eruption almost always appears first round the back of the elbows and front of the knees. It begins as small pimples, each covered with a white cap of scales, which enlarge in breadth till they form patches 2 or 3 inches wide. At the same time, patches appear on other parts of the body, the scalp and face especially. The disease is divided into several varieties according to the size, shape, and distribution of these patches.

Treatment.—It is essential first of

all to attend to the general health and relieve especially any constitutional condition, such as gout or rheumatism, by the appropriate remedies. The two chief remedies which are given internally for psoriasis are salicin and thyroid extract, while tar ointment, chrysarobin ointment, salicylic acid, and ammoniated mercury ointment are among the chief and most successful external applications. Generally the eruption disappears after some weeks of careful treatment, but occasionally cases occur in which all treatment seems of very little use. Arsenic is sometimes administered internally in very chronic cases.

PSYCHASTHENIA (*ψυχή*, mind; *ἀσθένεια*, weakness) is a condition in which the mind becomes temporarily weakened, the person a prey to anxieties and impulsive acts, the power of concentration poor, and the judgement capricious, without definite delusions or other signs of insanity. The condition is closely allied to neurasthenia and occurs especially in persons of neurotic temperament. (*See* NEURASTHENIA.)

PSYCHIATRY (*ψυχή*, mind; *ἰατρεία*, healing) is the name applied to that branch of medical science which treats of mental disorder and disease.

PSYCHO-ANALYSIS is a term strictly applied to the theories and practice of the Freudian school of psychology. It is often wrongly applied to medical psychology in general, of which there are various schools. It depends upon the theory that states of disordered mental health have been produced by a repression of painful memories or of conflicting instincts. By such repression these hurtful memories or instincts are kept constantly in a sub-conscious condition. As a result, the individual's mental power is needlessly occupied and diverted from the proper objects with which it should be concerned, and he finds difficulty in concentrating his attention upon and adapting himself to the practical realities of everyday life.

Psycho-analysis aims at discovering these repressed memories, which are responsible for the perversion of mental power and of which the affected person usually is only dimly or quite unaware. The fundamental aim of psycho-analysis as a method of treatment is the free expression of thoughts, ideas, and fantasies on the part of the patient. To facilitate this, he lies on a couch to relax mind and body, and the analyst may sit so as to observe the patient but not to be observed by him. The analyst's task is to adopt a neutral attitude to the patient, to encourage the free association of ideas, and to explain where explanation is necessary for the continuance of free association. The analyst will become a part of the patient's fantasies and represent in them from time to time objects of love and hate—especially members of the patient's family. In the course of analysis the patient will, so to speak, sink back into childhood and re-enact his early emotional attitudes, the analyst representing in this phase father, mother, or brother or sister. In this re-enactment various infantile emotional tensions are released, and relief of painful mental symptoms secured.

There is much that is highly speculative in the theories of psycho-analysis, but at the same time its fundamental conceptions have been widely adopted by other schools of psychology to their enrichment, and the new approaches to the study of the mind in health and disease opened up by the genius of Freud have entirely changed the attitude of the lay and the medical public to the problems of the neurotic, the morbidly anxious, the fearful, and the mental and emotional development of the child.

PSYCHOLOGY (*ψυχή*, mind; *λόγος*, discourse) is the branch of science that deals with the mind and its methods of working.

PSYCHONEUROSIS (*ψυχή*, mind; *νεῦρον*, nerve) is a general term applied to various functional disorders of the nervous system, with no ascertainable organic disease, and accompanied by a certain amount of mental impairment, *e.g.* hysteria, neurasthenia, psychasthenia, shell-shock, and states of marked anxiety, obsession, or forgetfulness, etc.

PSYCHOPATHIC (ψυχή, mind ; πάθος, suffering) means anything related to mental disease.

PSYCHOSIS (ψυχή, mind) is a term applied to serious disorder of the mind, which may amount to insanity.

PSYCHOTHERAPY (ψυχή, mind ; θεραπεία, healing) is the term applied to any form of treatment in disease which operates through the mind. Almost every form of disease or injury has a certain mental aspect even if this relates only to the pain or discomfort that it causes. In some diseases, and with some temperaments, the mental factor is much more pronounced than in others; and for such cases, psychic modes of treatment are particularly important. The chief methods employed in psychic or mental healing are the following:

Suggestion is the most commonly employed method. Indeed, it is used in almost every department of medicine. It may consist, in its simplest form, of a mere reiteration of the statement that the health is better, either by the medical attendant or by the patient, so that this idea becomes fixed in the patient's mind. Or a suggestion of efficacy to cure may be conveyed by the taste or other physical properties of a medicine or by the imposing appearance of some apparatus used in treatment. Again suggestion may be conveyed through an emotional channel, such as that of religious fervour. In occasional cases the result is secured when the suggestion is made to the patient in the hypnotic state.

Persuasion is a method of psychic treatment in which appeal is made to a patient's reasoning faculties. It presupposes a higher type of mind than that required for simple suggestion treatment.

Analysis consists in the elucidation of the half-conscious or subconscious repressed memories or instincts that are responsible for some cases of mental disorder. (*See* PSYCHO-ANALYSIS.)

Education and employment are important factors in mental treatment, and employment should be of a congenial character and one which the patient can carry out without great effort.

PTERYGIUM (πτερύγιον, wing) is the name applied to a patch of opaque tissue gradually extending over part of the clear cornea.

PTISAN (πτισάνη, barley) is another name for barley water.

PTOMAINE POISONING (πτῶμα, a dead body) is the general name that used to be applied to cases in which persons become seriously affected as the result of eating meat, fish, cheese, and other animal substances which have undergone some decomposition. These serious effects were thought to be due to the formation of animal alkaloids, known as ptomaines, in consequence of the action of bacteria upon the albuminous materials contained in the food. This view is no longer held, and so-called ptomaine poisoning is now regarded as an instance of poisoning by food contaminated either by living bacteria (especially of the *Salmonella* group) or by the toxins of bacteria. (*See* FOOD POISONING.)

PTOSIS (πτῶσις, a fall) means drooping of the upper eyelids. It is a sign of paralysis of the third cranial nerve, which governs the muscle that elevates the upper lid.

PTYALIN (πτύαλον, saliva) is the name of the ferment contained in the saliva, by which starchy materials are changed into sugar, and so prepared for absorption. (*See* DIGESTION.)

PUBERTY (*puber*, of ripe age) means the change that takes place when childhood passes into manhood or womanhood. This change is generally a very definite one, taking place at about the age of fourteen years, though it is modified by race, climate, luxurious habits, and bodily health, so that it may appear a year or two earlier or several years later. At this time, the sexual functions attain their full development, the contour of the body changes from a childish to a more rounded womanly, or sturdy manly form, and great changes take place in the mode of thought and feeling. About this time the larynx enlarges in boys, so that the voice, after going through a period of 'breaking', finally assumes the deep manly pitch. The hair on face and body takes on also a deeper and stronger growth, so that skin eruptions are not uncommon on the face. (*See* ACNE.)

The period is one of transition from a physical, mental, and moral point of view, and the pressure of physical and intellectual work should not be made too hard, care being rather taken that good habits and modes of thought are formed at this impressionable time.

Puberty is not to be regarded as a physiological 'coming of age', for full development and vigour are not attained till between twenty and thirty years of age.

PUBIS is the bone that forms the front part of the pelvis. The pubic bones of opposite sides meet in the 'symphysis' and protect the bladder from the front.

PUBLIC HEALTH (*see* SANITATION; *also* DISINFECTION, INFECTION, REFUSE AND SEWAGE DISPOSAL, VENTILATION; WATER-CLOSETS, DRAINS, AND SEWERS; WATER SUPPLY).

PUERPERAL FEVER (*puerperus*, bringing forth children), or CHILD-BED FEVER, was in former times the great dread of those whose duty it was to attend women in childbed, both in private practice and to a much greater extent in public hospitals.

Causes.—This fever is of various types and grades of severity. After the birth of a child, the mother is specially liable, for several reasons, to contract any infectious disease to which she may be exposed. In the first place, she is much weakened by the strain through which she has passed, and often by the loss of a great quantity of blood. In the second place, the injuries incidental to child-birth produce raw surfaces from which absorption occurs with great facility.

(For causation, *see under* LABOUR, PUERPERAL INFECTION.)

Symptoms.—The symptoms vary according to the form that the infection takes, and most commonly appear on the second or third day after labour, the first three days being regarded as the critical period in recovery. Thus the organisms may, in the mildest form, develop on the raw or wounded surface, to which they gain access without entering the system. In such a case, there are general discomfort and feverishness, rise of temperature and quickening of the pulse, but these symptoms disappear when the wound is cleansed by antiseptic douches and similar energetic measures.

When the organisms gain access to the surrounding lymphatic vessels and veins, inflammation in the cellular tissue of the pelvis results, and may be followed by abscesses, peritonitis, either localised or general (*see* PERITONITIS), or, later on, by the condition known as 'white leg', caused by blocking of the veins in one lower limb. In these conditions, which are less common, the symptoms are more severe. There are considerable fever, shivering, prostration, and quickening of the pulse as early signs, together with pain in the lower part of the abdomen, followed later on by the symptoms belonging to peritonitis, white leg, or other condition set up by the inflammation. The condition may be recovered from in a week or two, or long-continued ill-health may result, or the patient may speedily succumb.

If the organisms gain access to the general circulation, the serious condition known as 'septicæmia' results (*see* BLOOD-POISONING), and is accompanied by high fever, great prostration, delirium, and increasing feebleness of the heart's action. Recovery in this case is rare.

Treatment.—The prevention of the condition is of the greatest importance. For this reason, care in the choice of a lying-in room, great care to shield the patient from every risk of infection, and above all scrupulous cleanliness on the part of all the attendants, are necessary. (*See also* LABOUR, PUERPERAL INFECTION.)

Treatment resolves itself into careful nursing, drainage of the uterus, blood transfusion if hæmoglobin falls below 40 per cent, and administration of an appropriate sulphonamide drug. The recognition of the bacteria responsible for puerperal infection and the introduction of the sulphonamide drugs in treatment have gone a long way to remove the terrors of this grim attendant upon child-birth.

PUERPERAL PYREXIA is the name given to any febrile condition, other than 'puerperal fever', occurring in a woman within twenty-one days after childbirth or miscarriage in which a temperature of 100.4° Fahr. (38° C.) or more has been sustained during a

period of twenty-four hours or has recurred during that period. Any such feverish attack, as well as the more serious puerperal fever, must now be 'notified' in Great Britain to the local public health authority.

PUERPERIUM (*puerperium*) is the period which elapses after the birth of a child until the mother is again restored to her ordinary health. It is generally regarded as lasting for a month. One of the main changes that occur is the enormous decrease in size that takes place in the muscular wall of the womb. (*See* MUSCLE.) There are very often 'afterpains' during the first day in women who have borne several children, less frequently after a first child. (*See* AFTERPAINS.) The discharge is blood-stained for the first two or three days, then clearer till the end of the first week, after which it becomes thicker and less in quantity, finally disappearing altogether, if the case goes well, at the end of two or three weeks. The breasts, which have already enlarged before the birth of the child, secrete milk more copiously, and there should be a plentiful supply on the third day of the puerperium.

Treatment. — The patient should remain in bed for ten days. Among primitive peoples, childbirth causes little interference with the daily avocations, but the higher we proceed in civilisation the more care is necessary in the after-treatment, so that the period stated for rest in bed is not excessive. The patient may, after this, gradually get about as the strength permits, and can generally go out of doors during the third week. If care be not taken in the matter of rest, there is danger that the womb may become displaced, or may not undergo the proper diminution in size, leading to a degree of permanent ill-health.

Diet should consist of milk and starchy foods till the third day, after which a gradual return is made to normal diet. It is a common popular delusion that alcoholic liquors are necessary for a good formation of milk; but this is not the case. The bowels are generally sluggish, and it is usual to take an aperient, such as castor oil, on the second or third day.

Milk, as already stated, appears copiously on the third day. Sometimes there is a slight rise of temperature on the second or third day associated with its appearance. The child requires no food for the first three days after it is born, having stored up in its own body sufficient nutriment for that period. It should, however, be put to the breasts in order to obtain the small amount of fluid they are secreting, and also because suckling stimulates both the breasts and the natural changes taking place during this period. Suckling is beneficial therefore for both child and mother.

PULMONARY DISEASES (*pulmo*, a lung). (*See* LUNGS, DISEASES OF.)

PULSATION (*pulsatio*, a beating) or throbbing is an appearance seen or felt naturally below the fourth and fifth ribs on the left side, where the heart lies, and also at every point where an artery lies close beneath the surface. In other situations, it is generally a sign of aneurysm. In nervous persons great pulsation can often be seen and felt in the upper part of the abdomen, due to the throbbing of the abdominal aorta.

PULSE (*pulsus*, a blow).—If the point of one finger be laid gently on the front of the forearm, about one inch above the furrows that mark the wrist, and about half an inch from the outer edge, the pulsations of the radial artery can be felt. This is known as *the pulse*, but a pulse can be felt wherever an artery of large or medium size lies near the surface. (*See* HÆMORRHAGE.)

The cause of the pulsations lies in the fact that, at each heart-beat, from 4 to 6 ounces of blood are driven into the aorta, and a fluid wave, distending the vessels as it passes, is in consequence transmitted along the arteries all over the body. This pulsation gets less and less marked as the arteries grow smaller, and is finally lost in the minute capillaries, where a steady pressure is maintained. For this reason, the blood in the veins flows steadily on without any pulsation. Immediately after the wave has passed, the artery, by virtue of its great elasticity, regains its former size. In this wave, the physician has a valuable means of studying both the state of the artery as regards elasticity and the heart's action.

The pulse rate is usually about 72 per minute, but it may vary in health from 50 to 100, and is quicker in childhood and slower in old age than in middle life; it increases in all feverish states.

Further, the character of the vessel wall is of great importance. In childhood and youth, the vessel wall is so thin that, when sufficient pressure is made to expel the blood from it, the artery can no longer be felt. In old age, however, and in some degenerative diseases, the vessel wall becomes so thick that it may be felt like a piece of whipcord rolling beneath the finger. The extent to which this change has taken place gives the physician valuable information as to the existence of Bright's disease, the liability to apoplexy, etc.

The size of the column felt also gives information. For example, after great muscular exertion, or when the heart is beating strongly, the vessels of the limbs are full and the pulse is 'large', while, on the other hand, in the case of internal inflammations, the vessels of the limbs are empty, and the pulse therefore thin and 'wiry'.

Different types of heart disease have special features of the pulse associated with them. Thus, in auricular fibrillation the great character is irregularity, while in aortic disease the pulse tends to become rapid. In cases where the aortic valve is incompetent, the pulse has the peculiarity of rising very quickly and collapsing suddenly, suggesting the pulsation observed in the physical toy known as the water-hammer after which this type of pulse is named. In persons of habitually relaxed physique, or suffering from some weakening fever, the pulse is apt to become dicrotic. (*See* DICROTIC.)

It is only after long practice that the character of the pulse-wave can be readily appreciated by the finger, and a small instrument known as the 'sphygmograph' has been devised, whereby the artery is made to register these waves. The instrument consists essentially of a small pad connected with a fine writing point, and of a clockwork arrangement that drives a strip of smoked paper in front of the writing-point. A magnified pulse tracing is thus obtained of the movements of the arterial wall, and this sphygmogram presents typical characters in different diseases of the heart and blood-vessels. Another instrument known as the 'polygraph' enables tracings to be taken from different vessels at the same time. A tracing may thus be taken from the pulse at the wrist and from the veins in the neck and simultaneous events in the two compared. Much has been learned with regard to the action of the heart by this means, and particularly the condition known as auricular fibrillation has been studied in this way. (*See* HEART DISEASES.)

The pressure of the blood in various arteries is estimated by an instrument known as the 'sphygmomanometer'. (*See* BLOOD-PRESSURE.)

FIG. 385.—Pulse tracing, taken by the sphygmograph on smoked paper, from a case of auricular fibrillation in disease of the mitral valve. The pulse shows considerable irregularity. (Balfour's *Diseases of the Heart.*)

FIG. 386.—Pulse tracing from a case of incompetence of the aortic valve, showing the great extent to which the artery fills at each beat and empties between the beats. (Balfour's *Diseases of the Heart.*)

PUNCTUM (*punctum*, point) is the term applied to a minute spot or puncture, especially to the lacrimal punctures near the inner end of the upper and lower eyelids. (*See* EYE.)

PUPIL (*pupilla*) is the opening in the centre of the iris through which rays of light pass into the eye. (*See* EYE.)

PURGATIVES (*purgo*, I cleanse) are drugs or other measures which produce evacuation of the bowels.

Varieties and action.—Purgatives are divided into several groups, according to the manner and degree of violence with which they act.

LAXATIVES are those which very gently stimulate the bowels and render the motions slightly more frequent and softer without causing any griping. Most articles of food that leave a large indigestible residue upon which the intestine can contract, such as cabbage. brown bread, and oatmeal porridge, act in this way. Those fruits which contain rough seeds, sugar, and vegetable acids act similarly. Among the laxatives are honey, tamarinds, figs, raspberries, strawberries, prunes, stewed apples, sulphur and magnesia. Liquid paraffin also produces this effect.

SIMPLE PURGATIVES or APERIENTS produce one or more copious and slightly liquid movements, often accompanied or preceded by griping pains. Examples of this class are aloes, rhubarb, cascara sagrada, senna, castor oil.

DRASTIC PURGATIVES cause a violent action of the bowels, accompanied by considerable griping. In small doses many of them have a simple aperient action, while in excessive doses most are irritant poisons. Such are elaterium, colocynth, jalap, scammony, croton oil. Many of these produce very copious watery evacuations, and, since they remove a considerable quantity of water from the system, are known as *hydragogues*.

SALINE PURGATIVES are salts of the alkaline metals and alkaline earths. Such are sulphate of potassium, sulphate of sodium (Glauber's salt), sulphate of magnesium (Epsom salts), phosphate of sodium, bi-tartrate of potassium (cream of tartar), tartrate of potassium and sodium (Seidlitz powder), and citrate of magnesium. Taken in large doses, many of these salines also act as hydragogues.

CHOLAGOGUE PURGATIVES are those which, in addition to stimulating the bowels, increase the flow of bile. (*See* CHOLAGOGUES.) Examples of these are the mercurial preparations (such as blue pill, calomel, and grey powder), euonymin, and podophyllin.

Purgatives produce their effects either by stimulating the mucous membrane so that the amount of fluid in the intestine becomes larger, or by stimulating the muscular coat so that peristaltic contractions become more vigorous. Most purgatives have the double action, though one or other preponderates. Further, certain purgatives act all along the intestine, such as Epsom salts or castor oil, while others, such as cascara, are almost devoid of action until they reach the large intestine.

Uses.—The most common use of purgatives is to remove the contents of the bowels when their action is sluggish. (*See* CONSTIPATION.) In many cases of diarrhœa, due to the presence of irritating material in the intestine, a single dose of purgative medicine, such as castor oil, is given with the object of getting rid of the offending material, after which the diarrhœa ceases. In cases of dropsy due to heart or kidney disease, a hydragogue purgative, by removing fluid from the body, helps to diminish the dropsy. In cases of inflammation affecting the bowels, such as appendicitis and peritonitis, saline purgatives are often given with the view of diminishing the congestion in the bowel-wall. In plethoric persons or persons for whom any strain may be harmful, such as in cases of threatened apoplexy, and in persons suffering from hernia, or aneurysm, purgatives are given to reduce the general blood-pressure or to prevent straining at stool.

A protest must be entered here against the common domestic practice of administering purgatives on every occasion of slight illness, especially in children, regardless of the complaint or symptoms. Undoubtedly many cases of malaise are due simply to constipation; but care must be taken that no serious trouble is present, for many persons have undoubtedly died through receiving only

an aperient, whom timely medical aid might have saved. (*See* ABDOMEN, DISEASES OF.)

PURPURA (*purpura*, purple) is a disease characterised by the occurrence of purple-coloured spots upon the surface of the body, due to extravasations of blood in the skin, associated occasionally with hæmorrhages from mucous membranes. In persons suffering from such diseases as scurvy, rheumatism, phthisis, heart disease, cancer, Bright's disease, jaundice, as well as from certain of the infectious fevers, extravasations of the kind above mentioned are not infrequently present. But the term 'purpura' is, strictly speaking, applicable only to those instances where the symptoms exist apart from any antecedent disease.

Causes.—The view most commonly held is that the disease depends on an abnormal fragility of the minute blood-vessels owing to their malnutrition. It would seem sometimes to arise in persons enjoying perfect health; but in a large proportion of instances it shows itself among those who have been exposed to privation or insanitary conditions, or whose health has become lowered. Young persons suffer more frequently than adults, and repeated attacks may occur. Very often an attack of purpura is associated with rheumatic pains in the limbs.

Symptoms.—The complaint is usually ushered in by lassitude and feverishness. This is soon followed by the appearance on the surface of the body of the characteristic spots in the form of small red points scattered over the skin of the limbs and trunk. They are not raised above the surface, and they do not disappear on pressure. Their colour soon becomes deep purple or nearly black; but after a few days they undergo the changes which are observed in the case of an ordinary bruise, passing to a green and yellow hue and finally disappearing. When of minute size they are termed 'petechiæ' or 'stigmata', when somewhat larger, 'vibices', and when in patches of considerable size, 'ecchymoses'. They may come out in fresh crops over a lengthened period.

The form of the disease above described is that known as 'purpura simplex'. A more serious form of the malady is that to which the term 'purpura hæmorrhagica' is applied. Here there is a tendency to the occurrence of hæmorrhage from mucous surfaces, especially from the nose, but also from the mouth, lungs, stomach, bowels, kidneys, etc., sometimes in large and dangerous amount. Great physical prostration is apt to attend this form of the disease, and a fatal result sometimes follows the successive hæmorrhages, or is suddenly precipitated by the occurrence of an extravasation of blood into the brain.

Treatment will bear reference to any causes which may be discovered as associated with the onset of the disease, such as unfavourable hygienic conditions, and nutritive defects should be rectified by suitable diet. The various preparations of iron seem to be the best medicinal remedies in this ailment. The injection of serum has an effect in checking hæmorrhages; either horse serum or hæmoplastic serum may be used.

PUS (*pus*), or MATTER, is a thick, white, yellow, or greenish fluid, which is found in abscesses, on ulcers, and on in-

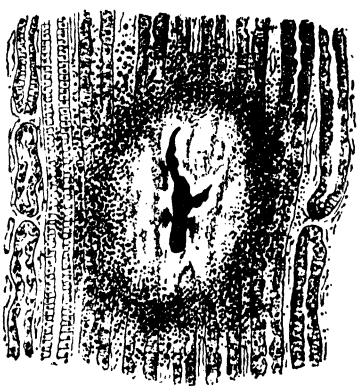


FIG. 387.—Small abscess in the kidney showing the formation of pus. In the centre is a mass of bacteria; round it is an area of dead tissue; at the margin of this the surrounding tissues are infiltrated with white corpuscles from the blood. Magnified by 162. (Thoma's *Pathology*.)

flamed and discharging surfaces generally. Its colour and consistence are due to the presence, in great numbers, of pus corpuscles. These are derived mostly

from the white corpuscles of the blood, and consist also of the superficial cells of granulation tissue or of a mucous membrane which die and are shed off in consequence of the inflammatory process. (*See* ABSCESS, PHAGOCYTOSIS.)

PUSTULE (*pustula*) means a small collection of pus. (*See* ABSCESS.) Malignant pustule is one of the forms taken by woolsorters' disease. (*See* ANTHRAX.)

PUTREFACTION (*putrefacio*, I make rotten) is the change that takes place in the bodies of plants and animals after death, whereby they are ultimately reduced to carbonic acid gas, ammonia, and other simple substances. The change is almost entirely due to the action of bacteria, and, in the course of the process, various offensive and poisonous intermediate substances are formed. In the case of the human body, putrescine, cadaverine, and other alkaloids are among these intermediate products.

The first sign of putrefaction is the appearance of a greenish tinge over the lower part of the abdomen, visible on the second or third day after death. This is not to be confused with the lividity seen on the back, due to the blood running down into the dependent parts, which is visible within eight or twelve hours. In from two to three weeks the body is greenish-brown throughout, the skin commencing to give way, and the features almost unrecognisable. By the end of one year, none of the organs is recognisable, and, according to Reinhard, bodies buried in gravel or sandy soil have, after the lapse of four to seven years, lost all trace of the soft parts, the bones alone remaining.

When bodies decompose in water, particularly that drained from peaty soil, the skin becomes white and sodden and the changes take place more slowly. Sometimes, in these circumstances, instead of going through the usual changes, the body undergoes a process of saponification, and the tissues are converted into a mixture of soaps, fatty acids, and volatile substances known as *adipocere*. This does not readily undergo further changes, and so bodies lying in ponds or damp graves may become changed in the course of some months or years into this wax-like substance, after which they may be preserved with the smallest details of feature for many years.

Mummification may prevent putrefaction in the dry air of deserts, and even in the case of a body lying in a strong draught of air these changes may be indefinitely postponed by gradual drying. A similar result has been known to occur in the bodies of persons who have taken antimony for a long period prior to death, the antimony deposited all through the body acting as an antiseptic.

PUTRID FEVER (*puter*, rotten) is an old name for typhus fever.

PYÆMIA (πύον, pus; αἷμα, blood) means a form of blood-poisoning in which abscesses appear in various parts of the body. (*See* BLOOD-POISONING.)

PYELECTAN is a proprietary term for IODOXYL, the *British Pharmacopœia* name for the original preparation, UROSELECTAN B (*q.v.*).

PYELITIS (πύελος, a vessel) means a condition of suppuration in the kidney producing pus in the urine. It is due to inflammation of that part of the kidney known as the pelvis, which is connected with the ureter. The inflammation may spread upwards from the bladder or may follow on febrile diseases in which bacteria leave the body by the urine. One of the commonest organisms productive of this condition is the *Bacillus coli* which produces a highly acid state of the urine accompanied by the presence of pus. Pyelitis usually occurs along with inflammation of the bladder (cystitis), and there are generally symptoms of feverishness, general malaise, loss of weight, discomfort in the region of the loins, and frequency in passing water. In some cases the kidney also becomes inflamed, tender, and enlarged. Treatment of this condition has always been difficult. Large doses of alkalies have been given. Next, a ketogenic diet had some success: ketosis was produced by giving the patient a high-fat and low-carbohydrate diet. Better results were obtained from the administration of mandelic acid; and, lastly, sulphanilamide was found to put the *Bacillus*

coli out of action. The condition, though not producing violent symptoms of illness, is often very protracted.

PYKNOLEPSY is the term applied to a type of epilepsy in which the only manifestation is a sudden and temporary loss of consciousness. There are no convulsions and the attacks tend to disappear in time.

PYLEPHLEBITIS (πύλη, gate; φλέψ, vein) means inflammation of the portal vein. It usually results from disease in the intestine and is part of a general blood-poisoning.

PYLOROSPASM means spasm of the pyloric portion of the stomach. This interferes with the passage of food in a normal, gentle fashion into the intestine and causes the pain that comes on from half an hour to three hours after meals and is associated with severe disorders of digestion. It is very frequently produced by an ulcer of the stomach or duodenum.

PYLORUS (πυλωρός, gate-keeper) means the lower or right opening of the stomach, through which the softened and partially digested food passes into the small intestine.

PYLUMBRIN (*see* UROSELECTAN B).

PYO- (πύον, pus) is a prefix attached to the name of various diseases to indicate cases in which an abscess forms, such as pyo-nephritis.

PYOGENIC (πύον, pus; γεννάω, I produce) is a term applied to those bacteria which cause the formation of pus and so lead to the formation of abscesses. Though many bacteria have this property, the most common cause of abscess is one of the rounded forms of bacterium (micrococcus).

PYORRHŒA (πύον, pus; ῥέω, I flow) is the name given to any copious discharge of pus. For *Pyorrhœa alveolaris* see under TEETH, DISEASES OF.

PYRAMIDON, or AMIDOPYRIN, is a whitish-yellow crystalline powder of antipyretic and analgesic properties related to antipyrine. It was much used for neuralgia and sciatica, but the risk of the severe blood condition known as agranulocytosis (a pronounced drop in the number of the granular white blood cells) has discouraged its use.

PYRETOTHERAPY is the term applied to the treatment of disease by raising the temperature of the body above normal.

PYREXIA (πυρέσσω, I am fevered) means fever. (*See* FEVER.)

PYRIDINE is an alkaloidal substance derived from coal-tar, tobacco, etc. It is used for the relief of asthma and similar conditions and is also added to methylated spirit in order to render this undrinkable.

PYRIDOXINE is the term now given to vitamin B6, also known as ADERMIN. Rats on a diet deficient in this vitamin develop a condition closely resembling PINK DISEASE in children (*see* ERYTHRŒDEMA). The rats so deprived also develop epileptic fits. It is not clear what part this vitamin plays in the human economy.

PYRO- (πῦρ, fire) is a prefix meaning anything connected with fire or produced by heating.

PYROGALLIC ACID is a substance derived from gallic acid and much used in the treatment of parasitic skin diseases. It has the disadvantage of staining the skin a deep brown colour.

PYROSIS (πύρωσις, heat), or WATERBRASH, is a symptom of dyspepsia consisting of an irritable, burning pain in the throat, accompanied by the constant secretion of mouthfuls of saliva (*See* DYSPEPSIA.)

PYROXYLIN is another name for gun-cotton, which is used for producing collodion. (*See* COLLODION.)

PYURIA (πύον, pus; οὖρον, urine) means the presence of pus in the urine, in consequence of inflammation situated in the kidney, bladder, or other part of the urinary tract. (*See* URINE.)

Q

QUADRICEPS is the name of the large four-headed muscle occupying the front and sides of the thigh, which straightens the leg at the knee-joint and maintains the body in an upright position.

QUADRIPLEGIA means paralysis of the four limbs of the body.

QUARANTINE (Ital. *quaranta*, forty) means that principle of preventing the spread of infectious disease by which persons, baggage, merchandise, etc., likely to be infected or coming from an infected locality are isolated at frontiers or ports till their harmlessness has been proved to the satisfaction of the authorities. (*See* INFECTION.)

Originally quarantine, as its name implies, involved detention for forty days; but, as this proved intolerable for persons engaged in business, the time of detention is now calculated so as simply to cover the incubation period of the disease whose presence is suspected.

Numerous international conferences upon the subject, notably one at Dresden in 1893, and one at Venice in 1897, have been held with the view of arriving at a uniform practice as regards quarantine in different countries. The diseases to which quarantine especially applies are cholera, yellow fever, and plague, and though Great Britain does not rely upon quarantine to prevent outbreaks of these diseases, this country has acquiesced to a certain extent in quarantine regulations for these diseases out of deference to the Continental countries.

The general practice with regard to quarantine is that when a serious disease breaks out in any country, the government of that country notifies surrounding governments as to the ports and other places that have become centres of infection. Any persons travelling from these centres and attempting to enter another country, are detained long enough to see whether they will take the disease or not, and in this interval their clothes, baggage, and other effects are disinfected.

QUARTAN AGUE (*quartus*, the fourth) is that form of malaria which returns after intermissions of two days, *i.e.* every fourth day. (*See* MALARIA.)

QUASSIA is the wood of *Picræna excelsa*, a large West Indian tree. Its virtues depend upon the presence of an active principle, quassin, which is excessively bitter and also irritating. The various preparations of the wood are mainly used as a bitter tonic. (*See* BITTERS.) An infusion made by adding 1 or 2 ounces of quassia chips to a pint of warm water is very useful when employed as an injection into the bowel for expelling thread-worms.

QUICKENING (*see* PREGNANCY).

QUILLAIA is the bark of *Quillaia saponaria*, or soap-bark, a South American tree. Tincture of quillaia is used in cases of bronchitis, pleurisy, and for making emulsions, in doses of about 1 dram.

QUINIDINE is an alkaloid obtained from cinchona bark and closely related in chemical composition and in action to quinine. It is commonly used in the form of quinidine sulphate in doses of 3 to 10 grains. It has been found more useful than quinine in the treatment of certain cases of chronic malaria, and it has been used in the treatment of cardiac irregularity due to the condition of auricular fibrillation, being particularly useful in cases of the latter condition of recent onset.

QUININE is an alkaloid obtained from the bark of various species of cinchona trees. This bark is mainly derived from Peru and neighbouring parts of South America, and for its introduction see MALARIA. Other alkaloids and acid substances are also derived from cinchona bark, such as quinidine and cinchonine, but these closely resemble quinine in action.

Quinine is generally used in the form of one of its salts, such as the sulphate of quinine, hydrochloride of quinine, or tannate of quinine. All are sparingly soluble in water, much more so when taken along with an acid.

Action.—Quinine lessens the activity of lowly forms of life, and to bacteria it is very deadly. It is therefore, when dissolved in acidulated water, a powerful

antiseptic, stronger even against some bacteria than carbolic acid. Its best-known action is as an ' antiperiodic ' in checking the recurrence of attacks of malarial fever, and this action it exerts in all probability by virtue of its destructive power against the malarial parasite in the blood. In fevers it acts as an ' antipyretic ', having a powerful action in reducing temperature, and it also diminishes the tendency to abscess formation by rendering the movements of the white blood corpuscles more sluggish.

In small doses it has a stimulating effect upon the stomach, though larger doses are capable of acting upon an irritable stomach to produce great nausea and vomiting. For persons affected in this manner it is said that the bisulphate or the tannate is much less irritating than the more commonly used sulphate of quinine.

Small doses have also a stimulating action upon the nervous system and a general tonic effect, while large doses cause decided depression of the respiration and the heart's action.

Among the other unpleasant effects, due to large doses, are ringing in the ears, temporary impairment of vision, and sometimes irritation of the kidneys: all these pass off when the drug is discontinued.

Uses. — The most marked use of quinine is its original one in malaria, attacks of which it quickly cuts short or prevents altogether. (*See* MALARIA.) It is not useful, however, in the chronic malarial state. In fevers it is generally held that sulphate of quinine is among the safest antipyretic drugs, in doses of 5 or 10 grains, but caution is necessary in giving even quinine when the heart's action is already feeble. Ammoniated liquor of quinine given in teaspoonful doses in water is a favourite household remedy in feverish colds and other mild febrile attacks. Black-water fever has by some been attributed to the excessive use of quinine in severe cases of malaria. Tannate is a less bitter form used for children. Urea quinine is often employed as a local anæsthetic with a prolonged effect. For hypodermic injection, when this is necessary in cases of malaria, a soluble form of quinine, the dihydrochloride, is used in doses of 5 to 10 grains.

As a tonic, minute doses of quinine are much used. For example, a single grain of quinine is often given after meals, or it is more commonly combined with other tonics, as in the citrate of iron and quinine, or in syrup of the phosphate of iron with quinine and strychnine.

QUINSY is a corruption of *cynanché* (κυνάγκη), and is an old name for acute tonsillitis, especially that form in which a tonsillar abscess forms. (*See* TONSILLITIS.)

QUOTIDIAN AGUE (*quotidie*, daily) means a type of malaria in which the attack recurs daily. (*See* MALARIA.)

R

RABIES (*rabies*, madness) is the name given in animals to the disease known as hydrophobia in man. (*See* HYDROPHOBIA.)

RACHIANÆSTHESIA is the term applied to the method of producing anæsthesia of a part of the body by the injection of various anæsthetic drugs into the space round the spinal cord.

RACHITIS (ῥάχις, the spine) is another name for rickets. (*See* RICKETS.)

RADIATION, or RADIOTHERAPY, is the term applied to treatment by radium, or other radio-active matter, or by sunlight. (*See* LIGHT TREATMENT.)

RADICULITIS is the term applied to the condition in which the root or roots of a spinal nerve is or are inflamed.

RADIOSTOL is a substance produced by the action of ultra-violet light upon ergosterol, and contains a large amount of Vitamin D.

RADIUM AND ITS ALLIES.—Radium is the most active of these bodies, and from its source, pitchblende, are got most of the others, viz. actinum, polonium, uranium, and thorium. Radiations consist of: (1) α-rays, which are positively charged helium nuclei; (2) β-rays, negatively charged electrons; (3) γ-rays, similar to X-rays but of shorter wave-length. A radium atom 'explodes' after about 1600 years, turning into the gas radon. After a succession of changes, the permanent form of lead is arrived at.

Radium emanation is a gas which is given off slowly from solutions of radium salts. If a little bromide or chloride of radium be placed in a closed flask, this in the course of some days becomes filled with a radio-active gas which can be drawn off by an air-pump and filled into glass tubes or dissolved in water. This gas or emanation possesses the power to give off rays like radium itself, but it very quickly wastes, and in four days has only half its original strength. As the radium requires about the same time to produce a fresh quantity of emanation, and as the supply is practically inexhaustible, a few milligrams of radium can be used to produce a constant supply of emanation, which is removed by the air-pump every few days.

Treatment by radium.—Radium salts are applied enclosed in various forms of applicator, most commonly a thin tube or plaque enclosed within a capsule of aluminium or platinum. External screens are made to enclose these fine tubes, serving the double purpose of filtration of the less penetrating rays, and strengthening the applicators against damage when inserted into a tumor.

At first the use of radium was limited to the treatment of superficial conditions like rodent ulcer, lupus, nævus, in which it sometimes effected brilliant cures. In recent years radium therapy has been slowly placed upon a sound foundation. Careful and laborious experimental work at many centres throughout the world has established firmly the place of radium in the treatment of malignant growths, particularly those situated within the body and which, through their proximity to an external opening are suitable for the insertion of radium in tubes. In a number of hitherto intractable forms of cancer, radium is used in preference to operation; more frequently it is used in conjunction with surgery. The combination of the two gives a better chance to the patient of a recovery from the disease.

Radium is also used for the destruction of tumors which by reason of their size or position cannot be removed by surgical means; capsules of radium are then buried in openings at various points of the tumor. The tumor cells, thus exposed to a cross fire of the rays, degenerate, and the tumor decreases in size, the capsules of radium being removed after acting for some hours or days. These capsules are also very suitable for application to internal cavities like the womb, where the X-rays could not come into play. Radium is, in some cases, applied as a preliminary to operation, and the tumor being then reduced in size can be more easily and completely removed.

Neither X-rays nor radium supersedes

active surgical measures when these are easily available for the complete removal of a tumor.

Where a very large quantity of radium is available, the method is sometimes adopted of enclosing this in a heavy lead box with a window, before which patients are successively exposed at a distance of some feet. The radium exerts a selectively destructive action on cancer cells while being less harmful to the normal tissues. Great care is necessary both to avoid giving too prolonged exposure to the patient and to prevent attendants from coming into repeated contact with the rays.

RADIUS is the outer of the two bones in the forearm. (*See* BONE.)

RAG-SORTERS' DISEASE is another name for anthrax. (*See* ANTHRAX.)

RAILWAY SPINE (*see* NEURASTHENIA, *and* SPINE, DISEASES OF).

RANULA (*ranula*, a little frog) is the name given to a swelling which occasionally appears beneath the tongue, caused by a collection of saliva in the distended duct of a salivary gland. (*See* MOUTH, DISEASES OF.)

RAPHE (ῥαφή, seam) means a ridge or furrow between the halves of an organ.

RAREFACTION is the term applied to the diminution in the density of a bone as a result of withdrawal of calcium salts from it.

RASH (*see* ERUPTION).

RAT-BITE FEVER is an infectious disease following the bite of a rat. It has an incubation period of about two weeks, followed by a reddish rash, fever, and muscular pains, and it usually passes off in two or three weeks.

RAY-FUNGUS is the organism that causes woody-tongue. (*See* ACTINOMYCOSIS.)

RAYNAUD'S DISEASE is a condition in which the circulation becomes suddenly obstructed in outlying parts of the body. It is supposed to be due to spasm of the smaller arteries in the part affected, as the result of nervous influences, and its effects are increased both by cold and by various diseases affecting the blood-vessels.

Symptoms.—The condition is most commonly confined to the occurrence of 'dead fingers', the fingers, or the toes, ears, or nose becoming white, numb, and waxy-looking. The circulation is often so much reduced that the part does not bleed if pricked or cut. This condition may last for some minutes, or may not pass off for several hours, or even for a day or two. Persons affected in this way are often of a decidedly nervous temperament, and suffer from 'bilious attacks' and other nervous disturbances.

In a more severe type, which depends apparently upon irregular contractions of the veins as well as of the arteries, periodic attacks come on in a similar manner, but the fingers and other parts affected, instead of being cold and white, are swollen, purple, and tingling.

In a third form, which is fortunately rare, after repeated attacks of one of the other forms, the circulation becomes so much cut off that the part dies and a localised gangrene results.

Treatment.—Massage and friction of the affected part often relieve the attack very speedily. The application of electricity has also been highly recommended. Persons who are subject to these attacks should be careful in winter to protect the feet and hands from cold, and should always use warm water when washing the hands.

RECTUM (*rectus*, straight) is the last part of the large intestine. It pursues a more or less straight course downwards through the cavity of the pelvis, lying against the sacrum at the back of this cavity. This section of the intestine is about 9 inches long. Its first part is freely movable, and corresponds to the upper three pieces of the sacrum, the second part corresponds to the lower two pieces of the sacrum and the coccyx, while the third part, known also as the anal canal, is about 1 inch long, runs downwards and backwards, and is kept tightly closed by the internal and external sphincter muscles which surround it. The opening to the exterior is known as the 'anus'. The structure of the rectum is similar to that of the rest of the intestine. (*See* INTESTINE.)

RECTUM, DISEASES OF.—Owing to the fact that this part of the intestine is more exposed to external influences than the rest of the bowels, and that it forms the place of lodgment of the stools prior to the evacuation of the bowels, and is therefore often subject to considerable irritation, the rectum is specially liable to various diseases.

Peculiarities of the motions are treated under STOOLS, while PILES and FISTULA are described under these headings. DIARRHŒA and CONSTIPATION are also treated separately.

ABSENCE OF AN OPENING may occur in newly born children, and, unless the condition be relieved by operation within a few days, the child dies.

ITCHING at the anal opening is often very troublesome. It may be due to slight abrasions, the presence of thread-worms, piles, and sometimes sexual irregularities. It is to be treated by the remedies suitable for piles if there be any congestion present, and especially if the condition gets worse after any stimulants, and when the sufferer begins to get warm in bed. (*See* PILES.) All stimulants, mustard, and pepper must be avoided in the diet. After evacuation of the bowels, the part should be washed with water and no paper used; a soothing lotion, such as calamine lotion, Goulard's water, or carbolic lotion may be applied night and morning, or an ointment of oxide of zinc or adrenalin.

PAIN of an acute cutting character, at stool, is often due to the presence of a small ulcer or 'fissure', which, owing to movements of the sphincter, will not heal; it is treated by rubbing the ulcer with a caustic point or injecting into it an analgesic of prolonged action. The pain soon disappears. Pain of an aching nature is not uncommonly caused by the presence of piles.

ULCERATION may occur here in the course of tuberculous disease of the bowels, in dysentery, or even as the result of the constant irritation due to long-continued constipation. Ulcers in this locality cause a discharge of matter and frequently streaks of blood mixed with the motions. If the ulcer last a long time, it may lead to narrowing and obstruction of the bowel.

ABSCESS in the cellular tissue at the side of the rectum, known from its position as an ischio-rectal abscess, is fairly frequent. It often arises at a late stage in the course of consumption, and is a serious sign with regard to hope of ultimate cure of the disease. It may also arise, like an abscess elsewhere, as the result of injury, exposure to cold, and other debilitating influences. In any case it is likely to produce a fistula. (*See* FISTULA.)

PROLAPSE or protrusion of the bowel is a very common complaint, particularly in weakly children. In slight cases, where a ring of bright red mucous membrane half an inch or an inch in width protrudes as the result of straining at stool, the condition is generally easily curable by care. Any irritable condition of the bowels due to diarrhœa, constipation, worms, etc., must be removed and the evacuations regulated by diet and laxatives, so as to avoid all straining. Each time the bowels move, the protruded portion must be returned by steady pressure with a cloth or sponge wrung out of cold water. If the bowel comes down when the child runs about, the wearing of a suitable pad is necessary and the child must lie down for some time each day. Various astringent injections are also used, and the general health is attended to by tonics and other suitable treatment. When the protruded part is very large and the condition does not yield to simple treatment it can be remedied by operation.

TUMORS of small size situated on the skin near the opening of the bowel, and consisting of nodules, tags of skin, cauliflower-like excrescences, etc., are very common, and may give rise to pain, itching, watery discharges, etc. These are easily removed if necessary. Polypus occasionally develops within the rectum, and may give rise to no pain, though it causes frequent discharges of blood. Like a polypus elsewhere, it may often be removed by a very slight operation.

CANCER of the rectum is fairly common, this part of the bowel being one of the chief sites of this disease. It is a disease of later life, seldom affecting young people, and its appearance is generally insidious. The tumor begins commonly in the mucous membrane, its structure resembling that of the glands with which the membrane is furnished, and it quickly infiltrates the other coats of the intestine and then invades neighbouring organs. Secondary growths in

most cases occur soon in the lymphatic glands within the abdomen and in the liver. The symptoms appear gradually and consist of diarrhœa, alternating with attacks of constipation, and, later on, discharges of blood or of thin blood-stained fluid from the bowels, together with increasing thinness and weakness, and pains about the lower part of the back and down the thighs. Upon examination, the tumor can be felt projecting from one side or in a ring-form into the interior of the bowel. These cases are usually far advanced before they give rise to much disturbance, and little can be done by way of cure. In early cases, and especially when the cancer affects the back wall of the bowel, it can sometimes be completely excised, a part of the sacral bone being removed for this purpose. More frequently the most that can be done usefully by the surgeon consists in 'inguinal colostomy', an operation by which an artificial opening is made into the bowel in the left groin, so that the stools are discharged at this point and are prevented from passing over and irritating the tumor. By the latter operation, life is often prolonged for years and much suffering prevented.

RECURRENT LARYNGEAL NERVE is a branch of the vagus nerve which leaves the latter low down in its course, and, hooking round the right subclavian artery on the right side and round the arch of the aorta on the left, runs up again into the neck, where it enters the larynx and supplies branches to the muscles which control the vocal cords. The importance of this nerve consists in the fact that it is apt in this long course to be pressed upon, especially when aneurysm of the aorta or right subclavian artery is present, and thus defects of vocalisation may point to disease situated within the chest.

RED GUM is the popular name for a red rash that often appears in children about teething-time, generally associated with diarrhœa. It is treated by care in dieting.

The term is also applied to the gum of the eucalyptus tree, which has astringent properties and is much used in throat pastilles.

RED LOTION is a lotion containing sulphate of zinc, compound tincture of lavender, which gives it a red colour, and water. It is used as an astringent application to ulcers.

REDUPLICATION is a term applied to a peculiarity in the heart-sounds as heard by auscultation. It is probably due to the fact that the two sides of the heart are not acting quite simultaneously, and is found in certain diseases of the heart, such as obstruction at the mitral valve.

REDUX (*redux*, returned) is a term applied to the reappearance of certain signs or symptoms which are absent at the height of a disease, and whose reappearance indicates that the disease is passing off. Such are 'redux crepitations' at the end of pneumonia.

REFLEX ACTION is one of the simplest forms of activity of the nervous system. For the mechanism upon which it depends, see NERVES. Reflex acts are divided usually into three classes. *Superficial reflexes* comprise the sudden movements which result when the skin is brushed or pricked, such as the movement of the toes that results from stroking the sole of the foot. *Deep reflexes* depend upon the state of mild contraction in which muscles are constantly maintained when at rest, and are obtained, as in the case of the knee-jerks, by sharply tapping the tendon of the muscle in question. *Visceral reflexes* are those connected with various organs, such as the narrowing of the pupil when a bright light is directed upon the eye, the contraction of the bladder when distended by urine, etc.

Faults in these reflexes, both in the direction of excess and of diminution, give valuable evidence as to the presence of nervous diseases and the part of the nervous system in which such disease is situated. Thus, absence of the knee-jerk, when the patellar tendon is tapped, means some interference with the sensory nerve, nerve-cells, or motor nerve upon which the act depends, as, for example, in locomotor ataxia, infantile paralysis, or peripheral neuritis, while an excessive jerk implies that the controlling influence exerted by the brain upon this reflex mechanism has been cut

of, as, for example, by a tumor high up in the spinal cord, or in the disease known as disseminated sclerosis.

The condition of the plantar reflex obtained by stroking the skin of the foot sole is regarded as an important point in diagnosing organic disease of the nervous system. The ordinary reflex and the reflex obtained in slighter functional disorders of the nervous system consists in bending downwards of the toes towards the sole; while in serious organic disease of the higher parts of the nervous system the great toe tends to bend upwards with spreading out of the other toes, as seen in infants (Babinski sign).

The reflex of the pupil to light is also of great diagnostic importance. The pupil quickly contracts when light falls upon the eye or when the eyes are directed suddenly to a near object. In certain serious diseases of the nervous system, especially in general paralysis and locomotor ataxia, the contraction on looking at a near object remains while the effect of light is lost (Argyll-Robertson pupil).

REFRACTION (*see* SPECTACLES).

REFRIGERANTS (*refrigero*, I cool) are substances which relieve thirst and give a feeling of coolness. The chief refrigerants are acidulous drinks such as lemon juice, weak mineral acids, tartaric acid, etc., in water. The parched condition of the mouth and throat that arises during hard work in a dry and dusty atmosphere is best relieved by water to which has been added some demulcent substance which forms a coating on the dried mucous membrane. Such liquids are obtained by mixing oatmeal or milk with water. (*See also* CITRIC ACID *and* IMPERIAL DRINK.)

REFRIGERATION ANÆSTHESIA (*see* CRYMOTHERAPY).

REFUSE and SEWAGE DISPOSAL. —*Dry refuse* consists of the ashes and dust of houses and buildings, food remnants of animal or vegetable origin, the sweepings of streets and open spaces, and the manure of animals.

Sewage, in towns supplied with water-closets, includes the urine and fæces, the waste waters of households, the effluents of trades, and the drainage from the soil, together with a large proportion of the rainfall. This liquid refuse is removed by a system of drains and sewers, known as the 'water-carriage system', to the place where it is to be destroyed or otherwise disposed of. The method of removal is treated in a special article (*see* WATER-CLOSETS, DRAINS, AND SEWERS), while its ultimate disposal is described farther on in this article.

1. **DRY METHODS OF DISPOSAL.** —The dry refuse in towns is usually at the present time stored in small covered tubs placed in the yard, or set at specified times on the street to be carted away, preferably daily, by the scavengers.

The dry refuse from houses should mainly consist of ashes, all food remnants being burnt in the kitchen fire. To this refuse from houses there are added sweepings from streets, the contents of gulleys, the manure and trade refuse from slaughter-houses, fish and fruit shops, and it may then be disposed of to farmers for agricultural purposes.

Frequently, owing to the impossibility of providing water-closets and sewers for the removal of human excreta, the urine and fæces have to be dealt with along with the 'dry' refuse. This implies the use of *middens* or the various forms of *dry closets*.

Middens originally consisted of a hole dug in the earth, into which all offensive matters were thrown, leading to the formation of offensive gases and the pollution of the soil round about. Over the midden, some form of 'privy' was erected, but the practice in itself was most objectionable and offensive. In order to minimise the unpleasant emanations, it is usual in rural districts and in towns where middens still exist, to mix the excreta with various substances, such as ashes, earth, and charcoal, which absorb the moisture, thus keeping the excreta dry to some extent, and preventing too early putrefaction. Nowadays, the midden pit usually consists of a small suitable receptacle under the seat of the closet, instead of a hole dug in the ground. The Ministry of Health of England, in order to make the midden and privy system as little offensive as possible, have suggested a series of by-laws by which the

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privy must be at least 6 feet from the nearest dwelling, 50 feet from a well, properly roofed, with the floor paved and sloped to the door, so that no rain may enter, and so that all liquids spilt on the floor may run outside and not enter the receptacle.

The receptacle must be lined with some impermeable material, unconnected with any drain, and not more than 8 cubic feet in size, so that its contents will require to be removed at least once a week by the scavenger, while the seat must be hinged, to allow of the ready addition of ashes. Even with all these precautions, the system of privy middens is highly objectionable, and should only be used where no other method can be provided.

Pail closets, now frequently employed, are simply small middens, consisting of a tub or pail placed under the seat of the closet, composed of iron or wood, with a close-fitting lid, and easily removable at least once a week. To the excreta are added various absorbent materials, rendering the contents as dry as possible, and so hindering decomposition.

Ashes, charcoal, and earth all fulfil this object, and act also as deodorants. In some cases, all the household refuse is added, while in others, as in the *Goux system*, the pail is lined with some absorbent material which absorbs the moisture. In this system, excreta only enter the pail, and a fresh pail is substituted every two or three days. In the *charcoal closet*, the charcoal acts as a dryer and powerful deodorant, and the resultant mixture is deprived of offensive emanations. The charcoal may be reburned in retorts and used over again.

Earth closets form a suitable method in which the excreta are largely disintegrated. In one of the special types, *Moule's earth closet*, the earth is dried previous to use and sprinkled over the excreta, half a pound of earth being usually allowed for each person. The earth deodorises and dries the excreta, leads to their disintegration, and consequently the earth closet is probably one of the best forms of pail closet.

Elsan closets are a newer and more satisfactory form used where there are no sewers and earth closets are unsuitable. The excreta are received into a pail containing a solution which is deodorant and disinfectant and which helps to liquefy the solids. They are much used in country places and temporarily for public gatherings, aeroplanes, etc.

Ultimate disposal of this dry refuse, whether singly or mixed with human excreta, varies in different towns. The street sweepings and animal manure are often sold for agricultural purposes. The human excreta, whether alone or mixed with ashes or earth, are also spread over fields. The ashes and dry refuse, such as broken glass and general débris, are still in places used to fill up large holes, such as disused quarries, and to raise up the level of hollows, thus forming 'made' soils. But just as all animal and vegetable food remnants should be burnt in the kitchen fire, so the general refuse of towns is now in many places cremated in 'Destructors'. These consist briefly of furnaces into which the refuse is thrown from above and burned, high temperatures being maintained by means of forced draughts. The indestructible portions which are removed at the bottom constitute what is known as 'clinker'. This may be ground down, and when mixed with lime is disposed of as mortar, while the 'clinker' itself, sifted into suitable sizes, is largely employed in the formation of 'beds' in the biological treatment of sewage (see below). The heat generated in the destructor may be utilised for working the machinery used in the general processes connected with the establishment, such as the grinding of mortar and the electric lighting of buildings. Thus, even the refuse of a town is a valuable commodity.

2. SEWAGE DISPOSAL. — **Cesspools.**—Formerly, a common method of disposing of sewage was to run it into a cesspool. This cesspool was formed of bricks or some porous material, so that the liquids soaked through and polluted the soil, while the solids accumulated and were removed for manure when the cesspool was full. Frequently these cesspools were placed in most objectionable situations, such as under the floor of the cellar, while occasionally they were so formed as to act only as catch-pits on the course of the drain for the solid materials, the liquid portions of the sewage flowing off into the sewer.

In country districts it may still be necessary to resort to the use of cesspools

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for single houses. They should be made of some impervious material, such as brickwork, lined internally with a layer of cement, well ventilated, cleaned at regular intervals, and should be provided with a trap or other arrangement to disconnect the cesspool from the house. Sometimes the liquid material is conducted in agricultural pipes lying about 1 foot under the surface of the ground, in order to let it soak through into the soil and nourish the vegetation, after all solid excreta and grease have been intercepted by the cesspool, from which they are removed from time to time. Care must be taken that no danger results from the cesspool and its effluent; consequently, a cesspool should

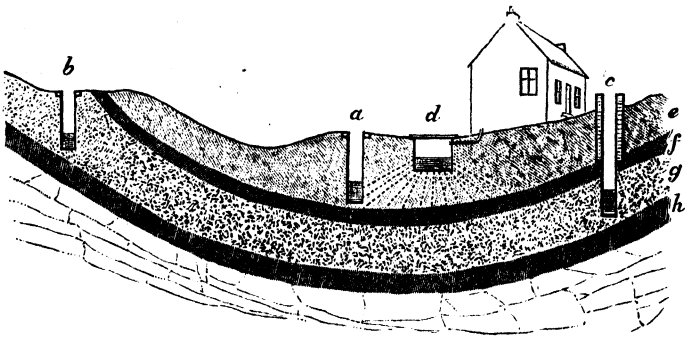

FIG. 388.—Diagram showing a common and objectionable arrangement of a cesspool. Its defects are that it is too near to the house, has no trap or other means of disconnection from the interior of the house, and is constructed of porous materials which allow pollution of the neighbouring soil. *a*, Surface well (polluted); *b*, surface well (safe); *c*, deep well; *d*, cesspool; *e* and *g*, porous strata; *f* and *h*, impervious strata.

be distant at least 50 feet from a dwelling, and at least 80 feet from a water supply. It is preferable, however, to use some method of sewage disposal other than that by cesspools, if it can be provided.

Discharge into river or sea.—It was the common custom before the 'Rivers Pollution Act, 1876', came into force in Great Britain, simply to run the sewage of a town or district into the nearest river or stream, with the consequent result that many rivers became thoroughly polluted and offensive. Where the rivers contain a large supply of fresh water, natural purification is undergone, but, if the supply of sewage is great, this process is entirely insufficient to render the stream pure. Efforts have been made under the above Act, by sanitary authorities, to purify the streams, but, while much has been done, a great number of rivers still remain practically open sewers.

In the case of *tidal rivers*, if sewage is discharged into them it tends to gather in the river, oscillating backwards and forwards with the tides, becoming deposited on the foreshore, or, when the tides flow, being driven up the river above the outfall of the sewer. The sewage, therefore, if discharged into the estuary of a tidal river is not immediately carried out into the sea The sewage may be discharged directly into the *sea*, the outfall of the sewer being placed below the level of the lowest tide, and so situated that the sewage will be carried out at once into the sea by currents, and not cast up on the shore in front of the town. To prevent the sea water entering the sewer, a tidal valve should be placed over the end of the sewer, so that the opening may close by the force of the water dashing against it. If there is difficulty at low tides, the sewage can be stored in tanks, and then allowed to flow out at times when the tide is suitable.

Precipitation. — Various processes have been introduced from time to time so as to render the effluent from the sewage more fit to be discharged into streams. The sewage is accordingly gathered in collecting tanks where the solid matter may settle. To hasten this process, various chemical agents have been utilised, the solid matters that are added settling and taking down with

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them the suspended materials of the sewage. The effluent is then discharged into a neighbouring stream or allowed to flow over land. *Lime* is one of the precipitants employed, about 15 grains to the gallon of sewage being allowed where lime slaked with water is used. Too much lime, however, renders the effluent alkaline, with a resultant tendency to putrefaction.

Sulphate of alumina renders the effluent acid, and acts as a good precipitant, though, when combined with lime in such proportions as to render the effluent practically neutral, its value is enhanced, the alumina carrying down the suspended organic materials of the sewage.

Proto-sulphate of iron, in addition to lime, is also employed; so is lime in conjunction with *black ash waste* (prepared from the residue of alkali works), the latter constituent having considerable deodorant powers. In the *A.B.C.* process a mixture of alum, blood, clay, and charcoal is employed, the second ingredient sometimes being excluded as unnecessary, the charcoal acting as the deodorant; but the cost is considerable, though the precipitation is good.

The effluent from sewage treated by these processes is simply sewage freed from its solid suspended materials, the dissolved matters remaining. It can be discharged into a river, if swift running and with a sufficient volume of clean water, without the likelihood of a nuisance; but, where these conditions cannot be obtained, it had better also be filtered through land or specially formed filter-beds.

The *sludge*, the result of the settling in tanks, may be dealt with in various ways. It may be allowed to flow in its semi-liquid condition over land into which it is dug later on, or it may have its liquid part pressed out, or it may be dried with hot air, the resulting material being sold for manure.

Intermittent downward filtration, in which the purifying influence of the soil as an oxidising agent is applied to the treatment of sewage, consists in the application of sewage at short intervals to a special piece of porous ground large enough to cleanse it efficiently. The requisites for such treatment are a porous, rich, loamy soil, with a good system of porous drains about 6 feet from the surface, the area being laid off in divisions, so that each plot may be in use for only six hours a day, resting for the remainder of the twenty-four hours. If the filter-beds are laid out in furrows along which the sewage flows, vegetables can be grown on the ridges, thus aiding in the purification, but the area of ground is limited, so that little use can be made of the manurial constituents of the sewage even where vegetables are produced. The Ministry of Health of England require 1 acre of land for each 1000 people where this process is in vogue, or, if preliminary treatment is employed to precipitate the sewage, 1 acre will suffice for 2000 persons. The resulting effluent is good, bright, and clear, and may be passed into streams.

Broad irrigation implies the application of sewage over a large area of agricultural land with the production of as great an amount of vegetation as possible, consistently with sufficient purification. This is the principle of the various sewage farms for dealing with the sewage of towns. The sewage ought to be brought to the farm in as fresh a condition as possible, so that the maximum effect may be secured, the money obtained for the vegetation helping to reduce the cost of the management of the farm. The sewage should be screened by passing through coarse strainers, so as to remove the larger substances present and prevent them forming a scum over the land. The land should be so situated that the sewage may reach it by gravitation, should be porous, preferably loamy, and arranged in a gentle slope, so as to allow the sewage to spread over it easily. It may be prepared in a series of ridges about 30 to 60 feet broad with a main sewage conduit at the summit, the sewage being allowed to trickle down over the slope. When the quantity of sewage to the one part is deemed to be sufficient, the sewage can be directed to another portion by the interposition of a sluice or plate in the stream of the main carrier. The water passes through the soil and reaches the porous earthenware drains about 6 feet from the surface. These drains are separated from each other by distances of 20 to 100 feet, depending on the porosity of the soil of the farm. The growth on sewage farms is usually heavy, Italian rye-grass especi-

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ally yielding abundant crops, and dealing by absorption with a large amount of sewage. Vegetables and cereals also may be grown on land which has been treated with sewage, but they should not, during their period of growth, be directly treated with sewage.

When the sewage filters through the soil, the solid suspended matters are arrested, while a natural nitrification is undergone, with the result that a passable effluent is produced, provided always that the sewage farm has been capably managed and the sewage efficiently dealt with. Sewage farms, if properly conducted, well constructed, and efficiently supervised, need not constitute a nuisance and give off offensive effluvia, but if the farm is not well managed or is neglected, the soil may become waterlogged, and lead to offensive emanations and consequent nuisance.

The area required by the Ministry of Health of England in this method of treating sewage is 1 acre for every 300 persons, or, if precipitation is also combined, an acre will suffice for the sewage of 1000 individuals.

Biological methods of dealing with sewage are now being largely employed. They depend upon a combination of two processes, in the first of which the organic matter of the sewage is liquefied by the action of certain organisms (anaerobic), which act in the absence of oxygen; and in the second of which processes the liquefied sewage is exposed to the air and acted upon by other organisms (aerobic), which oxidise and destroy the organic constituents of the sewage, while these latter organisms may in addition aid in the liquefaction.

One of the forms of treatment—*Scott Moncrieff system* — accomplishes this liquefaction by means of an open tank filled with large stones between which the sewage rises slowly from below, and is acted on by the liquefying organisms that grow in large colonies among the stones. The oxidation process is attained by leading the resulting effluent through a series of filter-boxes placed one over the other with air spaces between, the sewage as it passes down in the form of heavy raindrops getting aerated, and the resulting effluent flowing off as a clear liquid.

In another system, known as the *septic tank system*, a tank, which is closed to cut off oxygen, is required in order to provide for the *liquefaction*, and into this tank the sewage passes, sufficient capacity being given to hold a large quantity of sewage. The sewage arrives in the tank without previous treatment. The solid, heavier matters sink to the bottom, while microbes, which grow when deprived of air, render more soluble the organic matters present. For the second stage in the treatment — the *oxidation* of the sewage—the effluent from the tank passes out beneath the scum on the surface of the sewage, and flows into an aerating trough, falling over the sides of this trough in thin sheets to the channels which lead to the filters provided for nitrification. It thus becomes well aerated and fit for the action of the aerobic organisms in the filter-beds. These filter-beds are filled with the sewage in turn, allowed to remain full for some time, being subsequently emptied and allowed to rest free, and become aerated again. The filters are formed of crushed clinker and coarse gravel, or of coke breeze.

The dimensions of such a system for sewage treatment may be briefly indicated from the fact that in a recent installation to cope with the sewage of a burgh having a population of almost 17,000, the septic tank measures 204 feet in length, 76 feet in width, and has a depth of about 19 feet. The continuously aerating filters employed have a measurement of 204 feet in length, and are almost 100 feet wide. Owing to the level reached by the tide interfering to some extent with the work of these filters, 'contact' beds, in which the sewage remains for some time, and from which it is discharged at low tide, are employed, and are equal in dimensions to the filter-beds.

The latest development in this method of treating sewage is that known by the term 'activated sewage'. This, in brief, consists in taking some of the old sewage, which has been in a tank for a time and is rich in microbic life, then mixing it in certain proportions with the fresh sewage as it arrives at the sewage works. The mixture is kept in constant motion by special machinery and is aerated by compressed air being passed into it. This supply of oxygen enables the aerobic organisms to attack and

purify the sewage. The result gives an excellent effluent, although there is some little difficulty in disposing of part of the sludge.

This new process is as yet in its infancy, and further developments may be looked for.

REGIONAL ILEITIS (*see under* ILEITIS).

REGURGITATION (*re*, back ; *gurges*, a whirlpool) is a term used in connection with the heart to indicate a condition in which, as the result of valvular disease, the blood does not entirely pass on from the auricles of the heart to the ventricles, or from the ventricles into the arteries. The defective valve is said to be 'incompetent', and a certain amount of blood leaks past it or 'regurgitates' back into the cavity from which it has been driven.

The term is also applied to the return to the mouth of food already swallowed and present in the gullet or stomach.

REHABILITATION. — The restoration to health and working capacity of a person incapacitated by disease, mental or physical, or by injury. A word that came into prominent use in the forties of the twentieth century, reflecting the growing awareness of the medical profession that the treatment of a sick or injured person really only begins at the moment of recovery from the immediate effects of illness or injury. For example, a man with a fractured limb or spine has to recover full use not only of the injured part but of his whole body; and he has to recover confidence in his ability to work and enjoy life. Rehabilitation centres have been set up in different parts of Great Britain, especially for mining communities, where men have graduated exercises, gymnastics, games, and occupational treatment.

RELAPSE (*re*, back ; *lapsus*, slipping) means the return of a disease during the period of convalescence. Most relapses are due to some injudicious exposure or exertion on the patient's part, or to some error in diet, though certain diseases, such as typhoid fever, are peculiarly liable to relapses.

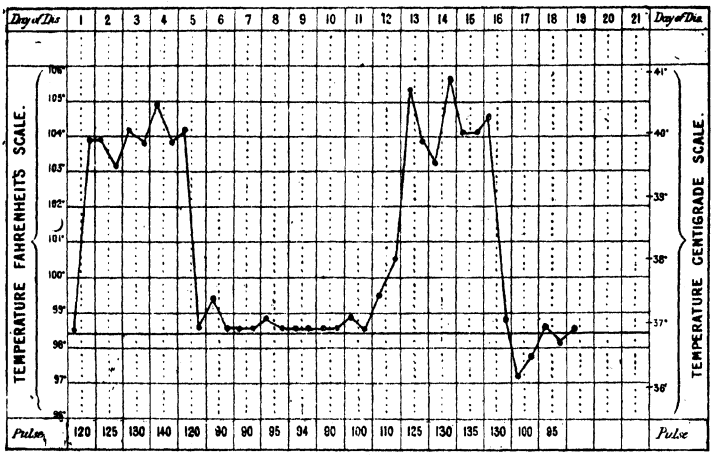


FIG. 389.—Temperature chart in a case of relapsing fever.

RELAPSING FEVER is a term applied to a number of infectious fevers characterised by relapses and occurring in various parts of the world, especially during wars and famines. It is characterised mainly by its sudden invasion, with violent fever, which continues for about a week, ends in a crisis, but is followed in another week by a return of the fever.

The disease has received many other names, the best known of which are

' famine-fever ', ' short-fever ', ' synocha ', ' bilious relapsing fever ', ' recurrent typhus ', and ' spirillum fever '. As in the case of typhoid fever, relapsing fever was long believed to be simply a form of typhus, and the distinction between them was first clearly established in 1826, during an epidemic of relapsing fever in Ireland. Outbreaks of relapsing fever have occurred in all parts of the world at times and in places where famine has arisen, and it has frequently been found to prevail along with an epidemic of typhus fever.

Causes.—Relapsing fevers are highly contagious, and are caused by different spirochætes, which are conveyed to man by ticks or lice.

Symptoms.—The incubation of the disease is about one week after infection. Then the symptoms come on suddenly with shivering, pains in the limbs, and headache. The temperature rises high (105°-107° Fahr.), and there are intense thirst, furred tongue, bilious vomiting, and occasionally jaundice. There is enlargement of the liver and the spleen. There is great weakness. After these symptoms have lasted five to seven days, the temperature suddenly falls to normal, and the patient feels well, and may even return to work. In another week, however, the same set of symptoms returns, and there may be third and even fourth relapses, usually, however, of a milder type.

Treatment is the same as that for typhus fever, but the disease is not a highly fatal one.

RELAXED THROAT (*see* THROAT, DISEASES OF, *and* CLERGYMAN'S SORE THROAT).

REMITTENT FEVER is the term applied to the form of fever in which, during remissions, the temperature falls, but not to normal.

RENAGLANDIN is one of the names applied to an extract of the suprarenal glands. (*See* ADRENALIN.)

RENAL DISEASES (*renes*, the kidneys). (*See* KIDNEY, DISEASES OF.)

RENIN is a protein-like substance extracted from the kidney which, when injected into animals, causes a rise of blood-pressure. This it does, apparently, by reacting with a substance normally present in the blood plasma to produce ' angiotonin '. Angiotonin has been obtained in crystalline form, and it is angiotonin which causes the rise in blood-pressure. This work may have an important bearing on the problem of high blood-pressure in man.

RENNET is a substance prepared from the stomach of the calf, in order to curdle and partially digest milk. Its activity depends upon a ferment known as rennin, which is also contained in the human gastric juice.

REPAIR of tissues after injury is described generally under WOUNDS, and the repair of special tissues which present various peculiarities is described under BONE, MUSCLES, NERVES, etc.

RESECTION (*resectio*, a pruning) is the name given to an operation in which a part of some organ is removed, as for example the resection of a fragment of dead bone.

RESIN is the general name for a class of inflammable vegetable substances obtained from plants and trees. They are complex bodies resulting from the oxidation of volatile oils and containing many different substances and acids. When mixed with alkalies they form resin soaps. The chief resins are common resin, or rosin, obtained from the distillation of oil of turpentine from crude pine oil, Canada pitch, india-rubber, mastic, and as drugs, resins of guaiacum, jalap, and podophyllum. Resins are chiefly used for making plasters. Oleo-resins are solutions of resin in volatile oils, such as copaiba and Canada turpentine. Gum resins are extracts from plants consisting of a mixture of gum and resin, the chief being ammoniacum, asafetida, and myrrh.

RESOLUTION (*resolvo*, I loosen) is a term applied to infective processes, to indicate a natural subsidence of the inflammation without the formation of pus. Thus a pneumonic lung is said to ' resolve ' when the material exuded into it is absorbed into the blood and lymph, so that recovery takes place

naturally ; an inflamed area is said to resolve when the inflammation fades away and no abscess forms ; a glandular enlargement is said to resolve when it decreases in size without suppuration. ' Resolvents ' was an old term applied to procedures capable of assisting this process. (*See* BLISTERS *and* INFLAMMATION.)

RESONANCE means the lengthening and intensification of sound produced by striking the body over an air-containing structure. Decrease of resonance is called dullness and increase of resonance is called hyper-resonance. The process of striking the chest or other part of the body to discover its degree of resonance is called percussion, and according to the note obtained, an opinion can be formed as to the state of consolidation of air-containing organs, the presence of abnormal cavities, and the dimensions and relations of solid and air-containing organs lying together. (*See* AUSCULTATION.)

RESORCIN, or RESORCINOL, is a white, crystalline, strongly antiseptic substance soluble in water, alcohol, and oils. It is mainly used in skin diseases which require a stimulating and antiseptic application.

RESPIRATION (*respiratio*) is the process in which air passes into and out of the lungs with the object of allowing the blood to absorb oxygen and to give off carbon dioxide and water.

Mechanism of respiration.—For the structure of the respiratory apparatus see AIR PASSAGES, CHEST, LUNGS. The air passes rhythmically into and out of the air passages, and mixes with the air already in the lungs, these two movements being known as ' inspiration ' and ' expiration '.

INSPIRATION is due to a muscular effort which enlarges the chest in all three dimensions, so that the lungs have to expand in order to fill up the vacuum that would otherwise be left, and the air accordingly enters these organs by the air passages. It must be understood that there is no direct pull upon the lungs, each of which is simply suspended within the corresponding pleural cavity by its ' root ', and made to fill this cavity in all conditions of the chest by the pressure of the outer air exerted through the nose, mouth, and air passages. The increase of the chest in size from above downwards is mainly due to the diaphragm, whose muscular

FIG. 390.—Diagram of a section lengthwise through the ending of a bronchial tube with its air-vesicles in the lung, to show the intimate relation into which the blood is brought with the air. *b*, Bronchial tube ; *lb*, lobular passage ; *vv*, air-vesicles ; in *v'* the side wall is shown ; *a*, branch of the pulmonary artery ; *cc*, pulmonary capillaries ; *e'*, ciliated epithelium lining the bronchial tubes ; *e*, flat epithelium lining the air-vesicles. The air is separated from the blood only by the walls of the capillary and of the air-vesicle. (Turner's *Anatomy*.)

fibres by their contraction reduce its domed shape and cause it to descend, pushing down the abdominal organs beneath it. The increase from before back is mainly due to a tilting forwards of the lower end of the breast-bone, and of the lower rib cartilages. The increase from side to side can best be understood by examining a skeleton, noting the very oblique position of the lower ribs, and observing how greatly the capacity of the chest is increased when each is raised, in the manner of a bucket-handle, taking its fixed points at the spine and breast-bone. (*See* RIBS.)

The muscles which chiefly bring about these changes in ' ordinary ', quiet inspiration are the diaphragm, intercostal muscles, and levators of the ribs, while in ' forced ' or ' extraordinary ' inspiration, when a specially deep breath is taken, the sterno-mastoid, serratus magnus, trapezius, and pectoral muscles are also brought powerfully into play. One must note that many other muscles take part to a slight extent, steadying the spine and the upper and lower ribs, while even the muscles of the face and of the larynx are thrown rhythmically into activity, dilating the nostrils and the entrance to the larynx at each breath.

EXPIRATION is in ordinary circum-

stances simply an elastic recoil, the diaphragm rising and the ribs sinking into the position that they naturally occupy, when muscular contraction is finished. Expiration occupies a slightly longer period than inspiration. In forced expiration many powerful muscles of the abdomen and thorax are brought into play, and the act may be made a very forcible one, as, for example, in coughing.

Nervous control. — Respiration is usually either an automatic or a reflex act, each expiration sending up afferent, sensory impulses to the central nervous system, from which efferent impulses are sent down various other nerves to the muscles that produce inspiration. From the recent researches of Mosso, it appears that there are several 'centres' which govern the rate, force, etc., of the breathing, though all are presided over by a chief respiratory centre in the medulla oblongata, which is sometimes spoken of as the 'vital knot' (*nœud vitale*). Though this centre appears to be absolutely essential to life, it in turn is under the control of the higher centres in the cerebral hemispheres, through which the will acts, so that breathing can be voluntarily stopped, quickened, or otherwise changed at will. It would be impossible, however, to cause death by voluntarily holding the breath, because, as the blood becomes more venous, the vital centre in the medulla again assumes control and breathing recommences. Apart from changes due to will-power, the respirations follow one another rhythmically at the rate of about 18 per minute, being in general one for every four heart-beats.

Quantity of air.—The lungs do not by any means completely empty themselves at each expiration and refill at each inspiration. An amount equivalent, in quiet respiration, to less than one-tenth of the total air in the lungs passes out and is replaced by the same quantity of fresh air, which mixes with the stale air in the lungs. This renewal, which in quiet breathing amounts to about 30 cubic inches or 1 pint of air or about 500 c.c. is known as the *tidal air*. By a special inspiratory effort, one can, however, draw in about 180 cubic inches, *i.e.* over 6 pints of air or 3000 c.c., this amount being known as *complemental air*. By a special expiratory effort too, after an ordinary breath one can expel much more than the tidal air from the lungs, this extra amount being known as the *supplemental* or *reserve air*, and amounting also to about 60 cubic inches or 1000 c.c. If one takes as deep an inspiration as possible and then makes a forced expiration, one breathes out the sum of these three, which is known as the *vital capacity*, and amounts to about 4000 c.c. in a healthy adult male of average size. These figures are the result of Hutchinson's researches for a man of average height. For every inch of height over 5 feet 8 inches, there is an addition of about 8 cubic inches in the respiratory capacity. A woman, however, has much smaller respiratory capacity than a man of the same height, the proportion being about 7 : 10. Over and above the vital capacity, the lungs contain air which cannot be emptied by the strongest possible expiration, and this *residual air*, which remains in the lungs even after death, amounts to at least another 1000-1500 c.c.

Peculiar forms of respiration. — Apart from mere changes in rate and force, respiration is modified in several important ways, either involuntarily or in conformity with the will. *Sighing* is a long-drawn inspiration following a pause when breathing has been checked by mental preoccupation. This form of breathing also characterises some conditions of extreme weakness of the nervous system, such as shock and diabetic coma. *Sobbing* is a series of convulsive inspirations, at each of which the larynx is partially closed; it follows grief or great exertion. *Hiccup* is a quick inspiration brought to a sudden end by closure of the larynx; it is generally due to gastric irritation. *Snoring* or stertorous breathing is due to a flaccid state of the soft palate causing it to vibrate as the air passes into the throat, or simply to sleeping with the mouth open, which has a similar effect. *Coughing* is a series of violent expirations, at each of which the larynx is suddenly opened after the pressure of air in the lungs has risen considerably; its object is to expel some irritating substance from the air passages. *Sneezing* is a single sudden expiration, which differs from coughing in that the sudden rush of air is directed by the soft palate up

into the nose in order to expel some source of irritation from this narrow passage. *Cheyne-Stokes breathing* is a type of breathing found in persons suffering from apoplexy, Bright's disease, heart disease, and some other conditions, in which death is impending; it consists in an alternate dying away and gradual strengthening of the inspirations. Other disorders of breathing are found in LARYNGISMUS STRIDULUS and in ASTHMA, for which see under these headings.

RESUSCITATION (*re*, again ; *suscito*, I arouse). (*See* DROWNING, RECOVERY FROM.)

RETCHING is an ineffectual form of vomiting. (*See* VOMITING.)

RETE MUCOSUM (*rete*, a net ; *mucosus*, slimy) is an old name for the true skin. (*See* SKIN.)

RETENTION OF URINE (*see* URINE, RETENTION OF).

RETICULOCYTES is the name given to newly formed red blood corpuscles, in which a fine network can be demonstrated by special staining methods.

RETINA (diminutive from *rete*, a net) is the innermost and light-sensitive coat of the eyeball. (*See* EYE.)

RETINITIS means inflammation of the retina. It is accompanied more or less by impairment of sight. It is found accompanying advanced conditions of Bright's disease, diabetes, and some forms of poisoning. A chronic degenerative form known as 'retinitis pigmentosa' is associated with great narrowing of the field of vision and blindness in dim light.

RETRO- (*retro*, backward) is a prefix signifying behind or turned backward.

RETROBULBAR NEURITIS is the term applied to inflammation of the optic nerve just behind the eyeball.

RETROFLEXION means bending of an organ so that its top is thrust backwards. Retroversion is a similar displacement in which the whole organ is turned backwards. These terms are particularly applied to the uterus.

RETROPHARYNGEAL ABSCESS is the name given to an abscess occurring in the cellular tissue behind the throat. It is the result in general of disease in the upper part of the spinal column.

RETROPULSION is the term applied to the involuntary act of running backwards which occurs in patients suffering from rigid paralysis — for example, paralysis agitans or Parkinsonism (occurring after encephalitis lethargica).

RHATANY is the root of *Krameria triandra*, a South American plant, which contains an astringent principle. It is mainly used in diarrhœa in the form of a tincture or extract, and to make lozenges for use in cases of relaxed throat.

RHEUMATIC FEVER is the usual medical term for acute rheumatism. (*See* RHEUMATISM.)

RHEUMATISM (ῥευματισμός, from ῥεῦμα, a humour) is a general term applied to a group of diseases, which have for their chief manifestations inflammatory or degenerative affections of the fibrous textures of joints, muscles, and other parts. The term is a very old one based upon the idea that the disease was of a moist nature leading to watery deposits in the joints. The parts affected may be the joints alone, either in acute or chronic form ; or various other tissues, especially the fibrous tissues and nerves, may be affected, either with or without disorder in the joints. The Ministry of Health in England, as the result of an extensive inquiry, recognised some nine varieties of disorder which may, in a clinical sense, be grouped under this name. These are (1) rheumatic fever or acute rheumatism, (2) subacute rheumatism, (3) muscular rheumatism or myalgia, (4) lumbago, (5) sciatica and brachial neuritis, (6) rheumatoid arthritis, (7) osteoarthritis, (8) gout, acute or chronic, and (9) various chronic joint changes. Gout is described elsewhere (*see* GOUT), and the remaining conditions will be noticed here.

1. **ACUTE RHEUMATISM**, or RHEUMATIC FEVER, is a general disorder accompanied by much pain in the joints,

feverishness, and copious perspiration, with a tendency to spread in an erratic manner, and to involve the smooth membranes lining various cavities of the body.

Causes.—The nature of this disease has been much discussed, and the general view is that it is an infection and probably a streptococcal infection. There is, for example, the common association of recurrent attacks of streptococcal tonsillitis with subacute rheumatic fever and the streptococcal tonsillitis which precedes the attack of acute rheumatic fever.

Certain predisposing causes are generally admitted. Climate is an important factor, and, although the disease is found all over the world, it is especially frequent in temperate climates, and particularly in the British Isles. The disease is prevalent in the late autumn, October and November in Britain, but in other countries reaches its chief frequency about March. It is rare in early childhood and occurs most frequently in young adults between the ages of 15 and 35 years, being especially common in the male sex. The tendency to attacks of rheumatic fever diminishes after middle life is reached. There is a distinct hereditary tendency in this disease, at least one out of six cases belonging to families in which it is common; and individuals who are liable to it often show a high-coloured complexion and reddish tinge of hair. The disease is more common among the poorer classes. Any depressing cause acting upon the general health, such as overwork or anxiety, or any habitual drain upon the system, has a similar effect in producing attacks in persons predisposed to them. Attacks of acute rheumatism may follow exposure to cold and damp and sometimes result from excessive fatigue. Persons who have once suffered from this disease are very liable to a recurrence.

The disease has important relationships to certain other diseases. Thus enlarged tonsils and adenoids are of great importance, especially in childhood. An attack of rheumatic fever sometimes follows upon tonsillitis, or an attack of the latter may occasionally occur in persons who are liable to recurring manifestations of rheumatic fever. Chorea also occurs in association with acute rheumatism and appears to have a similar cause.

Symptoms.—An attack of acute rheumatism usually begins with chilliness or rigors, followed by feverishness and a feeling of stiffness or pain in one or more joints, generally those of larger size, such as the knee, ankle, wrist, or shoulder. The pain soon becomes intense and is accompanied by severe constitutional disturbance. The patient lies helpless in bed, restless, but afraid to move or to be touched, and often unable to bear even the weight of the bed-clothes. The face is flushed, and the whole body bathed in perspiration, which has a sour, disagreeable odour and highly acid reaction. The temperature is elevated (usually about 103°); the pulse is rapid, full, and soft; the tongue is coated, and there are thirst, loss of appetite, and constipation. The urine is diminished in quantity, highly acid, and loaded with urates, which give it a dark colour and produce a brick-red deposit as the urine cools. At first the pain is confined to only one or two joints, but soon others become affected, very commonly similar joints on the two sides of the body. The affected joints are red, swollen, hot, and excessively tender. In mild cases one or two joints only are affected, but in severe cases scarcely a joint, large or small, may escape, and the pain, restlessness, and fever then render the patient's condition extremely miserable.

An attack of acute rheumatism is of variable duration, sometimes passing away in the course of a few days. The usual period during which the temperature remains elevated is a week or less, and, if the temperature subsides to normal and again rises, or if it continues elevated beyond ten days, some complication, such as inflammation of the lining membrane of the heart, may be suspected. Such cases may last for many weeks with relapses, in which all the former symptoms return and prolong the illness.

After an attack of acute rheumatism, the patient is much reduced in strength, and pallor persists for a considerable time, but if no complication has arisen, there may be complete recovery in the course of about three weeks. Sometimes, when all the acute symptoms have disappeared, the joints remain

swollen, stiff, and painful on movement, but this condition may also gradually pass away, or, on the other hand, the rheumatism may become chronic. In any case there always remains a liability to subsequent attacks.

Complications.—This disease derives much of its serious import from certain complications which are very apt to arise during an attack. Among these the most frequent and the most serious is heart disease. Pericarditis (inflammation of the membrane covering the heart), endocarditis (inflammation of the lining membrane of the heart), and myocarditis (inflammation of the heart muscle) may all happen. (*See* HEART.) The risk of cardiac complications seems to be greater the younger the patient, and, indeed, in children the joint pains are often so slight as to be overlooked, and the valvular disease may only be discovered accidentally at a later period of life. Pericarditis occurs less frequently but is more serious as regards the patient's immediate prospect of recovery.

Among other serious complications may be mentioned excessive fever (hyperpyrexia), which sometimes develops in a sudden and alarming manner, the temperature rising rapidly to 106°, 108°, or even higher, and thus endangering life unless prompt treatment be resorted to. Complications connected with the respiratory organs, such as pleurisy, pneumonia, and bronchitis, as well as inflammatory conditions of the skin, sometimes arise in the course of the disease. Delirium often occurs and chorea (St. Vitus's dance) sometimes follows after the acute symptoms have subsided.

Treatment.—The patient should be placed in bed between blankets, and should wear a flannel shirt, of which the front and arms can be opened to admit of examination of the heart and joints. Or he may wear a jacket of gamgee tissue, of which front and back are separate and fastened only by tapes over the shoulders and on the sides. Movements of all kinds should be, as far as possible, avoided. The diet should consist entirely of milk in the acute stage of the disease, and even when the patient is convalescent meat should be given very sparingly.

The affected joints should be wrapped in cotton-wool or gamgee tissue, kept in position by a light bandage or by tapes. If the pain is very great, relief is sometimes obtained by wrapping the painful parts in flannel cloths wrung out of a strong (5 per cent) solution of washing soda in water, to which some laudanum has been added. Methyl salicylate painted on the painful joints and covered with oil-silk and cotton-wool, and a mixture in equal parts of chloral-menthol and camphor, are similarly soothing applications. Blisters are sometimes applied with benefit over the inflamed joint, or over the heart when it is the seat of endocarditis or pericarditis, but this treatment is available only when the rheumatism is limited. Relief from very acute pain is obtained in all cases by fixing the joint by means of splints.

Sodium salicylate forms the sheet anchor of drug treatment. From 20 to 30 grains, with an equal amount of bicarbonate of soda, are given several times in the course of twenty-four hours, but its action must be carefully watched by the physician. In the dangerous complication of hyperpyrexia, the cold bath (in which the water is quickly cooled down from 94° to 68°), or the cold pack, has frequently been successful in lowering temperature and saving life. Tonics, such as iron and quinine, are necessary during convalescence when there are anæmia and debility. Persons who have suffered from acute rheumatism should ever afterwards be careful to avoid exposure to damp and chill, and to protect the skin by suitable underclothing.

2. **SUBACUTE RHEUMATISM** is a name sometimes applied to mild attacks of acute rheumatism, in which the temperature does not exceed 101°, and which respond quickly to treatment by salicylate of soda. These cases are often of long duration and they may be accompanied by endocarditis, especially in the case of children. Rheumatic affections of the skin occur especially in this form of the disease, and may consist of erythema nodosum, a condition in which bluish-red swellings appear, especially on the front of the legs; another form of skin eruption is purpura, in which small purple spots are scattered thickly over the skin; still another skin affec-

tion is the formation of 'rheumatic nodules', minute fibrous swellings, which are painful to the touch.

Small doses of sulphanilamide taken daily over a long period have been given to children with a rheumatic tendency, and this course is believed by some to lessen the risk of recurrent attacks.

3. **MUSCULAR RHEUMATISM** is also known as MYALGIA, FIBROSITIS, and in special parts of the body as pleurodynia (in the side), torticollis (in the neck), and lumbago (in the loins). The symptoms are those of pain, aching, and stiffness, with sudden agonising cramp coming on at times when the affected muscles are brought into action. Definite thickening of the fibrous tissues and large swellings in the muscles are often found for a time during its course.

Causes.—This form of rheumatism occasionally develops as the result of the acute form, but is more frequently an independent, constitutional affection, and usually a complaint of later life. It is specially associated with habitual exposure to cold and damp; hence its frequency among outdoor workers. It is also found in persons debilitated by overwork or depression. Certain poisons introduced into or developed within the system are often attended with symptoms of chronic rheumatism, for instance lead-poisoning, venereal disease, etc. A more common cause of this nature is found in the presence of a septic focus in the body, particularly the presence of defective teeth with decayed cavities or with abscesses at their roots. Another frequent source of infection is found in chronic enlargement of the tonsils. Yet another source of similar infection occurs in the intestine of persons who are the subject of habitual constipation. The rheumatic condition often disappears with surprising rapidity when such septic conditions are removed. In a person who is liable to chronic rheumatism, any part that suffers, or has previously suffered, injury, such as the scar of an old wound, is apt to become the seat of rheumatic pain.

Symptoms.—The general symptoms are the pain and stiffness in movement already described. These pains are greatly influenced by changes in the weather or by passing changes in the temperature of the body, as, for example, when the clothes are removed at night. Cold and damp aggravate them greatly. This form of rheumatism, though not directly dangerous to life, tends to lower the health and render the patient more vulnerable to other diseases. It is liable sooner or later to be associated with the severer form of chronic rheumatism in the joints leading to deformity and disablement. Rheumatic inflammation in special muscles and fibrous structures may cause important local symptoms through interference with the action of the organ affected; thus in the eye, iritis results (*see* IRITIS); in rheumatism of the heart-muscle (myocarditis) there are rapidity and feebleness, with a tendency to dilatation of the heart; when the muscle of the intestine is affected, spasm and colic ensue, etc.

Treatment. — A great variety of remedies is used for the relief of this condition. In the earlier stages salicylate of soda, salicin, or aspirin may be used as in acute rheumatism, but these are not as a rule of so much service as in the latter condition. Alkalies, such as citrate of potash and acetate of potash, often given in combination with arsenic and tonics, such as iron, quinine, cod-liver oil, etc., are very serviceable. Potassium iodide is used to a very large extent in this disease, and compounds containing alkalies, sulphur, and guaiacum, such as the well-known 'Chelsea pensioner' (*see* CONFECTIONS), enjoy a wide reputation. Turpentine in doses of 5 or 10 drops upon a lump of sugar thrice daily is also very effectual in some cases when it is continued for several weeks.

In the stage of acute pain, the application of a plaster, which may contain some soothing substance, *e.g.* belladonna plaster, is very serviceable in preventing painful muscular spasms. If the patient is confined to bed, warm applications, such as poultices, antiphlogistin, or hot baths, give great relief. At a later stage, rubbing of the affected parts, either in the form of massage or by friction with soothing or stimulating liniments, is very helpful. In long-continued cases counter-irritation either with blisters or the button cautery is a useful local remedy. Electricity is often tried in the form of faradism, galvanism, or high-frequency currents.

Hot baths, Turkish baths, and especially hot-air or light baths of very high temperature, may often be used with great advantage (*see* BATHS). Recently diathermy (electro-thermic penetration) has been found to give great relief (*see* DIATHERMY). The mineral waters and baths of various well-known resorts are of undoubted benefit, especially those containing alkalies or sulphur, such as those of Buxton, Bath, Strathpeffer, or Harrogate in Great Britain, those of Aix-les-Bains, Vichy, Wiesbaden, Homburg, Ems, Wildbad, Aix-la-Chapelle, and many others on the Continent, or Michigan Congress Spring, the Alleghany Springs of Virginia, and Saratoga Springs in America. In all cases careful search should be made for some source of chronic infection, such as in the teeth, tonsils, or intestine. Changes to warmer climates during the colder season, and, in any case, the wearing of warm clothing during cold weather and the avoidance of dampness, are important in all cases.

4. **LUMBAGO.**—This is myalgia or fibrositis occurring in the strong and dense sinews of the erector spinæ muscles of the back, and is considered separately because of its great frequency and importance in regard to occupation, and because it is readily distinguishable. For its causes, symptoms, and treatment see LUMBAGO.

5. **SCIATICA AND BRACHIAL NEURITIS.**—The rheumatic processes may affect the fibrous tissues of various nerves, the nerves of the arm and the great sciatic nerve running down the back of the thigh being especially liable to this affection. The causes described above under myalgia are also operative in producing neuritis, and, in the case of the nerves of the arm, overstrain at work, *e.g.* in hammermen, plays a very important part. The treatment of this condition is described under NEURALGIA.

6. **RHEUMATOID ARTHRITIS** is also known as CHRONIC RHEUMATIC ARTHRITIS, ARTHRITIS DEFORMANS, RHEUMATIC GOUT, and by several other names. It consists of a chronic inflammatory affection of joints, involving at first the fibrous tissues round the joint, and later the synovial membranes and articular cartilages. The condition develops slowly and progressively, and results in stiffening and deformity of the parts affected.

Causes.—This disease is held by some to partake of both the nature of rheumatism and gout (hence the term rheumatic gout); others regard it simply as a variety of chronic rheumatism of infective nature. It is more common in women than in men, and occurs at all ages, but usually begins before middle life is reached. It is closely connected with conditions of ill-health; and hence it occurs frequently among persons who are the subject of some drain upon the system caused by other chronic disease, or in persons worn out by hard and devitalising work, such as the prolonged nursing of an aged relative. It is particularly associated with some source of infection, such as from the teeth or intestine, as mentioned above under muscular rheumatism.

Symptoms.—The disease very commonly begins with an attack of feverishness, with a moderate rise of temperature of considerable duration. Accompanying this there is pain and swelling in one or more joints, usually small joints such as those of the fingers and toes. The swelling may subside for a time, but gradually many of the smaller joints become affected in the hands or feet, it may be, without rise of temperature. Short attacks of raised temperature occur from time to time with increasing frequency, gradually involving more joints, until, in the course of time, most of the joints in the body may be more or less affected. Thickening of the textures round the joints with stiffness is the result, and there is often considerable deformity from the joints being fixed in certain positions as well as swollen. The muscles of the affected limbs undergo atrophy, and the wasted limbs contrast strikingly with the abnormally enlarged joints. The patient becomes much reduced in strength by the constant irritation of the disease as well as by its original cause. The general changes in the joints are, firstly, swelling in the tissues around the joint, later inflammation of the synovial membrane with collection of fluid in the joint. At this stage the patient feels much creaking in the joint when it is moved. Finally, there is disintegration of the articular cartilages, which tend to split up and become gradually

absorbed, leaving the ends of the bone exposed. The bony surfaces thus brought into contact become hard and polished by friction in places, and bony outgrowths are developed toward their edges. This condition may produce complete locking of the joint so that movement is impossible, or, if the joint is still capable of movement, much grating is felt similar to that experienced when a bone is broken. The condition at this stage is, however, not necessarily painful. These changes can be well seen on X-ray examination, which, even at an early stage, may demonstrate a certain amount of deformity and absorption in the structure of the bones near the joint. This disease often lasts for many years, sometimes continuing for a lengthened period without much change, but tending gradually to progress and to render the patient more and more helpless. It is not attended with the complications of acute rheumatism and is not inconsistent with long life, but its weakening effects upon the system and the ill-health, which is apt to result from want of exercise, render the subject of it more liable to the inroads of other diseases.

Treatment. — Rheumatoid arthritis yields less readily to treatment than chronic rheumatism, and remedies for acute rheumatism, such as salicylate of soda, are not found to be of much value in this form of disease. Most success is obtained if the condition is recognised early and measures taken to strengthen the patient's general health and to remove sources of infection, such as those due to defective teeth and putrefaction of the intestinal contents. For this purpose careful dental examination and the administration of aperients and intestinal antiseptics are of great importance. The addition to the diet of buttermilk or milk containing lactic acid bacilli is often recommended for a similar reason. Measures which strengthen the patient's general health, such cod-liver oil, cream, and other fats as in the food, seem to be of especial benefit in this disease and may be taken in large quantities for a long period. Chalybeate mineral waters, are often of service. Aspirin has some effect in relieving pain in this condition, and the injection of fibrolysin, iodolysin, and

other preparations of thiosinamin aid in the absorption of the fibrous thickenings round the joints. A course of injections of anti-typhoid or other vaccine is beneficial in some cases. Locally electrical and hot-air baths or diathermy have a great measure of success in relieving pain and reducing the inflammatory condition of the joints. Blisters and other forms of counter-irritation, galvanism and ionisation (*see* IONISATION), are also used with success in certain cases. Injections of gold salts are also useful in some cases (*see* GOLD SALTS).

7. **OSTEOARTHRITIS** is a general term applied to chronic changes in a joint or joints, which come on gradually, and usually without any feverish symptoms. The condition may be the final stage of rheumatoid arthritis. In other cases, especially when a single joint is affected, it is the result of some injury, and in still other cases it follows as the result of a chronic inflammatory change in the joint of long standing, as, for example, in a tuberculous joint in which the tuberculous process has long previously subsided. The change is very commonly found in the hip-joint and in the spine of old people, and less commonly in the knee. There are fibrous changes in and around the joint, and the articular cartilage is absorbed, so that grating is present on movement. The formation of new bone takes place at the edges of the bones, so that the joint may become stiff or quite immovable. The condition may or may not be associated with pain, and, as in the case of muscular rheumatism, the pain and stiffness are apt to be aggravated by bad weather. Deformity and displacement are apt to ensue from stiffness of the joint, and the patient may, if several joints are affected, be reduced to a bedridden condition of complete helplessness. As regards treatment, very little can be done except for the relief of pain on the lines above indicated for rheumatoid arthritis, and care must be taken in aged and bedridden persons to prevent the formation of bed sores.

8. **GOUT.**—(*See* GOUT.)

9. **CHRONIC JOINT CHANGES.** In addition to the disease described as osteoarthritis above, several chronic changes take place in the joints, due

primarily to other diseases, but resulting in pain and deformity of very much the same nature as those above mentioned. Such changes occur, for example, as the result of atrophy of the bones in locomotor ataxia.

RH FACTOR is the term given to a certain property or substance in human red blood corpuscles which is presumed to be identical with or closely similar to a property or substance in the red blood corpuscles of Rhesus monkeys. Landsteiner and Wiener found that the serum of a rabbit injected with red blood corpuscles of a Rhesus monkey agglutinated the red corpuscles of most (85 per cent) human beings. That is to say, an agglutinogen is common to both human and Rhesus red corpuscles. In such cases the human being is called Rh positive. The remaining 15 per cent are Rh negative. For the practical significance of this *see* ICTERUS GRAVIS NEONATORUM.

RHIGOLENE is an extremely volatile petroleum oil, used as a spray in the production of freezing before small surgical operations.

RHINITIS (ῥίς, the nose) means inflammation of the mucous membrane of the nose. (*See* NOSE, DISEASES OF.)

RHINOPLASTY (ῥίς, nose; πλάσσω, I form) means the repair of the nose or the modification of its shape by operation. The operation is carried out by obtaining a flap of skin from the forehead or from the forearm. In milder cases of deformity the shape is often improved by injection of paraffin under the skin of the nose, or by insertion of a piece of cartilage taken from one of the ribs.

RHONCHI (ῥόγχος, snoring) is the term used to denote the harsh cooing, hissing, or whistling sounds (wheezing) heard by auscultation over the bronchial tubes when they are the seat of inflammation. (*See* BRONCHITIS.)

RHUBARB is the root of *Rheum officinale*, a plant originally derived from China and Thibet. It has a gentle purgative action when taken in large doses, and at the same time increases the flow of bile. In small doses it has merely a slightly stimulating action upon the functions of the stomach, and is very beneficial in atonic conditions of that organ. It is also used as a purgative.

RHUS is the name for a genus of trees and shrubs, some of which are used as astringents, while others, particularly *Rhus toxicodendrum*, or poison oak, and *Rhus venenata*, or swamp-sumac, are poisonous.

RIBOFLAVIN is now the generally accepted term for vitamin B2. It is also called LACTOFLAVINE and, in the U.S.A., vitamin G. It must be distinguished from the ' vitamin B2 complex ', which includes such vitamins now identified as nicotinic acid, pantothenic acid, and pyridoxine. Its empirical formula is $C_{17}H_{20}O_6N_4$. Riboflavin belongs to a group of animal and plant pigments which give a greenish fluorescence on exposure to ultra-violet rays. It is present especially in milk, and is not destroyed during pasteurisation. Deficiency of riboflavin in the diet is thought to cause inflammation of the substance of the cornea, sores on the lips, especially at the angles of the mouth (cheilosis), and seborrhœa.

RIBS are the long bones, twelve on each side, which enclose the cavity of the chest. The upper seven are joined to the breast-bone by their costal cartilages and are therefore known as ' true ribs '. The lower five do not reach the breast-bone, and are therefore known as ' false ribs '. Of the latter, the 8th, 9th, and 10th are joined by their costal cartilages, each one to the rib immediately above it, while the 11th and 12th are free from any such connection, and are therefore known as ' floating ribs '. Each rib is possessed of a ' head ', by which it is jointed to the upper part of the body of the vertebra with which it corresponds, as well as to the vertebra immediately above. Next comes a narrow part known as the 'neck', and then a 'tubercle', by which the rib is joined to the transverse process of the corresponding vertebra. Finally, the greater part of the bone is made up of the ' shaft ', which runs at first outwards and at the ' angle ' turns sharply forwards. On the lower margin

of the shaft is a groove, which lodges the corresponding intercostal artery and nerve.

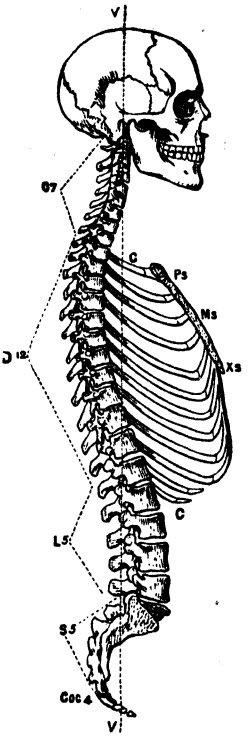


FIG. 391.—Outline of the spine with the ribs of the left side. The ribs of the right side have been removed. The line crossing each shows the end of the rib, the part in front being cartilage. For letters see SPINAL COLUMN. (Turner's *Anatomy*.)

RICE-WATER.—This forms a useful diluent drink for invalids, similar to barley-water. To prepare rice-water one takes 6 tablespoonfuls of rice, washes it in cold water, then place it in a saucepan with 1½ pints of water and allows to simmer for an hour or two, until the bulk of fluid is reduced to about a pint. The rice-water is then cooled, strained, and, if desired, sweetened with sugar and flavoured with lemon.

RICKETS is a disease of childhood characterised chiefly by a softened condition of the bones, and by other evidences of perverted nutrition.

Causes.—This disease is found chiefly among the ill-fed children of the poor, and is the result of deficiency of vitamin D in the diet, and also of deficiency of calcium. Healthy bones cannot be built up without calcium (or lime) salts, and the body cannot utilise these salts in the absence of vitamin D. Want of sunlight and fresh air in the dwellings where the children are reared are also of importance.

The changes that take place in the bones are due to an irregular process of bone formation. The periosteum, the membrane enveloping the bones, becomes inflamed, and in consequence the bone formed beneath it is defective in lime salts and very soft. At the growing ends of the bones there is an even more striking change. The epiphyseal plate of cartilage, from which growth takes place, is much thickened, the cellular elements in it much increased in number, and the bone which it produces markedly deficient in lime salts. The new bone shows a deficiency of lime amounting to 25 or 35 per cent, and this, too, notwithstanding the fact that there is abundance of lime in the body, as shown by its excessive excretion in the urine. The disease rarely occurs under the age of six months, from which it may be assumed that exposure to unsuitable conditions for several months is necessary before rickets ensues. It is most common between one and two years of age and is increasingly rare after the age of three.

Symptoms.—The symptoms of rickets most commonly attract attention about the end of the first year, and the disease very rarely appears for the first time after the age of five. The symptoms, which precede the outward manifestations of the disease, are marked disorders of the digestive and alimentary functions. The child's appetite is diminished; there is frequent vomiting and diarrhoea; or irregularity of the bowels appears, the evacuations being clay-coloured and unhealthy. Along with this the child ceases to gain in weight or actually falls away in flesh. One of the most noticeable symptoms is profuse sweating of the head and upper parts of the body, particularly during sleep, with a tendency in the child to kick off the bed-clothes and expose the limbs. Bronchitis is also a very common early symptom and often the first to attract attention. In infants, convulsions are

sometimes a symptom of rickets and disappear under the treatment appropriate to this disease. At the same time, there is tenderness of the bones as shown by crying when the child is moved or handled. A little later it is noticed that there is delay in learning to sit up and walk, so that the child which has begun to walk loses this power. The urine, if examined, contains a large amount of lime salts.

Gradually changes in the shape of the bones become visible, first chiefly noticed at the ends of the long bones, as in those of the arm, causing enlargement at the wrists, or in the ribs, producing a row of knobs at the junction of their ends with the rib cartilages (' rickety rosary '). The bones also from their softened condition tend to become distorted and bent both by the action of the muscles and by the weight of the body resting upon them. Those of the legs are bent outwards and forwards and the child becomes ' bow-legged ' or ' knock-kneed ', often to an extreme degree. The trunk of the body likewise shows various alterations and deformities owing to curvatures of the spine, flattening of the lateral curves of the ribs, and the projection forward of the breast-bone. (*See* CHEST DEFORMITIES.) The cavity of the chest may thus be contracted and interference produced with the development of the thoracic organs, whose functions thus become embarrassed. The liver is pushed outwards and the abdomen becomes protuberant (' pot belly '). The pelvis undergoes distortion which may reduce its capacity to such a degree that in females serious difficulties may arise later in life in the course of labour. The head of the rickety child is square with high ' intellectual ' forehead ; the individual bones of the cranium remain long ununited, while the soft ' fontanelle ' remains unclosed long after the end of the second year, the time by which it should have disappeared ; the face is small and ill-developed ; and the teeth appear late and fall out or decay early. The constitutional conditions of ill-health continue and the nutrition and development of the child are greatly retarded.

The disease usually terminates in recovery with more or less of deformity and dwarfing, the bones, although altered in shape, becoming ultimately firmly ossified. On the other hand, during the progress of the disease, various intercurrent ailments are apt to arise which may cause death, such as bronchitis and other chest complaints, meningitis, convulsions, laryngismus, etc. Another disease for which rickets is apt to be mistaken is infantile scurvy, in which all the symptoms are of more rapid development. In this disease a tendency to hæmorrhages is very marked and the result, if the condition be untreated, is in many cases fatal. This disease is due to causes similar to those producing rickets, particularly to the want of vitamins contained in fresh vegetables and fruits.

Treatment.—The treatment of rickets is more hygienic and dietetic than medicinal. The specific remedy is vitamin D, given in the form either of cod-liver or halibut-liver oil, or of special vitamin concentrates, or of calciferol (vitamin D_2). Full diet is of course essential, with emphasis upon a sufficient supply of milk. Rickets practically does not occur in breast-fed children, so that nursing by the mother for a period of eight or nine months is desirable, if at all possible. After the child is weaned, the provision of suitable food is of the greatest importance (*see* INFANT FEEDING). The digestive disorders characteristic of the setting in of the disease render necessary the greatest care and watchfulness as to diet.

General hygienic measures, including abundance of fresh air, cleanliness, warm clothing, and attention to regularity in all the child's functions, are of the greatest importance.

Whilst the disease is advancing, it is desirable to restrain the child from walking, and this must sometimes be achieved by the use of splints and other apparatus as supports of the limbs and body. This enables the child to move about without risk of bending and deformity of the bones, which would otherwise probably result. If deformities of the legs have occurred, operative treatment may be necessary at a later period of life in order to straighten the limbs.

RICKETTSIA is the general term given to a group of small bacteria-like living micro-organisms now believed to be the causal agents of typhus and

a number of typhus-like diseases, such as Rocky Mountain spotted fever, Japanese River fever, and trench fever. These micro-organisms are conveyed to man by lice, fleas, ticks, and mites.

RIGG'S DISEASE is another name for *Pyorrhoea alveolaris*. (*See* TEETH, DISEASES OF.)

RIGOR (*rigor*, stiffness) means shivering. If prolonged, it is generally accompanied by raised temperature, and may be a sign of the onset of some acute febrile disease, such as influenza, pneumonia, or some internal inflammation. *Rigor mortis* is the name given to the stiffness that ensues soon after death. (*See* DEATH, SIGNS OF.)

RIMA (*rima*) is a term, meaning a crack or fissure, applied to any narrow natural opening, *e.g.*, rima glottidis, the chink between the vocal cords.

RINGWORM is a vague popular name which includes various diseases of the surface of the skin, caused by vegetable parasites of the nature of moulds. The technical name for ringworm is 'tinea', and this term includes *Tinea favosa*, also known as favus and honeycomb ringworm; *Tinea sycosis*, or pustular ringworm of the beard; *Tinea versicolor*, or pityriasis, which produces brown patches on the skin, as well as *Tinea tonsurans*, the general name applied to ringworm affecting the scalp; and *Tinea circinata*, which is the same disease, as it affects the skin of the body and limbs.

There are many other forms of ringworm affecting cattle, dogs, cats, birds, etc., and these are occasionally conveyed to persons handling the animals, while special types of ringworm are found in different parts of the world.

These diseases are closely allied also to the more serious conditions actinomycosis and Madura-foot, in which the special fungus causing them penetrates to parts beneath the skin.

Causes.—As already stated, the cause in every case is a vegetable parasite that penetrates among the superficial cells of the cuticle and down the follicles of the hairs. The particular parasite causing ringworm of the scalp is, in the great majority of cases, either the *Microsporon audouini* or *Trichophyton megalosporon*, while ringworm of the body or limbs is generally due to the latter. Favus is due to the *Achorion schœnleinii*, while *Tinea versicolor* is due to a parasite known as *Microsporon furfur*. All forms are contagious, some much more so than others. Peculiarities of the individual skin have much to do with the contagion; for example, persons with fine, fair hair suffer notably in greater numbers from ringworm of the scalp than do dark-haired people. Though persons of all ages contract spots of ringworm on the body, especially from handling animals, and on the face, yet ringworm on the scalp is almost entirely confined to children below the age of fourteen. The medium of infection may be the cap of another child suffering from ringworm, or brushes and combs used by affected persons. Ringworm of the beard (sycosis) is generally attributed to a 'foul shave', the infection having probably been conveyed on a barber's soap or brush from another person similarly affected.

Symptoms.—Very often children who get ringworm are of a weak constitution, but, apart from this, ringworm has little or no effect upon the general health. The disease consists of a disorder in the cuticle and hairs, with more or less inflammation in the underlying true skin. *On the body*, it begins as a small red pimple, which spreads out into rounded patches with raised, red, scaly margin, the skin looking more natural in the centre of each patch, where the disease has partly subsided. The patches are

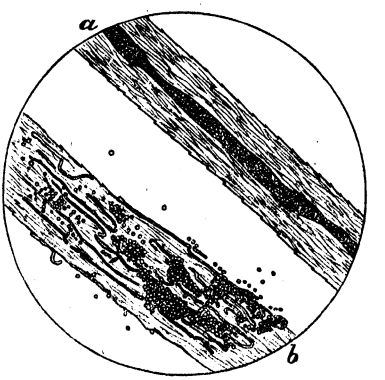


FIG. 392.—Microscopic appearance of two hairs: *a*, healthy hair; *b*, hair disorganised by the ringworm parasite, showing the spores and mycelium. Magnified by 300.

either in rings or spread in a serpentine course, this appearance having given the disease its name. *On the head*, one sees merely scaly patches showing the stumps of broken hairs; and if a hair be pulled out and examined under the microscope it is found to be surrounded by masses of the parasite or split up by its growth throughout the hair. Ringworm of the beard (sycosis) is apt to show great irritation, and each affected hair is surrounded by a small collection of pus. Ringworm of the head occasionally becomes pustular and inflamed, and, although this condition is a very disgusting-looking one, it generally brings about a natural cure. Favus appears as a yellow crust, and neighbouring crusts, being flattened by mutual contact, give the head its characteristic 'honeycomb' appearance. Even the nails may be affected by ringworm, and they then assume a discoloured, thickened, brittle condition. Many forms of eruption, formerly called eczema, and occurring on the hands, feet, armpits, and groins, are due to a form of ringworm parasite.

Treatment.—Ringworm on the body and limbs is almost always very easily got rid of; on the face it is harder to cure; while on the head, in children, it may run a course of months or years even under the most skilful treatment.

When on the body, it seldom fails to disappear speedily if painted night and morning with strong tincture of iodine (10 per cent). This has not only a destructive action upon the parasite, but it splits up the surface of the skin and gives the iodine free access to it.

Ringworm of the scalp in children is more difficult to treat. The hair must be cut as short as possible all round the patches, and thoroughly washed with soap at frequent intervals to remove all scales. Strong antiseptics are also rubbed in as ointments. Some of the most commonly used substances are perchloride of mercury, sulphur, carbolic acid, iodine, salicylic acid, chrysarobin, and formalin. Another mode of treatment, which is often successful, consists in painting the patch with croton oil. This causes a certain degree of inflammation down the hair follicles, the affected hairs drop out, and cure results. The application of the X-rays for a sufficient time just to make the hair fall out, very often effects a cure, and the hair should grow again after recovery.

In ringworm of the beard, the treatment is much the same as for the scalp condition. The hair may be either shaved or closely cut, and an antiseptic ointment rubbed in. A highly successful method of treatment, which is also quite painless, consists in pulling out several of the affected hairs daily, and pushing a carefully sharpened splinter of wood, which has been dipped in pure carbolic acid, down to the bottom of each empty follicle. A starch poultice may be applied each night.

Great precautions must be taken not to infect others. Children with ringworm of the scalp must not wear the caps of other children, nor go to school, nor to a barber. Persons with ringworm of the beard must not use shaving instruments employed by other people. When ringworm affects the body, the clothing must be disinfected.

RISUS SARDONICUS is the term used for describing the facial appearance when the muscles of the forehead and the face go into spasm in tetanus, giving the effect of a 'sardonic grin'.

ROCHELLE SALT, SEIGNETTE SALT, and TARTRATED SODA are other names for tartrate of sodium and potassium, a saline purgative which forms the chief constituent of Seidlitz powder. The dose of Rochelle salt as an aperient is 2 to 4 drams or a heaped dessertspoonful.

RODAGEN is the name of a preparation made from the milk of a goat from which the thyroid gland has been removed. It was formerly used as a remedy for exophthalmic goitre.

RODENT ULCER (*rodo*, I gnaw) is the name given to a very chronic form of ulcer, which is found chiefly about the nose and face of elderly persons, and which gradually increases in size. It stands between a simple chronic ulcer and a cancer, being much slower in its growth than the latter. Treatment consists in cutting out the ulcer with the healthy skin for a little distance all round. Recently, however, these ulcers

have been found to be very amenable to treatment by X-rays, radium, and other forms of radiant energy, and may heal up completely after a few exposures to radium.

ROENTGEN RAYS (*see* X-RAYS).

ROETHELN, or RUBELLA, is another name for German measles. (*See* GERMAN MEASLES.)

ROMBERGISM is a term applied to marked unsteadiness in standing with the eyes shut. It is found as a symptom in some nervous diseases, especially in locomotor ataxia.

RORSCHACH TEST is a method of investigating the personality and disorders of personality. It was devised by a Swiss psychiatrist now dead. He, Rorschach, determined persons' reactions to a series of symmetrical ink-blots, ten in number and standardised by him. The person investigated is shown the ink-blots in a defined order and is asked to describe what he sees. His descriptions and ideas about the blots are noted and an elaborate system of scoring is said to afford indications of the kind of personality and psychological make-up of the person investigated. Much work has been done on the test and it is thought highly of by experienced psychiatrists.

ROSACEA (*see* ACNE ROSACEA).

ROSE, or ST. ANTHONY'S FIRE, is an old name for erysipelas. (*See* ERYSIPELAS.)

ROSEMARY is a plant affording a fragrant volatile oil which is used in the form of spirit of rosemary. (*See* OILS.)

ROSEOLA is a term applied to any rose-coloured rash.

ROSE-RASH, or ROSEOLA, is an old name used to describe any eruption of a very faint red character. The term 'erythema' is now generally used in its place. (*See* ERYTHEMA.)

ROSE-WATER is prepared by soaking rose-petals in water and distilling over part of the fluid. It is used for gargles, as an ingredient of cold-cream, etc. Oil of rose, or attar of rose, is prepared by distilling the fresh flowers of *Rosa damascena*, about 180 pounds of roses being required in order to yield an ounce of this oil.

ROSIN, or COLOPHONY, is the name of a resinous substance remaining after oil of turpentine has been distilled from the pitch of pine wood. It is used for making plasters.

ROTENONE is the name of a substance obtained from derris root and used in the treatment of scabies.

ROULEAUX is the term applied to the heaps into which red blood corpuscles collect as seen under the microscope.

ROUND WORMS (*see* PARASITES).

ROUS SARCOMA is a malignant tumor of fowls which is caused by a filter-passing virus. This tumor has been the subject of much experimental work bearing upon the nature of cancer.

-RRHAPHY (*ῥαφή*, seam) is a suffix meaning an operation in which some opening or tear is closed by stitches.

RUBBING (*see* MASSAGE *and* LINIMENTS).

RUBEFACIENTS (*ruber*, red; *facio*, I make). (*See* BLISTERS AND COUNTER-IRRITANTS.)

RUBELLA is another name for GERMAN MEASLES.

RUBEOLA is another name for measles. (*See* MEASLES.)

RUE is the name of an herb, *Ruta graveolens*, from which a volatile oil with irritating properties is produced.

RUPIA (*ῥύπος*, dirt) is the term applied to an eruption characterised by the accumulation of thick crusts. Apart from the original cause of the eruption, the accumulation of the crusts is due to want of cleanliness.

RUPTURE (*rumpo*, I break) is a popular name for hernia. (*See* HERNIA.) The term is also applied to the tearing of a muscle or ligament, bursting of a blood-vessel, etc.

S

SACCHARIN is a soluble coal-tar product of white crystalline appearance. It has an extremely sweet taste, being prepared in various strengths so as to equal in sweetness from 300 to 500 times its own weight of cane-sugar. It escapes from the body unchanged, having practically no effect upon the tissues beyond its influence upon the sensation of taste. Accordingly it is used in doses of ½ to 2 grains by diabetics, corpulent persons, and others to whom sugar is harmful.

SACCHAROMYCES (*σάκχαρον*, sugar; *μύκης*, fungus) is another name for yeast.

SACCHARUM is the Latin name for ordinary cane-sugar or beet-sugar. (*See* SUGAR.)

SACRUM (*sacer*, sacred) is the name given to a portion of the spinal column near its lower end. The sacrum consists of five vertebræ fused together to form a broad triangular bone which lies between the two haunch-bones and forms the back wall of the pelvis.

SADISM (Marquis de Sade) is the term applied to a phase of insanity associated with sexual perversion, in which satisfaction is derived from the infliction of cruelty upon another person.

SAFE PERIOD.—That period during the menstrual cycle when fertilisation of the ovum is unlikely to occur. Ovulation usually happens about 15 days before the onset of the menstrual period. A woman is believed to be fertile for about 11 days in each menstrual cycle: *i.e.* on the day of ovulation and for 5 days before and 5 days after this. This would be the eighth to the eighteenth day of the usual 28-day menstrual cycle. Outside this fertile period is the SAFE PERIOD: the first week and the last ten days of the menstrual cycle. In the case of irregular menstruation it is not possible to calculate the safe period. In any event the safety is not absolute.

SAFFRON, or CROCUS, is a yellow powder derived from the dried stigmas and styles of the flower of *Crocus sativus*. It is used as a tonic and colouring matter, and there is a popular idea that its administration is useful in bringing out the rash of measles.

SAGITTAL (*sagitta*, arrow) is the term applied to a structure or section running from front to back in the body.

SAGO is the name of a starch derived from the pith of various species of palm.

ST. ANTHONY'S FIRE is an old name applied both to erysipelas and to ergot-poisoning.

ST. JOHN LONG'S LINIMENT is an old name for *Linimentum terebinthinae aceticum*, containing oil of turpentine, liniment of camphor, and glacial acetic acid. It is much used as an application for chronic rheumatism.

ST. VITUS'S DANCE, or CHOREA, is the name applied to a disorder of the nervous system occurring for the most part in children, and characterised mainly by involuntary jerking movements of the muscles. The name St. Vitus's dance was originally applied to those remarkable epidemic outbursts of combined mental and physical excitement which for a time prevailed among the inhabitants of some parts of Germany in the Middle Ages. It is stated that sufferers from this dancing mania were wont to resort to the chapels of St. Vitus, the saint being believed to possess the power of curing them. The name was transferred to the disease at present under consideration, with which it has evidently nothing to do, and the original application has been to a great extent lost sight of. The term SYDENHAM'S CHOREA is also frequently applied to this disorder to distinguish it from Huntington's chorea, a disease of hereditary nature which appears late in life, and is accompanied by mental defects.

Causes.—It is to be regarded as a rheumatic nervous disorder of wide extent, the manifestations of which appear chiefly in disturbances affecting the muscles. Among the predisposing

causes age is important, chorea being essentially an ailment of childhood, and more particularly of the period in which the permanent teeth are appearing. The greater number of the cases occur between the ages of nine and twelve. It is not often seen in very young children, nor after puberty; but there are many exceptions to this rule. It is twice as frequent with girls as with boys. It forms an occasional but rare complication of pregnancy.

There is a hereditary element in the disease. It is commoner in the highly strung than in the phlegmatic, and among the poor than among the rich. A family history of chorea, rheumatism, and of nervous disorders is common. The connection of some cases of chorea with rheumatism is shown not merely by its frequent occurrence before, after, or during the course of attacks of rheumatic fever in young persons, but even independently of this by the liability of the heart to suffer in a similar way in the two diseases.

The nature of this disease has given rise to much discussion. The fact that the great majority of cases recover would seem to show that there could have been no profound change in the structural integrity of the nerve-centres, while in those instances where a fatal result takes place, *post-mortem* examination reveals no constant morbid condition. In rheumatic and some other cases in which an organic change seems to be responsible, this is generally attributed to a degeneration of the cells in the ganglia at the base of the cerebrum, following upon acute congestion of these ganglia or blocking up of some of their vessels.

Symptoms.—The characteristic features are: (1) involuntary, purposeless, inco-ordinated movements; (2) weakness of voluntary movements; (3) loss of precision of movement; (4) psychological disturbances. The symptoms are usually preceded by changes in the temper and disposition, the child becoming sad, irritable, and emotional, while at the same time the general health is impaired. The first thing indicative of the disease is a certain awkwardness or fidgetiness of manner, together with restlessness, the child being evidently unable to continue quiet, but frequently moving the limbs into different positions.

In walking, too, slight dragging of one limb may be noticed. The convulsive muscular movements usually show themselves first in one part, such as an arm or a leg, and in most instances they may remain localised to that limited extent, while in all cases there is a tendency for the disorderly symptoms to be more marked on one side than on the other. The child when standing or sitting is never still, but is constantly changing the position of the body or limbs in consequence of the sudden and inco-ordinate action of muscles or groups of them. The shoulder is jerked up, the head and trunk twisted about, the limbs crossed suddenly and changed again, the fingers keep moving restlessly, while the face is distorted with grimaces, frowning and smiling irregularly. These symptoms are aggravated when purposive movements are attempted, or when the child is watched. Sometimes the disorder is first noticed owing to the frequency with which the child drops cups, plates, and similar articles. Speech is affected, both from the inco-ordinate movements of the tongue and from speech sometimes taking place during the act of drawing a breath. The taking of food becomes a matter of difficulty, since much of it is lost in the attempts to convey it to the mouth, while swallowing is also interfered with owing to the irregular action of the throat muscles. When the tongue is protruded, it comes out in a jerky manner, and is immediately withdrawn, the jaws at the same time closing suddenly and sometimes with considerable force. In walking the muscles of the limbs act inco-ordinately, and there is a marked alteration of the gait, and the child may be tripped by one limb being suddenly jerked in front of the other. The muscles of organic life (involuntary muscles) appear scarcely, if at all, affected in this disease, as, for example, the heart, the rhythmic movements of which are not, as a rule, impaired. But the heart may suffer in other ways, especially from inflammatory conditions similar to those which accompany rheumatism, and which frequently lay the foundation of permanent heart disease. (*See* HEART DISEASES.) Usually, there is a remission of the symptoms during sleep. The mental condition of the patient is

more or less affected, as shown in emotional tendencies, irritability, and a somewhat fatuous expression and bearing, but this change is in general of transient character, and ceases with convalescence.

This disease occasionally assumes a very acute and aggravated form, in which the disorderly movements are so violent as to render the patient liable to be injured and to necessitate forcible control of the limbs or the employment of anæsthetics to produce unconsciousness. Such cases are of very grave character, if, as is common, they are accompanied with sleeplessness, and they may prove fatal by exhaustion. In the great majority of cases of St. Vitus's dance, however, complete recovery is to be anticipated sooner or later, the symptoms usually continuing for from one to two months, or even sometimes longer.

Treatment.—The first step in treatment is to provide the patient with complete physical and mental rest. The disease, under suitable hygienic conditions, tends to recover of itself. These conditions, however, are all-important, and embrace the proper feeding of the child with a full nutritious diet, the absence of all sources of excitement and annoyance, such as being laughed at or mocked by other children, and the removal of any causes of irritation and of irregularities in the general health. For a time, and especially if the symptoms are severe, confinement to bed may be necessary, but as soon as possible the child should be taken out into the open air and gently exercised by walking. Of medicinal remedies the most serviceable are sodium salicylate and aspirin, especially the latter. After recovery the general health of the child should for a long time receive attention, and care should be taken to guard against excitement, excessive study, or any exhausting condition, physical or mental, from the fact that the disease is apt to recur and that other nervous disorders still more serious may be developed from it.

In the rare instances of the acute form of this malady, where the convulsive movements are unceasing and violent, the only measures available are the use of chloral or chloroform inhalation to produce insensibility and muscular relaxation, but the effect is only palliative and does not prevent the fatal result which in most cases quickly supervenes.

SAL AMMONIAC is another name for chloride of ammonium, which is largely used in cough mixtures and lozenges as an expectorant. A small piece placed between the teeth and cheek and sucked takes a long time to dissolve, and greatly softens the cough produced by irritation of the throat or bronchial tubes.

SAL VOLATILE is another name for aromatic spirit of ammonia, a liquid of burning taste and great stimulating powers. Its action depends upon various volatile oils, ammonia, and carbonate of ammonia which it contains. It is used as a stimulating expectorant in cough mixtures, and is very valuable as a stimulant in faints due to weakness of the heart's action. The dose is from half to one teaspoonful in a wineglassful of water.

SALEP is a mucilaginous substance derived from the dried tubers of various species of orchid. It is used to allay irritation of the stomach and bowels, and in India constitutes an article of diet.

SALERATUS is another name for bicarbonate of potassium.

SALICIN is an active principle derived from the bark of several species of poplar and willow trees. It is a crystalline powder of bitter taste and slight solubility. It is much used for the treatment of acute rheumatism, just as salicylate of soda is used.

SALICYLATE OF SODA is a white crystalline substance which is prepared from salicylic acid. It is very soluble in water, and has a sweet, mawkish taste, which to most people is very unpleasant.

Action.—This salt when dissolved in water has the power of increasing the solubility of various other substances. When taken internally in the course of acute fevers, and especially of acute rheumatism, it has the effect of reducing temperature, diminishing pain, and

causing profuse sweating. Its action is therefore similar to that of antipyrine, phenacetin, and other coal-tar products. When taken for some time, it causes fullness in the head, deafness, buzzing in the ears, curious disturbances of sight (so that the person may fancy he sees people in the room who are not there), and, if excessive doses be taken, great depression of the heart's action and of respiration. For the last-mentioned reason, great caution must be exercised when it is used by persons already exhausted by fever.

Uses.—The main use is in acute rheumatism, doses of 10, 15, or more grains being given several times daily, according to circumstances. Its harmful properties are avoided by giving it with an equal quantity of bicarbonate of soda. It not only diminishes pain and reduces temperature, but actually cuts short an attack of acute rheumatism. In tonsilitis and other inflammations of rheumatic nature its use is also followed by great benefit.

SALICYLIC ACID is a white substance in fine crystals, of sweetish taste, and sparingly soluble in water. It is derived from salicin, and is contained also in oil of wintergreen, oil of the sweet birch (*Betula lenta*), and in various other plants. It is also produced in large quantities by the action of carbonic acid gas upon carbolic acid. When produced in the latter manner it is much cheaper than when extracted from plants, though the natural salicylic acid is purer and better.

Action. — Salicylic acid prevents putrefactive processes, and is therefore used to preserve food substances, and also to saturate surgical wool, lint, and other dressings. It has no smell, like carbolic acid, but being non-volatile it is not so efficient as the latter. Externally it is used in ointments to check various skin affections due to bacteria, and, since it has in addition a softening action on the surface of the skin, salicylic acid plasters are used to remove corns, and various other superficial overgrowths.

Internally salicylic acid causes great irritation of the stomach, and is therefore seldom used, its place being taken for internal administration by salicylate of soda. (*See* SALICYLATE OF SODA.)

SALINES (*sal*, salt) are purgatives belonging to the class of salts which produce watery evacuations. (*See* PURGATIVES.) For normal or isotonic saline solution see ISOTONIC.

SALISBURY TREATMENT is a mode of dieting introduced by an American physician. Its chief use is in the treatment of corpulence (*see* CORPULENCE), but it is also valuable in other perverted states of health, where no acute disease is present.

SALIVA (*saliva*) is the fluid which is always present to some extent in the mouth, and is secreted in specially copious amount during a meal, or when the salivary glands are stimulated, as for example by an acid substance placed in the mouth. Saliva contains much mucus, a ferment known as ptyalin, which changes starch into dextrin and maltose (*see* DIGESTION), also many corpuscles similar to the white corpuscles of the blood, and large numbers of bacteria, which grow on the teeth.

An excessive flow of saliva known as *salivation* occurs as the result of taking certain drugs over a considerable period, the commonest being mercury, iodide of potassium, and arsenic. Salivation also occurs as the result of irritation in the mouth, from dyspepsia, etc. Dribbling of saliva is a common symptom of bulbar paralysis.

SALIVARY GLANDS are the glands situated near, and opening into the cavity of the mouth, by which the saliva is manufactured. They include the *parotid gland*, placed in the deep space that lies between the ear and the angle of the jaw; the *submaxillary gland*, lying beneath the horizontal part of the jaw-bone; and the *sublingual gland*, which lies beneath the tongue.

Each gland is made up of branching tubes closely packed together, and supported by strong connective tissue. These tubes are lined by large cells that secrete the saliva, and from their interior lead ducts that unite with one another to form ultimately the large main ducts that open into the mouth. The appearance and character of the secreting cells vary in different glands. In the parotid gland they secrete a clear fluid

containing the ferment ptyalin, in the sublingual gland they mainly produce mucus, while the submaxillary gland contains cells of both types.

SALMONELLA INFECTIONS (*see* FOOD POISONING).

SALOL is a white, crystalline, tasteless substance with faint aromatic odour. It is a compound of salicylic and carbolic acids, and since it remains unaffected in the stomach, but is broken up into its components by the pancreatic juice on entering the small intestine, it is widely used as an intestinal antiseptic, when it is desired to check fermentative and putrefactive changes. It is also used as an antiseptic for inflammation of the bladder, because its products, being excreted in the urine, exert an antiseptic action in the bladder.

SALOPHEN, or ACETYL-PARA-AMIDO-SALOL, is a crystalline substance containing about 50 per cent of salicylic acid, used in acute rheumatism like salicylate of soda and in similar doses.

SALPINGITIS (σάλπιγξ, a trumpet) is the name applied to inflammation situated in the Fallopian tubes.

SALPINGO- (σάλπιγξ, a tube) is a prefix indicating a connection with either the Fallopian or Eustachian tube.

SALT.—The substance produced by the replacement of the acidic hydrogen of an acid by a metal or basic radical. A synonym for common salt or sodium chloride.

SALTPETRE (*sal petræ*, salt of the rock). (*See* NITRE.)

SALUTARIUM (*salus*, health) is the name applied to a resort for the preservation of health.

SALVARSAN, or DIAMINO-DIHYDROXYARSENOBENZENE DIHYDROCHLORIDE, now usually known as ARSPHENAMINE, is a compound of arsenic used for the treatment of syphilis and other chronic infectious diseases. A modification, NEOSALVARSAN, or NEO-ARSPHENAMINE, prepared by the action of formaldehyde sulphoxylate on salvarsan has been found more suitable. It has a special affinity for and destructive action on lowly forms of animal life, like the parasites of sleeping sickness, syphilis, etc. Dissolved in distilled water or in emulsion, it is injected direct into a vein or into the substance of a muscle. Its action in syphilis is controlled by doing the Wassermann test before and again some time after its use.

SANATORIUM, or SANITORIUM (*sano*, I heal; and *sanitas*, health), is the name applied to an establishment for the treatment of sick persons, especially convalescents or those who are not extremely ill. The term is now applied particularly to institutions for the open-air treatment of tuberculosis. (*See* CONSUMPTION.)

SANDALWOOD OIL is a yellowish, fragrant-smelling oil with bitter taste obtained from the wood of *Santalum album* by distillation. It has an antiseptic action and is administered in doses of from 5 to 20 drops, frequently, for inflammation of mucous membranes, particularly those of the urinary organs.

SAND-FLY FEVER (*see* THREE-DAY FEVER).

SANDWORM is a popular name for the sand-flea or jigger. (*See* PARASITES.)

SANGUINEOUS (*sanguineus*) means containing blood.

SANIES means an evil-smelling, thin discharge from a wound or ulcer.

SANITARIUM is a modern term employed in much the same way as sanatorium, to indicate a health resort for treatment of non-tuberculous cases.

SANITAS is a fluid, consisting chiefly of oxidised turpentine dissolved in water which has a wide use as a disinfectant and deodorant. Its action depends upon peroxide of hydrogen, thymol, a soluble camphor, and camphoric acid.

SANITATION (*sanitas*, health), or the science which aims at the preven-

tion of disease, although really the product of modern years, was yet in its rudest elements recognised in ancient times. So well were its fundamental principles understood, that even in the Mosaic days isolation of infectious cases, disinfection of infected materials by burning, and regulations for the abatement of nuisances, were in force. The importance of adequate water supplies was appreciated even before the days of the Roman Empire, and the sewers of Nineveh point to the beginnings of the drainage systems of cities.

At first, preventive medicine took cognisance only of the preventable or infectious diseases, but in its vast ramifications at the present day it aims also at the improvements of the general health of the populace, by the mitigation of all external conditions which tend to disease in individuals. It is not a science independent or standing alone. It is the handmaiden of various sciences. It embraces a knowledge of medicine, bacteriology, engineering, meteorology, architecture, and geology. It aims at the reduction of infectious diseases, but these have been its greatest advisers and teachers. The recurrent epidemics of cholera which formerly invaded Britain forced the hands of the populace to remedy their water supplies and remodel their systems of drainage. Smallpox and its long roll of victims forced on the compulsory adoption of Jenner's discovery of the value of vaccination. These sowed the seed, and other infectious diseases have brought it nearer maturity. Improved sanitation in matters of ventilation, sewerage, water supply, hospital accommodation, the abatement of nuisances, and the inspection of meat has naturally followed from the first step in advance. Its value has been shown in the improved hygiene of the factory, where sanitation has been called in to save the workers from the dangers of their occupation, in meeting the demands of modern civilisation, and in the improved conditions of life in dwellings and in general surroundings. It aims at correcting the evils arising from the aggregation of people in cities and towns. It benefits the country dweller and the resident in town by improved methods of sewage and refuse disposal.

Much has already been accomplished. But a few years ago the death-rate in many places reached a total of more than 30 per 1000 inhabitants per year. To-day these places may show a death-rate of under 20 per 1000 per annum. We cannot estimate the effects of sanitary effort by single years. Results vary from year to year, but over a series of years the visible result of lives saved and lengthened, with its benefit to the State, is almost astonishing.

Sanitary law.—Numerous laws dealing with sanitary matters have been put in force in recent years. The general public health administration of the country is based, in England on the Public Health Act of 1875, and in Scotland on that of 1897, but into many Acts not primarily dealing with sanitation, sanitary provisions have been introduced, as in the various Factory and Workshop Acts. Special local Acts have also been obtained by various authorities, and almost every year some Act is passed by Parliament giving greater sanitary control.

In the various Public Health Acts, whether for England, Scotland, or Ireland, which constitute the basis of sanitary administration, machinery is provided for dealing with :

1. General nuisances and offensive trades.
2. Scavenging and cleansing and the formation of scavenging districts.
3. The seizure of unsound food.
4. The general prevention and mitigation of infectious diseases, including the provision of isolation hospitals, houses of reception, ambulances, disinfecting stations and apparatus. The diseases defined by Act of Parliament in Britain as infectious are,—smallpox, cholera, diphtheria, membranous croup, erysipelas, the disease known as scarlatina or scarlet fever, and the fevers known by any of the following names—typhus, typhoid, enteric, relapsing, continued or puerperal, and also any infectious disease to which the Act has been applied by the local authority in manner provided by the Act.
5. The regulation of common lodging-houses and houses let in lodgings.
6. The provision of water and sewers and the formation of special districts for water supply and drainage.
7. The regulation of buildings.
8. The constitution of port sanitary authorities.
9. Prevention of pollution of rivers by sewage.

10. Regulations as to sale and adulteration of foods.
11. Dairies, Cowsheds, and Milkshops Orders.
12. Various acts for housing of working classes, including Town Planning Acts.
13. Tuberculosis Orders, Factory and Workshop Acts.
14. Cleansing of persons.
15. Notification of births, Children's and Midwives' Acts.

Medical Officer of Health.—The Medical Officer of Health is required to acquaint himself with the general sanitary condition of his district, to suggest the steps he considers might be taken for its improvement, and to advise the local authority in all sanitary matters. He is expected to investigate all outbreaks of infectious disease, report upon them, and recommend and see carried into force such preventive measures as he deems necessary. He must, if it is advisable, or if he is directed by the sanitary authority, himself inspect any article exposed for food, and deal with it, if it is unsound. He advises also as to nuisances injurious to health. He is expected to keep a record of his actions, observations, and instructions. He is required to prepare an annual report on the sanitary condition of the district, the work accomplished by his department, the occurrence of infectious disease throughout the year, the general sickness and mortality returns, and the condition of the offensive trades, dairies, cowsheds, bakehouses, factories, and workshops, with a statement of his actions in regard to them. This report, and any special report prepared by him, must be forwarded to the Ministry of Health. He is also expected to inform the Ministry of any outbreak of dangerous infectious disease.

Sanitary Inspector.—The Sanitary Inspector attends to the general sanitation of the district, investigates all conditions of nuisances, sees that the regulations and by-laws relating to offensive trades are observed, and that all unsound meat is dealt with. He takes, if authorised by the sanitary authority to do so, samples under the Sale of Food and Drugs Acts, and if these be found adulterated, he takes action under the Act. He reports to the Medical Officer of Health any infectious disease, coming under his notice, occurring in the district. He is required to preserve records of his inspections and actions.

SANITATION

Nuisances.—A large number of objectionable processes are declared by the Public Health Acts to be 'Nuisances or injurious or dangerous to health.' Houses badly constructed or overcrowded, streets, ditches, water supplies, stables and byres, etc., if foul and unclean, accumulations of filth, factories overcrowded, ill ventilated and filthy, furnaces not consuming their smoke as far as possible, overcrowded cemeteries, etc., all constitute nuisances.

Every sanitary authority is required to have its district inspected for the detection of nuisances. Any person, however, who suspects the presence of a nuisance may complain to the sanitary authority, who will at once have the matter investigated. If the authority is convinced of the existence of a nuisance, a notice will be served on the person responsible, or, if the author cannot be found, on the owner or occupier of the premises, requiring the removal of the nuisance within a specified time. Under the Public Health Act, 1875, if the sanitary authorities fail to discharge their duty with reference to nuisances, individuals can appeal to the Ministry of Health, who may issue an order to be enforced in a High Court of Justice, or may direct any police officer of the district to institute the ordinary legal proceedings in case of nuisance. The most expeditious method, however, for individuals to gain redress in case of default by the sanitary authority, is to complain direct to a justice, and the court may make orders and exact penalties just as if the complaint had been made by the sanitary authority.

If the nuisance is not now removed, or is likely to recur, the sanitary authority may apply to a justice, who will require the presence of the person responsible before a court of summary jurisdiction. If satisfied that the nuisance exists, or is likely to recur, the court may at once decern, or may remit to a special inspector to report. When the court is satisfied of the existence of the nuisance, an order will be granted for its removal, and for the performance of such works as will prevent its recurrence. The

court has further the power, if convinced that the nuisance arises from wilful fault or negligence, to fine the author of the nuisance. Where the author is not known, the local authority may be directed to remove the nuisance themselves. Special by-laws are also made by municipal authorities with reference to their own towns.

Soil.—The nature of the soil is important as regards sites for building, the causation of disease, and the pollution of water. The soils which are porous, as gravels and sands, are held to be the most healthy. In such porous soils the interstices near the surface are filled with ground air, which gives place deeper down to ground or subsoil water. This ground air derives pollution from the decomposition of animal and vegetable matters, and of products brought down by the rain. The level of the ground water varies with the nature of the soil and the rainfall, in marshy land even reaching the surface, while in a dry season it may be several feet down. If, however, owing to a heavy rainfall, the level of the subsoil water is raised, the water rising in the interstices of the soil forces the ground air, which may be laden with microbes, out, and so the air may convey infective germs into houses. The ground water may further be contaminated by excreted discharges from leakages, from cesspools, sewers, and drains, and the water of wells drawn from the subsoil may therefore be seriously polluted. According to Pettenkofer, the ground-water level plays an important part in the occurrence of enteric epidemics. He holds that epidemics of enteric occur in Munich when a rise in the ground water is followed by a sudden fall, the temperature of the earth being suitable, and the specific organism of enteric fever being present. No conclusive proof of these statements has been found by experience in Britain.

'Made' soils from a town's refuse and rubbish contain all manner of vegetable and animal debris. The organic matter contained in such soils undergoes a gradual course of destruction. It is calculated that the more easily destructible matters are completely decayed in the course of three years. This decomposition is accomplished by microbes for whose work, moisture, oxygen, and a suitable temperature, all present in the soil, are required.

Houses and sites for building.—The health of the community depends in a large measure on the condition of its housing. Several factors contribute to the healthiness of a dwelling. The site must be suitable, the ventilation and water supply adequate, the construction must ensure the absence of dampness, and the sewage and refuse must be efficiently removed.

The site should be preferably on porous soil, such as gravel or sand, whence water can easily be carried away. In every case, whether on porous soil or on clay, the ground should be well drained. In towns, no choice can usually be made in the site, and houses are placed wherever convenient. Many are placed on 'made soils', but care ought to be taken that all organic matters have been completely decayed, a process which takes at least three years for completion, and not until that period has elapsed can a building be safely placed on a site of made soil. The site of the house should be covered by a layer of concrete to prevent the ground air and moisture gaining entrance into the house. The house should be so placed as to allow sufficient air to circulate around it, and to have abundance of light, and so elevated as to allow for proper drainage arrangements.

In the construction of houses, several points must be noted. The foundations must be strong enough to support the building upon them, while the walls should be built on a special basis of concrete. To obviate dampness further, an impervious layer of slates bedded in cement, or of lead, or asphalt, known as the *damp-proof course*, should be inserted in the wall, at least 6 inches above the ground level. This may also consist of a layer of perforated stoneware tiles, embedded in cement, which not only act as a hindrance to damp, but ventilate the area between the ground and the floor.

Where the basement floor has to be made under the ground level, a 'dry area' must be provided. This may be done by removing the earth to below the level of the floor, or the same end may be met by making the wall hollow (*see* Fig. 394) from the base to 6 inches above the ground level. In this case two damp-proof courses are needed: the

one at the foot of the hollow below the floor level, the other at the top of the cavity.

The walls of the house may be built

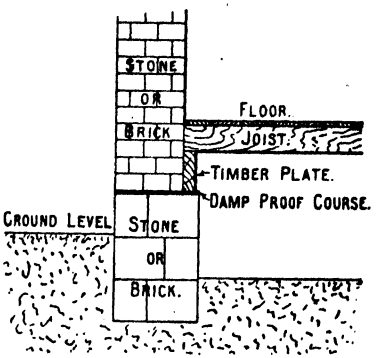


FIG. 393.—Foundation of a building in which the floor is above the level of the ground. The wall should rest on a concrete foundation.

of stone, bricks, mortar, and wood. The stones tend to absorb moisture, but not nearly so freely as bricks. One rod of brickwork has been shown, if the bricks are dry, to absorb no less than 40,000 ounces of water. Bricks also permit of the free percolation of air. Wood should be reserved for the inner

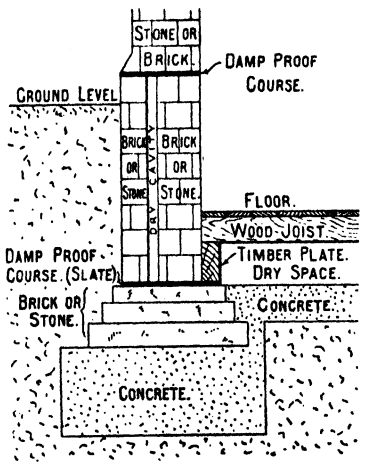


FIG. 394.—Foundation of a house with a sunk flat.

fittings of houses. It is desirable that the height of each room should be at least 10 feet. Each room should be supplied with adequate windows equal

in area to at least one-tenth of the floor space, while no boxed-in, ill-ventilated, and sunless apartments should be permitted. Special ventilators should be fitted up for each room, independent of the personal control of the occupants. (*See* VENTILATION.)

In towns great overcrowding of houses exists, due, only too frequently, to the inability of the householder to pay for a house large enough to accommodate his family with sufficient air-space. The Ministry of Health regard the minimum air space permissible as 300 cubic feet for an adult and half that amount for a child. Local authorities and private individuals have endeavoured to provide cheap and efficiently sanitary houses, so that the artisan may obtain a house sufficient for his needs at a low rent, but until more has been done in this way, the evils of overcrowding will still continue to exist.

Dampness in houses may arise from moisture finding its way up the walls where damp-proof courses are not provided; and, where the house is in an exposed position, by rain being driven through the walls. This dampness arising from the driven rain can be prevented by covering the walls with some impervious material, as glazed tiles or Portland cement. Defective mortar, broken rain-pipes and gutters, choked gutters and drains, leaks in water and drainage pipes, and defects in the roof and the slating may all lead to dampness. In very poor districts, where the house walls may be partially underground, the rain-water may collect, saturate the soil, and so soak through the bricks. In this case, each back-court should be paved and gulleys provided to conduct off the rain-water and prevent its collecting.

Streets and open spaces.—Streets not only act as thoroughfares for traffic, but also provide for ventilation and admission of sunlight to buildings, in addition to constituting the course for the main sewers and water-supply pipes. The width of the street is important with reference to the height of the houses along it. Too narrow a street with high buildings implies dingy, dark, ill-ventilated dwellings. Considerable powers have, therefore, been given to sanitary authorities under the various Public Health Acts to regulate the width of the street, the height of the buildings, and

as to repair. The model by-laws of the Ministry of Health, adopted largely by sanitary authorities, suggest regulations with regard to the formation of new streets. They fix the minimum width of any new street to be used as a carriage road and over 100 feet long at 36 feet. Where it is not intended to be used as a carriage-way and is less than 100 feet long, 24 feet of width is allowed as the least permissible. In a new street used as a carriage road the carriage-way of the street shall be at least 24 feet wide, and the footpaths on each side must be at least one-sixth of the total width of the street. The carriage-way must slope from the centre to the channels, and the foot-way must also be inclined towards the kerb. These latter precautions provide for easy removal of water, the moisture falling down to the channels. Each street must be open at one end, in its full width, from the ground. The regulation instanced above that 24 feet is the narrowest street now allowed to be made, guarantees a sufficient space in front of the buildings for the free circulation of air, and also provides for the gradual widening of the many narrow by-ways in old towns, as, whenever an old building is to be torn down and a new domestic building erected in its place, this new building must be set back so that there is space in front of it to the other side of the street of at least 24 feet.

More important still is the regulation dealing with the air-space required in the rear of the new house. The person who builds the new house must provide an open space in the rear, running the entire width of the building, of at least 150 square feet, free from any erection except a water-closet, earth-closet or privy, and an ashpit. The distance across this open space to the boundary of the land or premises opposite must at the least be 10 feet, and if the height of the building be 35 feet or more, this distance must be increased to 25 feet. This regulation aims at preventing the erection of 'back-to-back' houses, with their attendant evils of lack of ventilation and free circulation of air.

Air and ventilation.—Pure atmospheric air contains a little over 20 per cent by volume of oxygen, about 79 per cent of nitrogen, and about 4 parts per 10,000 of carbonic acid gas, together with traces of watery vapour, ammonia, etc. The carbonic acid present is generally accepted as the standard of impurity. The air is naturally purified by winds driving the impurities away and allowing fresher air to take its place; by rain removing dissolved gases and washing away suspended impurities; and by vegetable life absorbing carbonic acid in the day-time and giving off oxygen. Fogs tend naturally to pollute it. It is vitiated by respiration, combustion, putrefactive processes of animal and vegetable matters, and by the products of trades and industries, such as the mineral particles set free in grinding and the organic effluvia given off in soap-making, bone-boiling, and tannery work.

Sewer gas itself, in a well-ventilated sewer, differs little from the external air, but when the sewer is badly constructed, ill ventilated, and the sewage is stagnant and allowed to putrefy, the bubbles of sewage gas are highly offensive, and set free injurious gases, dead particles of organic matter, and living microbes of disease.

Smoke from factories and open fires is a serious problem in diminishing the sunshine of large towns, but is being gradually lessened by the increasing use of gas and electricity.

Water and water supplies.—An adequate supply of water is necessary for every condition of life. Its importance has been recognised and appreciated from earliest times, and is closely bound up with the industrial activity and progress, as well as the health of communities. The health and industries of Glasgow owe their prosperity in some measure to the excellent supply from Loch Katrine. The increase in the purity of the supplies of this country has undoubtedly lessened the occurrence of water-borne epidemics of disease. Every township of any importance at the present time aims at possessing a pure and abundant supply. This supply is utilised for domestic, municipal, and trade purposes. The domestic supply must be liberal for cleanliness, cooking, drinking, and sanitary requirements. Municipal requirements for washing the streets, flushing the sewers, and extinguishing fires, absorb a considerable quantity. Trade processes vary in their demands, according to the nature of the industries. It is generally

estimated that at least 25 gallons each day per head of the population are needed for domestic arrangements, 10 gallons for municipal purposes, and probably 25 gallons additional for manufacturing businesses. No hard and fast rule can be set. The only limitation to be given is that the supply be abundant and pure, no wasteful extravagance being permitted. In towns where the industrial demands are exceptional, considering the size of the population, an average as high as 70 gallons per day per individual for all purposes is required. As an average, however, in an ordinary town about 50 gallons per day per head for all purposes will be needed.

The original source of all water supply is the rain and the dissolved snow. This may be gathered and used. Part, however, may sink through the soil, to reappear in the form of springs, or to be reached by means of wells. Part may flow on the surface as rivers and streams, or may be collected together in lakes. All these may form the source of supply. (For further details consult the article on WATER SUPPLY.)

Refuse and sewage disposal.—The subject of refuse and sewage disposal is concerned with removal from towns and from buildings of the waste matters. These waste matters consist chiefly of two distinct kinds — the excreta and waste waters, commonly dealt with as one in the sewage; and, secondly, the dry refuse. The dry refuse includes the dust, ashes, and debris of vegetable and animal food from the households, the sweepings of streets and cattle-sheds, manure of horses and cows, and the dust and mineral particles of trade processes. The liquid and solid excreta and the waste water of houses have to be dealt with in sewage disposal. All the dry refuse is usually removed together by mechanical labour or scavenging, the scavengers, where it is possible, removing the refuse daily. Where a daily service cannot be instituted, the householder should burn at once all vegetable and animal food remnants, so that unpleasant decomposition may not set in before the arrival of the scavengers' carts. In many districts the dry refuse and human excretions are still removed together by the scavengers, the excretions being taken from the privies, dry-closets, and cesspools. This combination in treatment of the two divisions of waste matters is known as the 'conservancy system'. The ideal method, however, for the disposal of human excretions and waste waters is by means of drains and sewers, in which this refuse is removed in a liquid condition away from the neighbourhood of houses and dwellings by the 'water carriage system'.

Details of the various processes will be found in the article on REFUSE AND SEWAGE DISPOSAL.

Food and disease.—BUTCHER MEAT.—Butcher meat, if good, should be firm and elastic, marbled with fat, deep red in colour, neither purulent, livid, nor too moist. Various parasites may be present in meat which is diseased. The *Trichinella spiralis*, encapsuled, may be found in the muscles of the pig, and so infect man; while cysticerci in the ox and the pig produce tapeworms in man. (*See* PARASITES.)

Meat which is infected or contaminated with bacterial toxins, if eaten, may cause alarming symptoms of vomiting, diarrhœa, and colic. (*See* FOOD POISONING.) The microbes of putrefaction in this case have given rise to poisonous substances. Anthrax and tuberculosis may be spread to man from meat affected with these diseases, but cooking usually destroys all tubercle bacilli.

Meat may be preserved by salting, pickling, or canning.

MILK.—Milk, being one of the chief articles of food, is often suspected of being the means of carrying disease. The cows are, therefore, periodically inspected, under the powers given in the Dairies, Cowsheds, and Milkshops Orders for the detection of diseases. Milk may convey the infecting organisms of bovine tuberculosis, scarlet fever, enteric fever, diphtheria, undulant fever, septic sore throat, and of FOOD POISONING (*q.v.*). Being so largely used as a food, it is frequently adulterated, water being the commonest adulterant, while cream is often abstracted. Occasionally the dealer adds such articles as borax, salicylic acid, and boracic acid, in order to preserve the milk fresh and sweet. (*See* MILK.)

BUTTER.—Butter may be adulterated with foreign fats and additional water. Margarine is occasionally substituted.

COFFEE.—Coffee may contain excess of chicory.

WHEAT FLOUR.—Wheat flour is sometimes adulterated with other grains.

Foods are now rigidly inspected. Samples are taken for analysis, and if these are found to be adulterated the owners are prosecuted, and may be heavily punished. At every slaughter-house, inspection of meat is carried through as a matter of routine, and no meat which is declared unsound is allowed to be sold. (*See also* ADULTERATION OF FOOD.)

Infectious diseases are due to the entrance into the body of certain bacteria or their toxins, or of filterable viruses which multiply in the system, and can be given off from the person affected, and thus may be received into the body of other individuals, in whom they may reproduce the disease. Hence the diseases are known as infectious diseases. For several diseases, definite organisms have been found to be the cause.

The infectious diseases may be spread from a person in various ways.

1. By the breath, as in scarlet fever, measles, whooping-cough, smallpox, etc. In many cases the expired air gathers its infection from the throat. In typhus the organism is carried from the infected person to the healthy by means of the body-louse. In smallpox, infection is, however, believed to be able to be carried long distances through the air. It is for this reason that smallpox hospitals are best situated far in the country.

2. By particles of skin and the dried purulent crusts of smallpox.

3. By excretions and secretions. The discharges from the throat and nose are highly infectious in scarlet fever, diphtheria, and measles. The fæcal excretions in enteric fever and cholera contain the infection. The purulent discharges of abscesses and pustules in certain diseases infect. The sputa of phthisical patients contain the tuberculous organism. The urine in enteric fever is infected and can convey the disease. Milk, water, and foods are often infected by excretions, defects in the drains allowing the excretions to soak through and infect the waters of wells, or the water used in washing and cleaning conveys the infection to the utensils in which the milk is received and the food cooked. These articles of diet may also be infected by direct contact with the excretions of a carelessly treated patient, and localised epidemics of infectious disease may thus frequently originate. Contamination of food frequently occurs through the medium of flies. (*See* INSECTS IN RELATION TO DISEASE.)

If the person is susceptible to the disease, a period elapses after the organism is received, known as the incubation period, during which no symptoms develop, but during which the organism multiplies and produces its poison. This period varies with each disease. (*See* INCUBATION, INFECTION.)

METHODS OF PREVENTION may embrace removal of cases to hospital or isolation at home; disinfection of clothing, bedding, and premises; isolation, if necessary, of persons who have been in contact with certain diseases; closure of schools if the disease is being spread by the school connection (*see* INFECTION); stoppage of milk supplies if these be infected, and injection of protective sera, as in those exposed to diphtheria, and the performance of vaccination upon persons who have come in contact with cases of smallpox.

SMALLPOX.—Smallpox was formerly an extremely common disease in this country, but is now largely limited to epidemics at considerable intervals. Before vaccination was made compulsory children were largely affected. It is now chiefly a disease of adults. The greatest season of prevalence is during the cold months of winter and spring. The exhalations and purulent crusts are the chief means of conveying infection. (*See* SMALLPOX, VACCINATION.)

SCARLET FEVER.—The greatest number of cases occurs in young children It is generally endemic in the large towns of Britain, but from time to time assumes epidemic proportions. Since isolation has been carried out, the fatality rate has been greatly reduced, the type of the disease being milder, but the prevalence of the disease has been little reduced. The infection is chiefly spread by discharges from the throat and nose, and the particles of desquamation. Milk is occasionally infected and spreads the disease. (*See* SCARLET FEVER.)

DIPHTHERIA.—Infection passes from case to case by the exhalations and discharges from the nose and throat. Milk epidemics occasionally occur where

the milk has become infected by the discharges from some patient living at the dairy or from some case infecting the milk during the course of distribution. Schools aid in spreading the disease by the presence of some scholar suffering from a mild unrecognised attack. The most important preventive measure is the inoculation of school children and the 'pre-school child' with diphtheria prophylactic, as, for example, with alum-precipitated toxoid (A.P.T.). Great advance was made with this measure in the Ministry of Health's campaign in the early 1940's. (*See* DIPHTHERIA.)

ENTERIC or TYPHOID FEVER.—Its prevalence has been largely reduced by adequate water supplies and improved sanitary conditions. The excreta are highly infectious and must be carefully disinfected. Milk and water have been contaminated and have led to large epidemics. (*See* ENTERIC FEVER.)

TYPHUS FEVER.—Poverty, with its consequences in privation, overcrowding, and filth, is the chief predisposing cause of this disease. (*See* TYPHUS FEVER.)

MEASLES and WHOOPING-COUGH are largely diseases of childhood. With increase of years the liability to attack is reduced. The severity is greatest in the very young, who should, therefore, be protected from infection and not exposed. The number of deaths per year among children due to these diseases is much larger than is commonly supposed. Convalescent serum and immune globulin are useful in preventing measles in the very young or frail, or in modifying the disease in the robust child, when known exposure to infection has occurred. Prevention of whooping-cough by means of a vaccine now (1943) seems to be in sight. (*See* MEASLES, WHOOPING-COUGH.)

PHTHISIS, or CONSUMPTION, due to the tubercle bacillus, is now recognised as an infectious disease. Preventive measures are now beginning to be employed, as disinfection of clothing, apartments, and sputa, and isolation of cases in sanatoria. The mortality has steadily declined for several years, due to the effect of sanitary improvements, but much still remains to be done to check this most fatal infectious disease. (*See* CONSUMPTION.)

Disinfection and disinfectants.—Disinfection consists in the destruction of the organisms or other agencies of disease. It is accomplished by means of disinfectants, of which sunlight, fresh air, and fire are the most efficient and natural. During epidemics, milk or water, if suspected of being infected, should be boiled. All cloths, etc., used to clean up discharges from infectious cases should, if possible, be destroyed, while, if the bedding and clothing are totally worthless or in a wretched condition, they may also be burned. Many of the ordinary disinfectants, though containing disinfectant materials, are used in such strength as only to act as deodorants, and so, while removing the noxious odours, particularly of excreta, do not destroy the infecting material and consequently give only a false sense of security. For the varieties and uses of disinfectants see DISINFECTION.

Disposal of the dead.—The chief object in the disposal of the dead is the speediest method by which the body can be dissolved into its simplest components. Two methods are in vogue in Britain, namely, burial and cremation.

BURIAL, from a sanitary point of view, should take place in a loamy or sandy porous soil, well drained, and so situated as not to contaminate any water supply, and preferably removed from the neighbourhood of houses. The body should be confined in a thin, easily disintegrated coffin. Oak and lead coffins and brick vaults all violate the first principles of burial. Coffins must be separated from each other by at least one foot of earth, and no coffin is permitted to be nearer the surface of the ground than 4 feet.

Under the Public Health (Scotland) Act, 1897, section 16, any 'Churchyard, Cemetery, or place of Sepulture so situated or so crowded or otherwise so conducted as to be offensive or injurious to health,' may be dealt with as a nuisance. Under this power many of the old overcrowded churchyards have been closed.

CREMATION is, perhaps, the best sanitary method of disposal, especially in cases of infectious disease, the germs of some of which can exist in the soil. The sanitary reason for it is powerful, but its adoption prevents the possibility of exhumation, and so might occasionally

prevent the detection of crime. (For further details see DEAD, DISPOSAL OF.)

SANOCRYSIN is a proprietary name for thiosulphate of gold and sodium which is used for the treatment of some cases of early tuberculosis of the lungs, rheumatoid arthritis, etc. (*See* GOLD SALTS.)

SANTONIN is a yellow crystalline powder obtained from 'santonica,' also known as 'worm-seed', the dried flowers of *Artemisia maritima*, which is brought from the Levant. It is used for its action in expelling worms, as it is highly poisonous to round-worms and thread-worms, though it has little or no action upon tapeworms. Santonin is generally given in doses of about 1 grain to children or 3 grains to adults, repeated several times on one day, and it is very commonly taken in the form of lozenges containing one grain each. Like other remedies against worms, its use must be preceded by a period of fasting and followed by castor oil or other purgative. When too large a dose has been taken, yellow or green vision is apt to result for a time.

SAPHENOUS (*σαφηνής*, manifest) is the name given to the two large superficial veins of the leg. The external saphenous vein which runs up the outside and back of the leg joins the deep veins at the bend of the knee; the internal saphenous vein which has a long course from the inner ankle to the groin is specially subject with its branches to become the seat of varicose veins.

SAPO is the Latin name for soap.

SAPRÆMIA (*σαπρός*, decayed; *αἷμα*, blood) is the name applied to a mild form of blood-poisoning. (*See* BLOOD-POISONING.)

SAPROPHYTE (*σαπρός*, putrid; *φυτόν*, plant) is the term applied to organisms which live usually upon decaying and dead matter and produce its decomposition.

SARCINA (*sarcina*, a bundle) is a microscopic vegetable growth, which is found in the material vomited or drawn off by the stomach tube from a dilated stomach. Its presence is a valuable diagnostic point in this condition, since

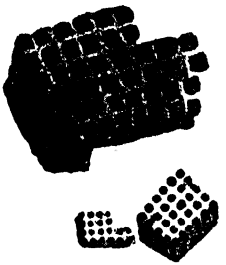


FIG. 395.—Sarcinæ, large and small varieties, from the contents of a dilated stomach. Magnified by 1500. (Thoma's *Pathology*.)

it does not grow in a stomach which empties itself naturally within a few hours of each meal.

SARCO- (*σάρξ*, flesh) is a prefix signifying flesh or fleshy.

SARCOMA (*σάρκωμα*, a fleshy growth). (*See* CANCER.)

SARCOPTES is another name for the *Acarus scabiei*, the mite which causes itch. (*See* ITCH, PARASITES.)

SARSAPARILLA is the root of various species of *Smilax*. It is largely used in domestic medicine as a 'blood-purifier', and is an ingredient of many patent medicines, but it seems to be really possessed of very little power. It is said, however, when combined with other drugs, such as iodide of potassium, to increase the effect of the latter.

SASSAFRAS is the name for a genus of laurel trees. The root bark of *Sassafras variifolia* contains an oil, and its fluid extract was formerly much used in the treatment of various skin diseases. Mucilage derived from sassafras is also used in bronchial and gastric affections.

SATURNINE POISONING (*saturnius*, belonging to Saturn, leaden) is another name for lead-poisoning. (*See* LEAD-POISONING.)

SAUSAGE POISONING may be of the nature of ptomaine poisoning or of the special form known as botulism. (*See* PTOMAINE POISONING *and* BOTULISM.)

SAVIN is the name applied to the leaves of *Juniperus sabina* which affords an acrid volatile oil. It is used in small doses in the treatment of rheumatism, gout, and painful menstruation. It is very liable to produce abortion, and in any but very small doses is an irritant poison.

SAXIN is a substance closely resembling saccharin.

SCAB is the name given to the crust which forms on superficial injured areas. It is composed of fibrin which is exuded from the raw surface together with blood corpuscles and epithelial cells entangled in its meshes. Healing takes place naturally under this protection, and the scab dries up and falls off when healing is complete. Scabs appearing on the face without any previous abrasion are frequently of infectious nature. (*See* IMPETIGO.)

SCABIES (*scabies*, scab). (*See* ITCH.)

SCALD HEAD is the old name for favus. (*See* RINGWORM.)

SCALDS (*see* BURNS AND SCALDS).

SCALP is the soft covering of the skull upon the top of the head. It consists of five layers, which from the surface inwards are as follows: the skin, thickly furnished with hair; next a subcutaneous layer of fat, rendered tough and stringy by many bands of fibrous tissue passing through it to bind the skin and the third layer together; thirdly, a tough membrane composed of fibrous tissue, known as the 'epicranium'; fourthly, a loose layer of connective tissue attaching the epicranium to the deepest layer, and permitting the free movements of which the scalp is capable; and, finally, another fibrous layer clinging closely to the skull, and known as the 'pericranium'.

SCALPEL (*scalpellum*) is a small, straight, surgical knife.

SCAMMONY is a resin derived from the root of *Convolvulus scammonia*, a plant of Asia Minor and Syria. It acts as a powerful purgative, and is used as an ingredient of medicines intended for this purpose.

SCAPULA is another name for the shoulder-blade. (*See* SHOULDER-BLADE.)

SCAR is the name applied to a healed wound, ulcer, or breach of tissue. A scar consists essentially of fibrous tissue, covered by an imperfect formation of cuticle in the case of scars on the surface of the skin. The fibrous tissue is produced by the connective tissue corpuscles that wander into the wound in the course of its repair (*see* WOUNDS), and is at first delicate in texture and richly provided with blood-vessels. Accordingly a scar at first is soft, and has a redder tint than the surrounding skin. Gradually this fibrous tissue contracts, becomes more dense, and loses its blood-vessels, so that an old scar is hard and white.

The more specialised textures are not repaired when a scar forms: thus on the skin-surface the scar does not reproduce hairs and sweat-glands, only the general epithelium growing over the

FIG. 396.—Fibrous tissue, of which a scar is mainly composed. The upper figure shows the delicate network formed by cells in the repair of a wound; the lower figure shows the dense fully formed state. (Miller's *Surgery*.)

wounded surface. Similarly in the case of internal organs, such as the stomach, no glands form anew in the scar. When muscles or nerves are wounded, however, new muscle- or nerve-fibres grow into the scar. Bone is repaired by a formation of fibrous tissue, which is produced just as in the soft parts, and later lime salts are deposited in the scars. (*See* BONE.)

The contraction that takes place in a scar has already been mentioned. The

more quickly the surfaces of a wound are brought into contact with one another, the less fibrous tissue is produced for the union. Consequently a wound whose edges are accurately brought together and in which healing is rapid shows far less contraction afterwards, and leaves a fainter scar, than one in which the wound is allowed to gape, and in which healing is slow. Burns are therefore followed by very marked scars and great contraction, which frequently produces marked deformity of the part concerned. Similarly, when inflammation takes place, as when an operation wound becomes infected, or when such a disease as lupus is present, causing great irritation of the wound, a wide, unsightly scar results and causes much puckering of the surrounding skin as it contracts. Such scars are also of low vitality, stretch easily, so as to become still more evident, and if irritated, as, for example, by the pressure of a boot or badly fitting artificial limb, readily give way and produce an ulcer which is slow to heal. Unsightly scars on the face often can be removed by a combination of surgical procedure and radium applications.

Scars are sometimes extremely painful, especially those which are left after the amputation of part of a limb. This is caused in general by the involvement of a sensory nerve in the hard contracting tissue of the scar.

SCARF-SKIN is another name for the cuticle or epithelium which forms a thin, horny covering everywhere for the true skin. (*See* SKIN.)

SCARIFICATION (σκάριφος, a scratching tool) means the making of shallow cuts in the skin for the purpose of drawing blood.

SCARLET FEVER and SCARLATINA are names applied indifferently to an acute infectious disease, characterised by high fever, sore throat, and a diffuse red rash upon the skin, due to infection with a hæmolytic streptococcus. This fever appears to have been first accurately described by Sydenham in 1676, before which period it had evidently been confounded with smallpox and measles.

Causes.—Scarlatina is a highly contagious malady. The patient is infectious from the time of the first symptoms, and the infectivity is greatest at the height of the fever, thereafter gradually falling off as the disease declines. It is not always easy to say with certainty when infectivity ceases. The tendency is to shorten the period of isolation, four weeks being quite usual, provided that at the end of this time the patient has no infectious discharges, as from the nose. The clothes and other articles which have been in contact with a patient are infectious, and may remain so for a long time, especially if they are excluded from light and air. The disease may be carried by milk, which is probably as a rule contaminated by some infected person working on its distribution or in the dairy. Scarlatina is a disease especially of young children, although school infection does not play as important a part in its spread as in the case of diphtheria or measles. Adults may also suffer if they have not had this fever in childhood, but one attack usually confers immunity from a second. Certain constitutional conditions predispose to its development, such as overcrowding and neglect of children, and susceptibility varies very markedly in different persons. Women in the puerperal state are particularly liable to contract infection, and inflammatory conditions of the throat such as diphtheria also render persons more vulnerable to scarlatina.

Surgical scarlatina is a name given to a mild condition of fever with red rash and sometimes enlargement of glands, which may accompany septic conditions such as burns, empyema, and other abscesses. It appears to be due to streptococcal infection, but is seldom if ever conveyed from person to person.

Symptoms.—The period of incubation (*i.e.* the time elapsing between the reception of infection and the development of symptoms) varies somewhat. In most cases it lasts only two to three days, but in occasional cases the patient may take a week to develop his first symptoms. The invasion of this fever is usually short and sharp, with rapid rise of temperature to 104° or thereabouts in the first few hours. There also occur shivering, vomiting, headache, sore throat, and marked increase in the rate of the pulse. In young children convulsions

SCARLET FEVER

or delirium may also usher in the fever. At the end of about 24 hours from the commencement of the fever the characteristic eruption appears. It is first seen on the neck, chest, arms, and hands, but quickly spreads all over the body and legs. The rash consists of minute, thickly set, red points which coalesce to form a general redness not unlike that produced by application of mustard to the skin. The rash tends to avoid the region of the nose and lips (circumoral pallor). Sometimes the redness is accompanied by small vesicles containing fluid. In ordinary cases the rash is at its height in about two days and then

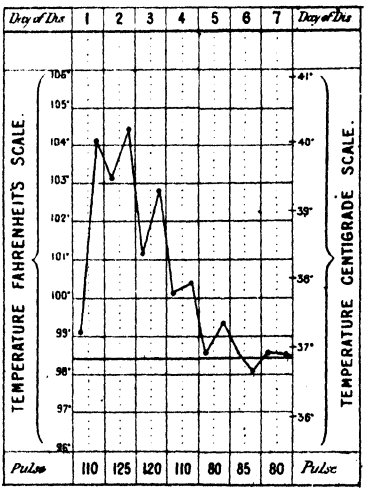


FIG. 397.—Temperature chart from a case of scarlet fever.

begins to fade, being gone at the end of a week from its first appearance. The severity of a case is to some extent measured by the copiousness and brilliancy of the rash, except in the malignant variety of the fever when the rash may be suppressed. The tongue at first is covered by thick, white, creamy fur through which on the second day red papillæ project, giving the appearance of a 'white strawberry tongue'. The fur is then gradually denuded, and by the fourth or fifth day the tongue is red, bare, and glazed—'red strawberry tongue'. The interior of the throat is red and swollen, especially the uvula, soft palate, and tonsils, and a considerable amount of secretion is found on the inflamed surfaces. The glands under the jaw are slightly swollen and tender. In favourable cases the fever falls distinctly about the third day, the symptoms at the same time rapidly improve, and the rash fades. The throat becomes more comfortable, and desquamation of the cuticle shows itself first about the cheeks and neck, and later spreads all over the surface of the body. The desquamation may be in the form of fine bran-like scales, or the cuticle may come off in large pieces, especially about the hands and feet. The duration of this process is variable, but it is rarely completed before the end of six weeks, or even more. During this stage the patient, who is now feeling quite well, must take particular care against exposure to cold, for during the desquamating stage there is special liability to inflammation of the kidneys.

Varieties.—Scarlet fever shows itself in certain well-marked varieties, of which the following are the chief:

1. SCARLATINA SIMPLEX is the most common form; in this the symptoms, both local and general, are moderate, and the case usually runs a favourable course. It is always, however, to be borne in mind that the duration and the infectiveness of the disease, including its convalescence, are uninfluenced by the mildness of the attack. In some instances the evidences of the disease are so slight, as regards both fever and rash, that the disease escapes observation and only becomes known by the patient subsequently 'peeling' or suffering from some of the complications associated with it. In such cases the name *latent scarlet fever* (*scarlatina latens*) is applied. Such cases are often responsible for spreading the disease, because, though there may be little more in the way of symptoms than a sore throat, the disease is nevertheless infectious.

2. SCARLATINA ANGINOSA is a more severe form of the fever, particularly as regards the throat symptoms. The rash may be well marked or not, but it is often slow in developing and in subsiding. There is intense inflammation of the throat; the tonsils, uvula, and soft palate being swollen and ulcerated, or having upon them membranous patches not unlike those of diphtheria, while externally the gland tissues in the neck are enlarged and indurated and fre-

quently become the seat of abscesses. There is difficulty in opening the mouth; an acrid discharge exudes from the nostrils and excoriates the lips, and the countenance is pale and waxy-looking. This form of the disease is marked by great prostration of strength, is often attended by delirium, and is much more frequently fatal than the preceding. In any case the rise of temperature is prolonged; swallowing is difficult; there is very often inflammation of the middle ears; and broncho-pneumonia, inflammation of the joints, and albuminuria are frequent complications.

3. SCARLATINA MALIGNA is the most serious form of all. The malignancy may be variously displayed. Thus a case of scarlatina anginosa may acquire such a severe character, both as to throat and general symptoms, as rapidly to produce profound exhaustion and death. But the typically malignant forms are those in which the attack sets in with great violence and the patient sinks from the very first. In such instances the rash either does not come out at all or is of the slightest amount and of livid rather than scarlet appearance, while the throat symptoms are often not prominent. Death in such cases may take place in from twenty-four to forty-eight hours, and is frequently preceded by great elevation of the temperature of the body and by delirium, coma, or other nervous symptoms. A further example of a malignant form is occasionally observed in cases where the rash, which has previously been well developed, suddenly recedes, and convulsions or other nervous symptoms and rapid death supervene. These exceptionally severe cases are not now so common as they were some thirty or forty years ago.

Complications.—The most common and serious of these is *inflammation of the kidneys*, which may arise during any period in the course of the fever, but is specially apt to appear in the convalescence, while desquamation is in progress. Its onset is sometimes announced by a return of feverish symptoms, accompanied with vomiting and pain in the loins; but in a large number of instances it occurs without these and comes on insidiously. One of the most prominent symptoms is slight swelling of the face, particularly of the eyelids, which is rarely absent in this complication. If the urine is examined, it will probably be observed to be diminished in quantity and of dark smoky or red appearance, due to the presence of blood; while it will also be found to contain albumin. This, together with the microscopic examination which reveals the presence of tube casts containing blood, epithelium, etc., shows a condition of acute inflammation of the kidney (glomerular nephritis). In favourable cases these symptoms may soon disappear, but they may, on the other hand, prove extremely serious—the risks being the suppression of urine, leading to uræmic poisoning and causing convulsions which may terminate fatally, or, further, the rapid development of general dropsy, and death from this cause. If this complication ensues it commonly does so about the third or fourth week after the beginning of the illness, and is frequently caused by a chill. Occasionally this condition does not wholly pass off, and consequently lays the foundation for chronic Bright's disease. (*See* BRIGHT'S DISEASE.) Another of the more common complications or results of scarlet fever is *suppuration of the ears*, due to the extension of the inflammatory process from the throat along the Eustachian tube into the middle ear. This not infrequently leads to permanent ear-discharge, with deafness from the disease affecting the inner ear, and an abscess sometimes forms in the mastoid cells. (*See* EAR, DISEASES OF.) Other maladies affecting the heart, lungs, pleura, etc., occasionally arise in connection with scarlet fever, the chief of these being *endocarditis*, which often lays the foundation of valvular disease of the heart later in life. Arthritis or *scarlatinal rheumatism* is a fairly common complication of the disease producing swelling and pain in the smaller rather than in the larger joints. This complication usually occurs in the second week of illness and especially in people who are subject to rheumatism at other times, and it generally abates without serious trouble. Apart, however, from such definite forms of disease, there may remain as the result of scarlet fever simply a general weakening of health, which may render the patient delicate and vulnerable for a long time.

Treatment.—In the treatment of

scarlet fever, one of the first requirements is the isolation of the case, with the view of preventing the spread of the disease. In large houses this may be possible, but in most instances it can only be satisfactorily accomplished by sending away those other children of the family who have not suffered from the fever. The hospitals for infectious diseases, which provide accommodation for patients of all classes, afford the best of all opportunities for thorough isolation. Children who have been in contact with cases of scarlet fever should be quarantined for seven days before being allowed to mix with other children in school or elsewhere. This affords a sufficient margin beyond the longest possible period of infection. A method has been devised (*Dick reaction*) for finding out those children who are susceptible to scarlatina; it is carried out by injections of minute quantities of streptococcus toxin similarly to the Schick reaction in diphtheria. Thereafter susceptible cases can be rendered immune by injection of a series of increasing doses of standardised streptococcus toxin at intervals of a fortnight. This is useful for persons exposed to infection.

When the patient is treated at home, the sick-room should contain only such furniture as may be required, and the attendants should come as little as possible in contact with other members of the household. It is usual to keep the patient in bed for three weeks from the onset of the disease, and thereafter great care must be taken to avoid chills owing to the danger of kidney complications. Should other children be in the house, they should be kept away from school during all the time that the risk of infection continues. The possibility of the fever being communicated by letters sent from the sick-room should not be forgotten by those in attendance. Disinfectants, such as carbolic acid, permanganate of potassium, etc., may be used freely in the room and passages, and all body or bed linen when removed should be placed at once in boiling water, or in some disinfecting fluid. In convalescence, with the view of preventing the transmission of the desquamated cuticle, the inunction of the body with carbolic oil may be performed or, as practised in the 'Milne Treatment', with pure eucalyptus oil twice daily for the first four days of illness and thereafter once daily for the next ten days. At the same time the throat may be swabbed with carbolised glycerin (1 of carbolic acid in 10 of glycerin) frequently during the early stage of the fever.

All books, toys, etc., used by the patient during the illness should be carefully destroyed or given to fever hospitals, as their preservation has frequently been known to cause an outbreak of the disease at a subsequent time. With respect to the duration of the infective period, the modern tendency is to look upon this as shorter than the six weeks which used to be taken as the turning point. In fact scarlet fever is now regarded and treated as a highly infectious streptococcal infection, the chief source of contagion being the discharges of ear, nose, and throat. The desquamating skin is not infectious. Anti-scarlatinal serum is of value in treating those seriously ill, and, as scarlet fever is predominantly a streptococcal infection, the sulphonamide drugs have a place in treatment. As to general management during the progress of the fever, in favourable cases little is required beyond careful nursing and feeding. The diet all through the fever and convalescence should be of light character, consisting mainly of milk food. Soups may be taken, but solid animal food should as far as possible be avoided. During the febrile stage a useful drink may be made from bitartrate of potassium (*see* CREAM OF TARTAR), of which the patient may partake freely. Attention to the daily movement of the bowels is of special importance in reference to the onset of kidney complications, and any mild aperient, especially a saline, may be used for this purpose. In the more severe forms of the disease, where the throat is much affected, the application with a brush of some strong antiseptic solution, such as carbolised glycerin or permanganate of potassium, or syringing of the throat with peroxide of hydrogen, or spraying with weak perchloride of mercury solution, may be practised. When there is discharge from the ears, they may be syringed with warm boric lotion, which both gives relief and purifies the dis-

charge. In the malignant variety, where the eruption is not appearing, or is but ill-developed, stimulants internally, and the hot bath or pack, may sometimes afford a chance. The treatment of the kidney complication and its accompanying dropsy is similar to that for acute Bright's disease. The abscesses of the neck which occasionally occur as complications should be opened antiseptically, while the ear disorders, which are apt to continue long after the termination of convalescence, will demand the special attention of the aurist. The management of the joint affections, enlarged glands, and discharge from the nose, which frequently occur, is conducted on general principles.

SCHICK'S TEST is a method designed for finding out the liability of individuals to contract diphtheria. (*See* DIPHTHERIA.)

SCHISTOSOMA, also known as DISTOMA and BILHARZIA, is the name given to a genus of parasitic worms found in the blood-vessels which cause the appearance of blood in the urine and stools. (*See* PARASITES.)

SCHISTOSOME DERMATITIS (*see* BATHER'S ITCH).

SCHIZO- (σχίζω, I divide) is a prefix signifying splitting.

SCHIZOPHRENIA (σχίζω, I divide; φρήν, mind) is a term applied to forms of psychosis in which there is a cleavage of the mental functions, associated with assumption by the affected person of a second personality.

SCHOOL CHILDREN.—With regard to the earliest period of life, the management of children will be found under INFANT FEEDING and CHILDREN, PECULIARITIES OF. After infancy, there follows a period between the ages of two and five, during which the child is more or less independent but requires a considerable amount of care, which at the present day is supervised by Child Welfare Clinics. Thereafter from about the age of six to fourteen years the child comes under the discipline of school, and special arrangements for the welfare of children are then made through the educational agencies.

Schools are now built on a 'pavilion' plan, and great care is taken in regard to their site, construction, ventilation, warming, etc. The appropriate temperature for rooms in infant departments is about 65° Fahr., and in classrooms for older children from 56° to 60° Fahr. Some form of central heating is necessary, and also some system of artificial ventilation. The minimum requirement of space per scholar is 100 cubic feet of air with 10 square feet of floor space, but, as a rule, the space allowed is larger than this.

Seats and desks form a very important matter both in regard to the comfort and, more particularly, in regard to the development of growing children, because if they are badly constructed or unsuitable in size the child is apt to assume unsuitable postures and undergo deformity in development (*see* SPINE, DISEASES OF). The seats and desks should be arranged in parallel rows at right angles with the windows, and, if possible, the chief illumination should be from the left. The desks should be from 15 to 18 inches wide and slightly sloped. The height of the seat from the ground should be equal to the length of the scholar's leg from the sole of the foot to the knee, and the front of the seat should be almost under the edge of the desk. The height of the edge of the desk above the seat should be one-sixth of the scholar's height. Seats and desks should be carefully adjusted to growing children twice yearly, and it must be remembered that the heights of scholars of the same age often vary as much as 10 inches, while children often increase in height 4 to 6 inches in a year. Each pupil should have from 20 to 40 inches of seat room.

The provision of cloakrooms with pegs, of covered sheds for recreation, and of suitable closet and lavatory provision is very important.

Drinking-water is an important matter, because drinking-cups often form a means of communicating disease such as diphtheria. In the crystal stream drinking-fountains provided in American schools no cups are necessary, scholars drinking directly from a weak upward jet of water. Small folded paper cups are cheap and can be thrown away after use. In England, education authorities are empowered to provide

meals for school children in cases where it is believed the children are not suitably nourished, and to recover the cost from the parents where possible. The **diet** for school children should be plain, generous, easily digested, and varied, with only a limited amount of fresh meat, but with a liberal allowance of cooked and fresh fruit. Milk is a highly nutritious food, which is specially suitable for children. The craving for sweet things should be met by supplying these at the end of a meal after the appetite has been satisfied. Over 75 per cent of the elementary school children of Great Britain give evidence of **dental caries**, and an early investigation of the teeth is desirable, together with inculcation by the teacher of the use of the tooth-brush as an essential act of cleanliness.

Under the Education Acts of Great Britain, children from five to fourteen years of age must attend school, while mentally defective, blind, and deaf children must receive education up to the age of sixteen years. For the successful teaching of scholars it is important that they should not suffer from **mental fatigue**. This is brought about not so much by long hours of work as by a wrong system of teaching. A time-table and a method which economise brain energy and direct its application are essential. With children, no individual subject should be pursued for longer than three-quarters of an hour, and the succession of subjects taught should be suitably varied. There should be sufficient intervals for rest, play, physical exercise, and food. In the classroom, quiet and fresh air are very important (*see* FATIGUE). For the amount of sleep requisite at different ages see CHILDREN, PECULIARITIES OF. The teaching of mentally defective children presents special problems, as these children make very slow progress (*see* MENTAL DEFECTIVENESS). In any case, children up to the age of five years whose nervous system is rapidly developing and easily tired should be educated chiefly through their senses and physical activities. For the next five years, which is probably the chief period of character formation, the important object is the development of good habits; and after the age of ten the child's reasoning powers and imagination can be most suitably developed.

The **eyesight** of about 20 per cent of scholars is defective, and in 10 per cent seriously defective. Young children are specially handicapped by short sight; and at a later stage, when reading of books is a more essential part of study, those who suffer from long-sight are apt to develop symptoms of eye strain. (*See* VISION, DISORDERS OF, *and* SPECTACLES.)

Defective hearing due to ear disease is present in between 10 and 20 per cent of scholars. The effect of this as regards lessons is that the child misses spoken words and shows seeming inattention or stupidity. Owing to the strain of his attention in class he is more readily exhausted by lessons. Physical symptoms are earache, headache, discharge from the ears, and, if the condition is complicated by adenoids and enlarged tonsils, a habitually open mouth which gives him a still further appearance of stupidity. The hearing should be carefully tested once a year, and if children are found to be deaf they should undergo the necessary treatment and should be given a suitable position in the class.

Exercise (*see* EXERCISE) is a matter of great importance, partly because when physical exercises are suitably interspersed with lessons the circulation and general sense of well-being are increased so that more ready attention is given to teaching. Also physical exercises can be made to correct faulty and defective conditions in development and bad habits in regard to posture. Combined exercises, in which a large number take part, aid in school discipline and develop qualities of alertness, decision, and activity. These exercises should, if possible, take place in the open air, should be carefully graded to suit the ages of the scholars, and should be designed to develop specially important muscles and movements such as those of deep breathing. Special attention should be given to children who develop faulty postures or have a tendency to deformities. These include children with the chest defectively formed as the result of rickets or early tuberculous disease, and particularly children with a tendency to lateral curvature of the spine

or the development of round shoulders. Also at lessons the maintenance of a good posture is important, the scholar sitting squarely to his desk with the head erect, the shoulders squared, the back straight, and the elbows kept at the same level.

Among the **diseases** for which the teacher must be specially on the outlook are measles, diphtheria, and scarlet fever among the infectious diseases (*see* INFECTION); discharges from the nose and from the ears which indicate inflammation in these cavities; the presence of bald patches indicating ringworm (*see* RINGWORM); and also the presence of scabies about the hands, and impetigo as shown by crusts about the face.

SCHOTT TREATMENT is a system of treatment devised by a German physician for persons suffering from disorders of the heart. The treatment is specially carried out at Nauheim in Germany, and consists in a combination of baths in spring-water containing brine or carbonic acid gas, with carefully graduated exercises, and suitable rules for the guidance of the daily life.

SCIATICA (*ἰσχίον*, the hip) means pain connected with the great sciatic nerve which runs down the back of the thigh. (*See* NEURALGIA.)

SCILLA is the Latin name for squills.

SCIRRHUS (*σκῖρος*, a hard tumor) is the name applied to a hard form of cancer in which much fibrous tissue develops.

SCLERITIS means inflammation of the sclerotic coat of the eye, usually of a rheumatic or gouty nature.

SCLERODERMA, or SCLERODERMIA (*σκληρός*, hard; *δέρμα*, skin), also known as 'hidebound disease', is a condition in which the skin becomes hard like leather, causing stiffening of the joints, and leading to gradual wasting of the muscles.

SCLEROSIS (*σκληρός*, hard) means literally 'hardening', and is a term applied to conditions in which portions of organs become hard and useless as the result of an excessive production of connective tissue. The term is especially applied to a change of this type taking place in the nervous system. (*See* DISSEMINATED SCLEROSIS.) When a change of this nature takes place in other organs it is generally known as 'cirrhosis' or 'fibrosis'. (*See* CIRRHOSIS.) These conditions are generally attributed to some form of chronic inflammation.

SCLEROTIC COAT (*σκληρός*, hard) is the outermost hard coat of the eyeball. (*See* EYE.)

SCOLIOSIS (*σκολιός*, twisted) is the name applied to curvature of the spine consisting partly of a bend to one side, partly of a rotary twist. It may arise in weakly children from so slight a cause as a bad habit in standing or in leaning one arm on the table at lessons. It also arises from disease affecting one side of the chest, such as chronic pleurisy or consumption. (*See* SPINE, DISEASES OF.)

SCOPARIUM is the tops of *Cytisus scoparius*, the common broom. It has a valuable action in cases where the heart is weak, very similar to that of digitalis. The action depends upon an alkaloid known as sparteine, which is a valuable remedy in cases of dropsy.

SCOPOLAMINE is an alkaloid identical with hyoscine and often used in combination with morphine for an anæsthetic, or as a hypnotic in delirium or to produce 'twilight sleep'.

SCORBUTUS (*see* SCURVY).

SCOTOMA (*σκότωμα*) is the term applied to a blind or partly blind area in the visual field. It may affect either the outer part of the visual field (peripheral scotoma), or the blindness may affect the centre, vision being retained round about (central scotoma).

SCRIVENER'S PALSY is another name for writer's cramp. (*See* CRAMP.)

SCROFULA (*scrofa*, a sow), or STRUMA, is a state of constitutional weakness, generally exhibiting itself in early life, and characterised mainly by defective nutrition of the tissues, which

renders them a ready prey to tuberculosis. The condition is also known as the tuberculous constitution. (*See* CONSTITUTION.) The condition, as it manifests itself in disease of the glands in the neck, was formerly known in England as ' king's evil ', from the belief that the touch of the sovereign could effect a cure. This superstition can be traced back to the time of Edward the Confessor in England, and to a much earlier period in France. Samuel Johnson was touched by Queen Anne in 1712, and the same supposed prerogative of royalty was exercised by Prince Charles Edward in 1745.

SCROFULODERMA is a term applied to any tuberculous affection of the skin.

SCROTUM is the name applied to the pouch of integument within which the testicles are suspended. It consists of a purse-like fold of skin, within which each testicle has a separate investment of muscle-fibres, several layers of fibrous tissue, and a serous membrane known as the ' tunica vaginalis '.

SCRUM-POX is a popular name for a contagious affection of the face and head affecting football players. (*See* IMPETIGO.)

SCURF, or DANDRIFF, is a popular name for the scaly condition that is frequently found on the scalp, and usually precedes baldness. (*See* BALDNESS.)

SCURVY, or SCORBUTUS, is a morbid condition of the blood and tissues shown by marked impairment of the nutritive functions and by the occurrence of extravasations of blood in the tissues of the body, and depending on the insufficiency of vitamin C, or ascorbic acid, in the diet.

Causes.—In former times this disease was extremely common among sailors, and gave rise to a frightful amount of mortality. It is now, however, of rare occurrence at sea, its cause being well understood and its prevention readily secured by simple measures. Scurvy has also frequently broken out among soldiers on campaign, in beleaguered cities, as well as among communities in times of scarcity, and in prisons, workhouses, and other public institutions. In all such instances it has been found to depend closely upon the character and amount of the food, the occurrence of serious illness, and a diet too limited, either in amount or variety. These conditions predispose to scurvy, but the essential cause lies in deprivation of fresh food and especially of fresh vegetables for a period of four to six months. The want of vitamin C, which is soluble in water and is found chiefly in citrus fruits, potatoes, green vegetables, black currants, is the essential deficient factor. Besides this essential defect, a diminution in the total amount of food, the large use of salted meat or fish, and all causes of a depressing kind, such as exposure, anxiety, bad hygiene, etc., will powerfully contribute to the development of the disease.

Infants too may suffer from scurvy as the result of insufficiency of vitamin C in the diet.

Symptoms.—The symptoms of scurvy come on gradually, and its onset is not marked by any special indications beyond a certain failure of strength, most manifest on making efforts. Breathlessness and exhaustion are thus easily induced, and there exists a corresponding mental depression. The countenance acquires a sallow or dusky hue; the gums are tender and the breath offensive almost from the first. These preliminary symptoms may continue for weeks, and in isolated cases may readily escape notice, but can scarcely fail to attract attention where they affect large numbers of men. Later the gums are livid, spongy, ulcerating, and bleeding; the teeth are loosened and drop out; and the breath is excessively fetid. Extravasations of blood now take place in the skin and other textures. These may be small, like the petechial spots of purpura (*see* PURPURA), but are often large, and cause swellings of the muscles in which they occur, having the appearance of extensive bruises, and tending to become hard and brawny. These extravasations are most common in the muscles of the lower limbs; but they may be formed anywhere, and may easily be produced by very slight pressure upon the skin or by injuries to it. Bleeding into joints is a very troublesome symptom because it produces stiffness later. In addition, there are bleed-

ings from mucous membranes, such as those of the nose, eyes, and alimentary or respiratory tracts, while effusions of fluid take place into the pleural, pericardial, or peritoneal cavity. Painful, extensive, and destructive ulcers are also apt to break out on the limbs. There is also a considerable amount of anæmia. The further progress of the malady is marked by profound exhaustion, with a tendency to fainting, and with various complications, such as diarrhœa and lung or kidney troubles, any of which may bring about a fatal result. On the other hand, even in desperate cases, recovery may be hopefully anticipated when the appropriate remedy can be obtained.

Treatment. — No disease is more amenable to treatment, both as regards prevention and cure, than scurvy, the single remedy of fresh vegetables or pills of ascorbic acid. Potatoes, cabbages, tomatoes, swede turnips, most fresh fruits, especially black currants, will be found of great service for this purpose. Orange-juice or lemon-juice is often employed, but must be fresh to be of much value. The use, in a fresh state, of lime-juice in the British navy, which has been practised since 1795, had the effect of virtually extinguishing scurvy in the service, while similar regulations introduced by the British Board of Trade in 1865 had a like beneficial result as regards the mercantile marine. It is only when these regulations have not been fully carried out, or when the supply of lime-juice has become exhausted, that scurvy among sailors has been noticed in recent times. The anæmia and debility are best overcome by the continued administration of iron tonics, aided by fresh air and other measures calculated to promote the general health.

SCYBALA (*σκύβαλον*, dung) is the name applied to the extremely hard condition which the stools assume in aggravated constipation.

SEA-SICKNESS is a peculiar set of symptoms experienced by many persons when subjected to the pitching and rolling motion of a vessel at sea, of which depression, giddiness, nausea, and vomiting are the most prominent.

Causes.—Although the vast majority of persons appear to be liable to this ailment at sea, they do not all suffer alike. Many endure distress of a most acute and even alarming kind, while others are simply conscious of transient feelings of nausea and discomfort. In long voyages, while many are affected with sea-sickness for the first few days only, others are tormented with it during the entire period, especially on the occurrence of rough weather. In short voyages, such as across the English Channel, not a few even of those susceptible escape, while others suffer in an extreme degree, the sickness persisting long after arrival on shore.

A great number of theories have been advanced to account for the connection between the motion of a ship and sea-sickness. The conditions concerned in the production of the malady are apparently of complex character, embracing more than one set of causes. In the first place, the rolling or heaving of the vessel disturbs that feeling of the relation of the body to surrounding objects upon which our sense of security rests. The nervous system being thus subjected to a succession of shocks or surprises fails to effect the necessary adjustments for equilibrium. Giddiness, nausea, and vomiting follow, aided probably by the profound disturbance which produces such manifest depression of the circulation. Much importance has been laid by some upon the effects of the displacement of the abdominal viscera, especially the stomach, by the rolling of the vessel; but, while this may possibly operate to some extent, it can only be as an accessory cause. The same may be said of the influence of the changing impressions made upon the vision—which has been regarded by some as so powerful in the matter—since attacks of sea-sickness occur also in the dark, and in the case of blind persons. Other contributory causes may be mentioned, such as the feeling that sickness is certain to come, which may bring on the attack in some persons even before the vessel has begun to move. The sense of the body being in a liquid or yielding medium as it descends with the vessel into the trough of the sea, the varied odours to be met with on board ship, and circumstances of a like nature, tend also to precipitate or aggravate an attack. In the

few rare instances where sea-sickness has proved fatal, *post-mortem* appearances have been almost entirely negative, and only such as are met with in death from syncope.

Symptoms.—The symptoms generally show themselves, soon after the vessel has begun to roll, by the onset of giddiness and discomfort in the head, together with a sense of nausea and sinking at the stomach, which soon develops into intense sickness and vomiting. At first the contents of the stomach only are ejected; but thereafter bilious matter, and occasionally even blood, are brought up by the violence of the retching. The vomiting is liable to exacerbations according to the amount of oscillation of the ship; but seasons of rest, sometimes admitting of sleep, occasionally intervene. Along with the sickness there is great physical prostration, as shown in the pallor of the skin, cold sweats, and feeble pulse, accompanied with mental depression and wretchedness. In almost all instances the attack has a favourable termination, and it is extremely rare that serious results arise, except in the case of persons weakened by other diseases, although occasionally the symptoms are for a time sufficiently alarming.

Treatment. — Innumerable preventives and remedies have been proposed, but most of them fall far short of the success claimed for them. No means has yet been discovered which can altogether prevent the occurrence of sea-sickness, nor is it likely any will be found, since it is largely due to the pitching movements of the vessel, which cannot be averted. Swinging couches or chambers have not proved of any practical utility. No doubt there is less risk of sickness in a large and well-ballasted vessel than in a small one; but, even though the rolling may be considerably modified, the ascending and descending movements which so readily produce nausea continue. None of the medicinal agents proposed possess infallible properties: a remedy which suits one person will often wholly fail with another. There appears to be a wide concurrence of opinion that nerve sedatives are among the most useful drugs which can be employed; and full medicinal doses of bromide of potassium or chloral taken before sailing appear to act usefully in the case of many persons. On the other hand, the employment of nerve stimulants, such as a small cupful of very strong coffee to be taken about two hours before sailing, will frequently prevent or mitigate the sickness. When the vessel is in motion, or even before starting, the recumbent position with the head low and the eyes closed (so that the motion of the ship and sea cannot be seen) should be assumed by those at all likely to suffer, and, should the weather admit, on deck rather than below—the body, especially the extremities, being well covered. Many persons, however, find comfort and relief from lying down in their berths with a hot bottle to the feet, by which means sleep may be obtained, and with it a temporary abatement of the distressing giddiness and nausea. Another good preventive measure consists in taking a large dose of aperient medicine before leaving land. Should sickness supervene, small quantities of some light food, such as thin arrowroot, gruel, or soup, ought to be swallowed if possible, in order to lessen the sense of exhaustion, which is often extreme, as well as to mitigate the pain of retching by giving the stomach something upon which it can contract. The vomiting may be mitigated by saline effervescing drinks, ice, chloroform (3 or 4 drops on a piece of sugar), or dilute hydrocyanic acid. Alcohol tends to aggravate the sickness.

SEASIDE, SEA-VOYAGES (*see* CLIMATE IN RELATION TO DISEASE).

SEAT-WORM is another name for thread-worm. (*See* PARASITES.)

SEBACEOUS CYST is the term applied to a cyst in the skin formed as a result of blockage of the duct of a sebaceous gland.

SEBACEOUS GLANDS (*sebum*, grease) are the minute glands situated alongside of hairs, and opening into the follicles of the latter a short distance below the point at which the hairs emerge on the surface. These glands secrete an oily material, and are especially large upon the nose, where their openings form pits that are easily visible. Some varieties of eczema, as well as acne, result from disorders of these glands.

SEBORRHŒA (*sebum*, grease; *ῥέω*, I flow) is the name given to a group of diseases of the skin in which the sebaceous or oil-forming glands are at fault. It is shown either by accumulations of dry scurf, or by the formation of an excessive oily deposit on an otherwise healthy skin. (*See under* SKIN DISEASES.)

SECRETIN is the name given to a hormone secreted by the mucous membrane near the commencement of the small intestine when food comes in contact with it, which, on being carried by the blood to the pancreas, stimulates the secretion of pancreatic juice.

SECRETION (*secerno*, I set apart) is the term applied to the material formed by a gland as the result of its activity. For example, saliva is the secretion of the salivary glands, gastric juice that of the glands in the stomach wall, bile that of the liver. (*See* GLANDS.) Some secretions consist apparently of waste material which is of no further use in the chemistry of the body. These secretions are often spoken of as 'excretions'; for example, the urine and the sweat. For further details see SALIVA, URINE, CIRCULATION OF SECRETIONS, ENDOCRINE GLANDS, etc., and also under the headings of the various organs.

SECUNDINES is another name for the afterbirth, consisting of the placenta and membranes expelled in the final stage of labour.

SECUNDUM ARTEM is a Latin expression meaning in a skilful professional manner.

SEDATIVES (*sedo*, I calm) are drugs and other measures which soothe over-excitement of the nervous system, whether the effect of this excitement be pain, sleeplessness, delirium, muscular spasm, etc. Those sedatives that soothe pain are generally spoken of as anodynes, sedatives in sleeplessness or delirium are known as hypnotics, sedatives of spasm are called antispasmodics. (*See* ANODYNES, COLIC, HEADACHE, HYPNOTICS, NEURALGIA, PAIN.)

SEDIMENTATION TEST is a test for measuring the activity and progress of a disease. If blood is drawn and put into a test-tube the red blood corpuscles sink and leave above a clear layer. In disease the rate of sinking is increased and can be measured. The more active the disease, the higher the rate of sinking of red blood corpuscles.

SEIDLITZ POWDER, or COMPOUND EFFERVESCENT POWDER, is a mild purgative composed of Rochelle salt and bicarbonate of soda, which are wrapped together in a blue paper, and tartaric acid, which is wrapped in a white paper. The contents of each paper are dissolved separately in half a tumblerful or less of water; the two solutions are mixed and swallowed while effervescing.

SEIGNETTE SALT is another name for Rochelle salt.

SELLA TURCICA is the name applied to the deep hollow on the upper surface of the sphenoid bone in which the pituitary gland is enclosed.

SEMEIOLOGY (*σημεῖον*, sign; *λόγος*, discourse) is the part of medical science dealing with the symptoms and signs of disease.

SEMILUNAR CARTILAGES are two crescentic layers of fibro-cartilage on the outer and inner edges of the knee-joint, which serve to form hollows on the upper surface of the tibia in which the condyles at the lower end of the femur rest. The inner cartilage is specially liable to be displaced by a sudden and violent movement at the knee. (*See* KNEE.)

SEMOLINA is a preparation of wheat. (*See* FARINACEOUS FOODS.)

SENEGA is the root of *Polygala senega*, a small plant of the United States. It has a considerable action as a stimulating expectorant, and its preparations are much used in cough mixtures.

SENILITY (*senilis*, old). (*See* AGE, NATURAL CHANGES IN.)

SENNA is the leaves of various species of *Cassia* plant, being known as Indian senna and Alexandrine senna, according to its source. It is one of the most active of the simple laxative drugs,

producing considerable griping if used alone. Senna is excreted in the urine, giving it a dark red or yellow colour. In the case of nursing mothers, some of the drug is excreted in the milk and may have a purgative effect upon the nursling.

SENSATION (*see* PAIN, TOUCH, etc.).

SENSITISATION is a term used in several ways. Sensitised vaccine is a vaccine in which the bacteria have been exposed to contact with the immune serum prepared against them and then washed free from the latter before injection. Such a vaccine is supposed to produce immunity more quickly and to be less irritating than a plain vaccine. Sensitisation of a person means the production of anaphylaxis by a particular food, vaccine, etc. (*See* ANAPHYLAXIS.)

SEPSIS (σῆψις, decay) means poisoning by the products of a putrefactive process. This process is set up by the growth of micro-organisms in the body, and the general symptoms which accompany it are those of inflammation. (*See* INFLAMMATION.) It is prevented by the various procedures mentioned under ASEPSIS, and is neutralised, when it has occurred, by various substances. (*See* ANTISEPTICS.) Two forms of sepsis to which attention has been particularly directed are *oral sepsis* and *puerperal sepsis*.

SEPTICÆMIA (σηπτικός, putrid; αἷμα, blood) is a serious form of blood-poisoning due to the multiplication in the blood of bacteria—in fact, it is an infection of the blood. (*See* BLOOD-POISONING.)

SEPTOFORM is a product of the combination of formaldehyde with terpin and phenol compounds used as a disinfectant in five or ten per cent strength, and as an antiseptic wash in 3 per cent strength.

SEQUELÆ (*sequor*, I follow) is the term applied to symptoms or effects which are liable to follow certain diseases. For example, bronchitis and other chest complaints may be sequelæ of measles, heart disease is frequently a sequel of rheumatic fever, paralysis may follow diphtheria.

SEQUESTRUM (*sequestro*, I separate) is the name given to a fragment of dead bone cast off from the living bone in the process of necrosis. (*See* BONE DISEASES.) A sequestrum often remains in contact with and partly enveloped by newly formed bone, so that a sinus is produced, and a constant discharge goes on, till the dead bone is removed.

SEROTHERAPY is the term applied to the method of treating or of preventing disease by the injection into a patient of serum containing antibodies to the toxins or bacteria from the effects of which he is suffering, or against which it is desired to protect him—as, for example, in diphtheria, scarlet fever, tetanus. (For further details see SERUM THERAPY.)

SEROUS MEMBRANES are smooth, transparent membranes that line certain large cavities of the body. The chief serous membranes are the peritoneum, lining the cavity of the abdomen; the pleuræ, one of which lines each side of the chest surrounding the corresponding lung; the pericardium, in which the heart lies; and the tunica vaginalis on each side, enclosing a testicle. The name of these membranes is derived from the fact that the surface is moistened by thin fluid derived from the serum of blood or lymph. Every serous membrane consists of a 'visceral' portion, which closely envelops the organs concerned, and a 'parietal' portion, which adheres to the wall of the cavity. These two portions are continuous with one another so as to form a closed sac, and the opposing surfaces are close together, separated only by a little fluid. This arrangement enables the organs in question to move freely within the cavities containing them. For further details see under PERITONEUM.

SERPENTARIA, or SNAKEROOT, is the root of various species of *Aristolochia* plants of the Southern United States. It has a stimulating action, and is used in combination with other remedies in the treatment of indigestion.

SERPIGINOUS (*serpo*, I creep) is a term used in connection with ulcers or eruptions that spread in a creeping manner.

SERUM (*serum*) is the fluid which separates from blood, lymph, and other fluids of the body when clotting takes place in them. (*See* HÆMORRHAGE.) Blood-plasma is the name given to the fluid of the blood circulating in the vessels, by which the corpuscles are carried along. As clotting takes place, fine threads of fibrin form from the fibrinogen contained in the plasma. These threads produce a network of increasing density in which the corpuscles are entangled, and, as a result, the fluid (serum) which is left outside this clot is clear, unmixed with corpuscles, and of a pale yellow colour.

The relation of these substances is seen at a glance from the following table:

$$\text{Blood} = \begin{cases} \text{Plasma} \\ \text{Corpuscles} \end{cases} - \begin{cases} \text{Serum} \\ \text{Fibrin} \end{cases} = \text{Clot.}$$

Serum is a clear, yellowish fluid and contains, in addition to water, about 7 per cent of albumin and globulin, with

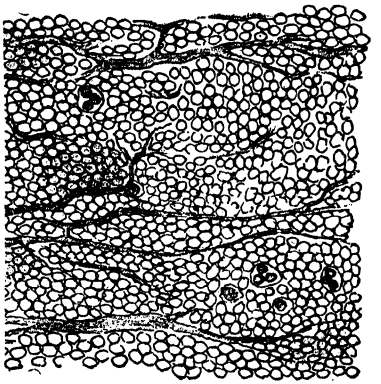


FIG. 398.—Section through a blood-clot, showing the corpuscles entangled in a meshwork of fibrin; the clear fluid which drains off from the clot is serum. Magnified by 300. (Thoma's *Pathology*.)

smaller quantities of salts, fat, sugar, urea, uric acid, and other extractives, as well as minute amounts of other albuminous bodies, which are of great importance in the prevention of disease. (*See* IMMUNITY.) The chief salt in the serum is common salt.

Serum is derived from the lymph also, and the fluid which is found in effusions into the pleura and other cavities of the body is very similar in composition.

The serum used for the administration of antitoxins in cases of diphtheria, tetanus, and other diseases, is generally derived from the blood drawn from horses which have been subjected to a long course of treatment. (*See* IMMUNITY *and* SERUM THERAPY.)

SERUM THERAPY.—The treatment of disease by the administration of serum (usually horse serum; sometimes human) containing antibodies against bacteria or viruses, or antitoxins against toxins, which are causing the symptoms of the disease. If bacteria are injected into an animal in gradually increasing doses—perhaps of dead bacteria first and of living bacteria later—antibodies to the bacteria appear in the blood serum of the animal injected. Similarly, if the toxins of bacteria are injected, antitoxins are produced. This reaction is the basis of immunity. The serum is then collected from the animal (usually a horse) for injection into a human being infected with the micro-organism against which the serum has been prepared. Serum therapy has proved highly successful in those infections in which the damage to the infected person is done by the toxins of the infecting micro-organism. For example, in diphtheria the diphtheria bacilli multiply in the throat, and the toxins there produced by the bacilli are absorbed into the blood, circulate round the body, and damage such structures as the heart and the nervous system. Here an antitoxic serum will provide the infected body with ready-made antitoxins which by uniting with the toxins will render them inert. Antitoxic serum is also of much value in the treatment of tetanus and botulism.

In other diseases bacteria invade the body and multiply therein, their harmful effect being due to this fact rather than to the local manufacture of toxins subsequently disseminated throughout the body. Here antibacterial sera are administered to the infected person, and the different kinds of antibodies in such sera immobilise the bacteria by killing them or by agglutinating them, etc. The action between toxin and antitoxin, and bacterium and antibody, is a specific one. Antibacterial sera have been used against pneumococci,

meningococci, typhoid bacilli, cholera vibrio, etc. In the U.S.A. immune sera (antibacterial sera) against the numerous types of pneumococcus have been used with good effect. But the brilliant results achieved in treatment of bacterial infections with the sulphonamide drugs and penicillin have put antibacterial sera rather in the shade. One interesting use of immune serum is the inhalation of such serum in the treatment of influenza. Immune serum is also used with effect in the prevention and treatment of measles.

Dangers of serum.—The serum which contains the antitoxic and other bodies is derived from the horse, and being different from human serum, it occasionally sets up serious symptoms when it is injected. The use of serum has even been known to cause death in very susceptible persons. This has been treated under ANAPHYLAXIS.

SETON is the name applied to a few strands of silk or thin strip of lint or gauze passed through the skin and underlying tissues by means of a large flattened needle, and left projecting at both ends. Formerly this method of treatment was widely used as an effective means of counter-irritation in many chronic conditions for which repeated blistering is now employed.

SEWAGE (*see* REFUSE AND SEWAGE DISPOSAL).

SEX CHROMOSOMES. — In the human being there are 24 pairs of chromosomes. Male and female differ in respect of one pair. In the nucleus of the female somatic cell the two members of the pair are identical and are called X-chromosomes. In the male nucleus there is one X-chromosome and another, unequal, dissimilar chromosome called the Y-chromosome. In the sex cells, after reduction division, all cells in the female will contain X-chromosomes. In the male, half will contain X-chromosomes and half Y-chromosomes. If, then, a sperm with an X-chromosome fertilises an ovum (with, of course, an X-chromosome) the offspring will be female. If a sperm with a Y-chromosome fertilises the ovum the offspring will be male. It is the sex chromosomes which determine the sex of an individual.

SHAKING PALSY is another name for paralysis agitans. (*See* PARALYSIS.)

SHELL-SHOCK, or TRAUMATIC NEURASTHENIA, is a condition of neurasthenia brought on, as its name implies, by the shock of explosions. It is aggravated by the special degree of physical strain and mental worry encountered on active service; and its worst forms are seen in persons who are already of a neurotic temperament, or those who have been suffering from some weakening condition like trench fever, or those in whom the horror and injury of burial under earth have been added to the explosion.

Symptoms.—Most men suffering from severe shell-shock have been rendered unconscious by the concussion for a period of several minutes to several days, and for some time after regaining their senses behave in an automatic manner. The memory is also defective for a long time, the man sometimes forgetting everything that happened to him for days or weeks before the shock, or even being totally unable to tell his name, residence, and similar intimate facts. Sooner or later, however, memory begins to return. Sleeplessness, or sleep troubled by fearful dreams, is a very troublesome symptom which greatly retards recovery, and a good test of the patient's progress in these cases is the gradual diminution of fright or unpleasantness in the character of the dreams. The usual symptoms of neurasthenia, viz. headache, mental irritability, exaggeration of the reflexes, easily induced fatigue, and shakiness on making an effort are almost always present to a variable extent. In addition to these, blindness, partial or complete deafness, dumbness, stammering, or paralysis of one or more limbs is very common, though these are all of a 'functional' nature and pass away under treatment. Fits are also occasionally a consequence of shell-shock, though as a rule these appear only in persons who already in early life have been affected in this way.

Treatment.—The great essential in the cure of these cases is complete mental and physical rest. A period of rest in bed which may extend to two or three weeks, or in severe cases even longer, is the first requirement, and occasionally complete seclusion is de-

sirable. For further treatment see under NEURASTHENIA.

SHINGLES (*cingulum*, a girdle) is a popular name for herpes zoster, which forms more or less of a belt round the body. (*See* HERPES.)

SHOCK is the name applied to a condition in which the vital activity is profoundly lowered, usually as a result of severe injury.

The problem of shock, to the fore in the war of 1914–18 and the war which started in September 1939, is still unsolved. Surgical shock may result from injury or hæmorrhage, or from both. The modern view (1941) relates the shock of both injury and hæmorrhage to the same underlying pathology—diminution of the fluid element of the blood. The blood, in other words, becomes concentrated. In treatment, therefore, the aim is to restore the blood volume, and to this end plasma is often given as a transfusion fluid.

Symptoms.—The person suffering from shock is in a state of great prostration, but can be roused to answer intelligently. The face and skin generally are pale, and copious perspiration breaks out. The lips and ears are pallid, and the voice whispering. The pulse is rapid and often almost imperceptible, the respiration irregular and sighing, and the temperature may be subnormal. The patient complains greatly of thirst.

Treatment.—The immediate treatment of shock is to keep the patient flat and at complete rest, to keep him warm—but not too warm—with blankets and hot-water bottles, to relieve pain, and to give hot fluids to drink so long as there is no abdominal injury. The foot of the bed is raised; the limbs are often bandaged.

SHORT-SIGHT is a condition in which objects near at hand are seen clearly, while objects at a distance are blurred. The condition is technically known as 'myopia'. (*See* MYOPIA, SPECTACLES, *and* VISION.)

SHOULDER is the joint formed by the upper end of the humerus and the shoulder-blade or scapula. The acromion process of the scapula and the outer end of the collar-bone form a protective bony arch above the joint, and from this arch the wide and thick deltoid muscle passes downwards, protecting the outer surface of the joint, and giving to the shoulder its rounded character. The joint itself is of the ball-and-socket variety, the rounded head of the humerus being received into the hollow 'glenoid' cavity of the scapula, which is further deepened by a rim of cartilage. One tendon of the biceps muscle passes through the joint, grooving the humerus deeply, and being attached to the upper edge of the glenoid cavity. The joint is surrounded by a loose fibrous capsule, strengthened at certain places by ligamentous bands. The main strength of the joint comes from the powerful muscles that unite the upper arm with the scapula, clavicle, and ribs.

SHOULDER-BLADE, or SCAPULA, is a flat bone, about as large as the flat hand and fingers, placed on the upper and back part of the thorax. To it many of the large muscles that move the arm are attached. It is not in contact with the ribs, and its only attachment to the trunk of the body is through a joint between its acromion process and the clavicle on the tip of the shoulder, and by the powerful muscles which suspend it from the backbone and ribs. With the arm hanging by the side the scapula extends from the second to the seventh rib, but as the arm is raised and lowered it slides freely over the back of the chest. From the hinder surface of the bone springs a strong process, the 'spine' of the scapula, which arches upwards and forwards into the 'acromion process'. The latter forms the bony prominence on the top of the shoulder, where it unites in a joint with the outer end of the clavicle.

SIALAGOGUES (σίαλον, saliva; ἄγω, I draw) are substances which produce a copious flow of saliva.

SIBBENS is an old name for a disease formerly prevalent in Scotland, which was probably syphilis.

SICK-HEADACHE (*see* HEADACHE).

SICKNESS (*see* VOMITING *and* SEA-SICKNESS).

SICK-NURSE (*see* NURSING).

SICK-ROOM (*see* NURSING).

SIDEROSIS (*σίδηρος*, iron) is a name given to chronic interstitial pneumonia occurring in ironworkers and due to the inhalation of fine iron particles. The term is also applied to the condition in which there is an excessive deposit of iron in the tissues of the body.

SIGHT (*see* VISION).

SIGMOID FLEXURE (*σιγμοειδής*, like the letter S) is the term applied to the part of the large intestine immediately above the rectum which is freely movable and hangs down into the pelvis. It is also known as the pelvic colon.

SILICOSIS (*silex*, flint) is a form of chronic interstitial pneumonia occurring in stonecutters, potters, and other workers in an atmosphere containing silica dust. The presence of this dust has a special effect in causing the development of fibrous tissue in the lungs, and in aiding the development of phthisis.

SILVER is used in medicine externally, and to a less extent internally, in the form of its salt, nitrate of silver. (*See* NITRATE OF SILVER.) Mild silver proteinate, also known as argyrol, argein, argyn, silver nucleinate, etc., is a compound of silver oxide with albumin. It is a brown powder soluble in water and is much used as an unirritating antiseptic in conjunctivitis (25 per cent in water), and for washing out the bladder in cystitis (5 per cent or stronger).

SIMMONDS' DISEASE, or HYPOPHYSIAL CACHEXIA, is a rare condition in which cachexia, wasting of the skin and the bones, impotence, loss of hair, and premature senility occur as a result of destruction of the pituitary gland.

SIMPLE is an old term applied to an herb with real or supposed medicinal virtues.

SINAPISM (*σίναπι*, mustard) is an application containing mustard. (*See* MUSTARD.)

SINGER'S NODULE is the term applied to a minute warty excrescence on the vocal cords interfering greatly with the voice, although not otherwise of serious importance. (*See* THROAT DISEASES.)

SINGULTUS is the Latin term for hiccup.

SINUS (*sinus*, a hollow) is a term applied to narrow cavities of various kinds, occurring naturally in the body, or resulting from disease. Thus it is applied to the air-containing cavities which are found in the frontal and maxillary bones, and which communicate with the nose. (*See* ANTRUM.) The term is also used in connection with the wide spaces through which the blood circulates in the membranes of the brain. Those cavities, the result of disease, which are produced when an abscess has burst but remains unhealed, are also known as sinuses. (*See* ABSCESS, FISTULA.)

SINUSOIDAL CURRENT (*see* ELECTRICITY IN MEDICINE).

SKATOL (*σκῶρ*, dung) is a strongly smelling crystalline substance contained in the stools, produced by decomposition of protein material.

SKELETON (*σκελετός*, dried up) is the comprehensive term applied to the hard structures that support or protect the softer tissues of the body. Many animals are possessed of an 'exoskeleton', consisting of superficial plates of bone, horn, etc.; but in man the skeleton is entirely an 'endoskeleton', covered everywhere by soft parts, and consisting mainly of bones, but in places also of cartilages. The chief positions in which cartilage is found in place of bone are the larynx and the front of the chest. For the details of the skeleton see BONE.

SKIAGRAM (*σκιά*, shadow; *γράμμα*, writing) is the name applied to a photograph—strictly speaking a 'shadowgraph', for this is what it is—made by X-rays.

SKIN.—Skin is the membrane which everywhere envelops the outer surface of the body, meeting, at the various

orifices of the body, with the mucous membrane which lines the internal cavities. The skin consists of two distinct layers, which differ entirely in structure and in origin. These are (a) *the cuticle*, also known as *scarf-skin*, *epidermis*, or *epithelium*, which is a cellular covering formed from the outer layer of the embryo; and (b) *the true skin*, also known as the *cutis vera*, *corium*, or *dermis*, which is a fibrous covering developed from the middle embryonic layer.

(*a*) **The cuticle** is the cellular layer which covers the outer surface of the body, varying in thickness from $\frac{1}{100}$ of an inch on the palms and soles to $\frac{1}{1000}$ inch on the face. It is composed of four layers, which are, from the surface inwards, as follows:

(1) THE HORNY LAYER, made up of several thicknesses of flat cells, forming an impervious covering pierced only by the openings of the sweat-glands, and by the hairs. The flat cells are rubbed off the surface constantly as minute white scales, being replaced by growth from below.

(2) THE CLEAR LAYER, in which the cells are firmly fixed together into a kind of membrane.

(3) THE GRANULAR LAYER, in which the cells are undergoing a change in form and substance from those of the fourth layer to those of the two on the surface.

(4) THE MALPIGHIAN LAYER, in which the cells are soft, tender, and living. These cells lie in several rows, the deepest being set directly upon the uneven surface of the true skin, which is richly supplied with blood-vessels that nourish the cells. These cells divide continually and, as they multiply they are pushed upwards to supply the constant wear and tear on the surface of the horny layer. There are no blood-vessels in the cuticle, but fine sensory nerves terminate between the cells of the Malpighian layer. These cells are joined together by cement substance and by minute processes that are continued from each cell into its neighbours. The layer is often called the 'prickle-cell' layer.

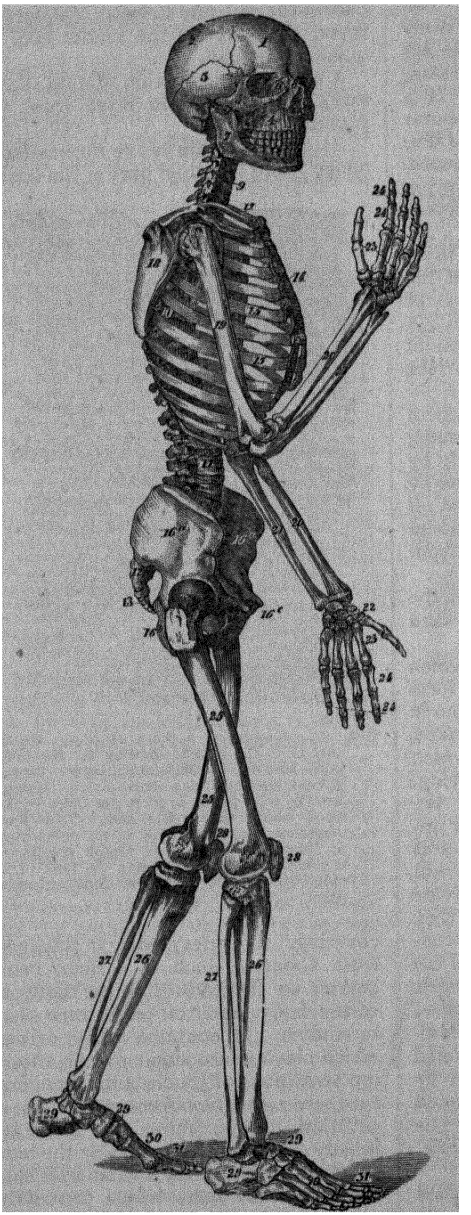
These four layers can be distinguished readily at the *nails*. The horny layer ends abruptly in the scarf-nail. The clear layer, in this place thick and stiff, forms the nail itself. Through it can be seen the granular layer, which also ends abruptly in the white 'linule' at the base of the nail, and the pink Malpighian layer, which forms the tender bed, or quick of the nail.

A *blister* is a collection of fluid separating the Malpighian layer from the superficial ones.

(*b*) **The true skin** is the fibrous layer which forms the chief part of the bodily

FIG. 309.—Section of a piece of skin. On the surface is the cuticle showing *hs*, the horny layer, and *rm*, the Malpighian layer; through it runs the duct of a sweat-gland. Beneath lies the true skin; *p*, *p*, *p*, are three papillæ upon which the cuticle rests; *t*, a touch corpuscle connected with *n*, its nerve-fibre; *bc*, blood capillaries; *lc*, lymph capillaries; *ct*, connective tissue forming the bulk of the skin; *f*, fat-cells; *n*, nerve-fibre; *s*, sweat-gland. (Turner's *Anatomy*.)

covering. It varies greatly in thickness from about $\frac{1}{50}$ inch to $\frac{1}{8}$ inch, being coarser on the back than on the front of the body, and thicker in men than in women. It contains many nerves, which play an important part in affording sensations of touch, pain, temperature, etc., and blood-vessels which, in addition to nourishing the skin, are largely concerned in regulating the temperature of the body. The true skin bears also the hairs which pierce the cuticle, and the sweat-glands, whose ducts also penetrate the cuticle to reach the surface. Beneath the true skin lies a loose fibrous layer of subcutaneous



1. Frontal bone.
2. Parietal bone.
3. Temporal bone.
4. Upper jaw (maxilla).
5. Cheek-bone (malar bone).
6. Lacrimal bone.
7. Lower jaw (mandible).
8. Nasal bone.
9. Cervical vertebræ.
10. Thoracic vertebræ.
11. Lumbar vertebræ.
12. Sacral bone.
13. Coccygeal bone.
14. Sternum.
15. Ribs.
16. *a-c.* Pelvis.
17. Clavicle.
18. Scapula.
19. Humerus.
20. Radius.
21. Ulna.
22. Carpal bones.
23. Metacarpal bones.
24. Phalanges.
25. Femur.
26. Tibia.
27. Fibula.
28. Patella.
29. Tarsal bones.
30. Metatarsal bones.
31. Phalanges

FIG. 400.—Human skeleton. (Schmeil's *Zoology*.)

tissue which joins the skin to deeper parts and contains more or less fat, according to the stoutness of the person.

The fibrous tissue of the true skin is composed of interlacing bundles of white fibrous tissue that form a dense feltwork. Here and there, elastic fibres are mixed with the others, and these serve to give the skin pliability, and at the same time to keep it always stretched. On the surface the network is very fine and close, and the skin is raised up into projections, known as ' papillæ,' which fit into corresponding depressions on the under surface of the cuticle, and thus render the two inseparable. The true skin is crossed everywhere by numerous folds, which are specially plentiful over joints and on the palms of the hands, and which are followed closely by the cuticle. Further, there is a special arrangement on the palms and soles, where the papillæ are so placed as to form continuous ridges with intervening grooves. These ridges remain permanent throughout life, and, as the formation by them of whorls and loops upon the finger-tips varies in different individuals, an impression of these in ink is used as a means of identifying criminals. On the summit of each ridge the orifices of the sweat-glands can be seen, with the help of a magnifying glass, arranged in a row.

The endings of the sensory nerves in the skin have been described under NERVES.

HAIRS spring from the true skin, each having a root and a stem or shaft. The stem is generally rounded, and varies greatly in thickness, while in the case of curly hair it is oval or flattened in section. The surface is covered by scales, imbricated like the tiles on a roof, and it is in consequence of their projecting edges that felted or matted hair is so difficult to separate. The chief part of the stem is of a fibrous character, the fibres being composed also of elongated cells. Some hairs have, running up the centre, a pith composed of soft cells with air-spaces between them. The varying tint of hair is due to pigment scattered in varying amount throughout the hair, while a white hair is produced by the formation of very numerous air-spaces throughout the cells composing it. The root of the hair ends in a knob, and is set upon a fibrous papilla, from which the hair appears to derive its principal nutriment. This root is set deep in the true skin, and is the growing part of the hair, which pushes the older part of the hair out through the cuticle.

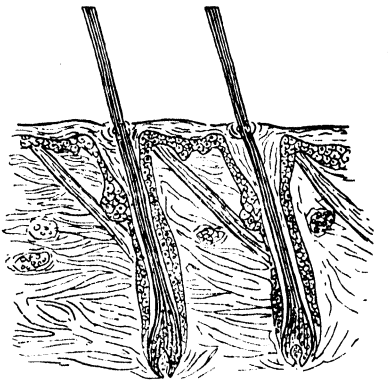


FIG. 401.—Two hairs showing root, sebaceous glands, and erecting muscle.

The rate of growth of hair is about 6 inches in a year, though in some persons when the hair reaches a certain length, it ceases to grow at the root and is gradually pushed upwards, till it falls out, by a new hair which develops from a fresh papilla. The tube which contains the part of the hair embedded in the skin is known as the ' hair follicle ' and is lined by a fibrous coat derived from the true skin and a cellular coat developed from the cuticle, each of which consists of three distinct layers. When a hair is roughly pulled out, the clear membrane that is often found surrounding it is part of the cellular root sheath. The follicle does not run straight down into the skin, but has a considerable obliquity, so that the part of the hair above the surface has a natural slope to one side. Attached to the under side of each sloping hair-follicle, near its deep end, is a small muscle, whose other end is attached to the surface of the true skin a little distance off. These muscles have the action of raising the hair, and also of producing ' goose-flesh ', when stimulated to contract by the influence of cold or of fear.

GLANDS are found in immense numbers in the skin, and are of two kinds, *sebaceous glands*, which secrete a fatty

substance, and *sweat-glands*, whose secretion is a clear, watery fluid.

The *sebaceous glands* lie in the true skin, and open into the follicles of the hairs a little way from the surface. Each consists of a bunch of small sacs, within which fatty material is produced. The secretion reaches the surface by the hair-follicle, and serves to lubricate the hair and give pliability to the surface of the skin.

Sweat-glands, or sudoriparous glands, are very numerous, are found all over the surface of the body at a slightly deeper level than the sebaceous glands, and have no connection with the hairs. Each consists of a long tube, coiled up into a ball, from which a duct leads in a zigzag manner up towards the surface. The outlets of these ducts can just be seen with the naked eye as minute openings (pores), though with a magnifying glass they are readily visible. The number is said to vary from 400 in a square inch, on the lower limbs and back, to 2800 in the same area on the palm of the hand. The structure of these glands is simple. Each is a coiled-up tube, which is lined by a layer of cells surrounded by muscle fibres, and these again by a thin membrane. In the fibrous tissue between the coils of the glands run many small blood-vessels, and from the blood in these the materials that form the sweat are extracted.

Functions of the skin.—The main use of the skin is a *protective* one. It covers the underlying muscles, both preventing them from injury, and, especially by virtue of the layer of fat immediately beneath the skin, warding off extremes of temperature. The cuticle forms a highly impenetrable surface, its horny character and elasticity being well calculated to resist wounds; while the sebaceous matter with which it is provided renders it almost waterproof. Thus poisons, drugs, etc., are not absorbed in any appreciable amount through the unbroken skin, unless combined with some fatty material, as in ointments, and diligently rubbed in.

Secretion is an important function of the skin, the two secretions being sebaceous material and perspiration. Of these, the former is a lubricant for the hair and skin, the latter is treated of under PERSPIRATION.

Heat regulation is one of the most important functions of the skin. Man is a 'warm-blooded' animal, that is to say, his temperature remains constant in health between 98° and 99° Fahr., no matter what the temperature of the surrounding medium may be. In order to maintain this constancy, it is evident that he must be provided with some means of quickly developing heat which shall come into action when the body is cooled down by exposure to cold, and also some mechanism which can quickly get rid of heat when necessary. The main source of heat in the body lies in the muscular tissue, which develops heat every time a contraction takes place. The skin also plays in this connection a very prominent part. When cold air, water, etc., come in contact with the surface, the skin blanches, the numerous blood-vessels of the true skin contracting and thus preventing much blood from circulating through the skin, and being thereby unduly cooled. On the other hand, when the surface is exposed to a temperature approaching that of the body, say one of 80° or 90° Fahr., or when an excessive amount of heat is produced by great muscular efforts, the blood-vessels of the surface dilate, the skin reddens, as much blood comes to the surface, and there is a copious secretion of perspiration, which produces great cooling as it evaporates from the surface. These actions of narrowing and dilatation of vessels, and of sweat-secretion, are brought about through reflex nerve influence. When the temperature rises so high that these processes are unable to take place, very serious results ensue. (*See* SUNSTROKE.) It can be readily understood why the body tolerates great temperatures at a dry heat much better than continued moist heat, since evaporation of the perspiration takes place more readily the drier the surrounding air, and thus produces more rapid cooling. The serious effects of varnishing the skin or covering it with such an impervious material as gold-leaf, are due to interference with this process. The nerves of the blood-vessels appear to be thrown out of action, and delicate animals subjected to this process speedily die of cold.

Respiration is a function of the skin which in man is not of so great importance as in the lower animals. In the frog, the lungs and skin are of equal im-

portance as breathing organs, though in man the amount of carbonic acid gas given off by the skin is only about $\frac{1}{100}$ or $\frac{1}{300}$ of the amount given off by the lungs. It is probable, however, that much of the organic matter which gives to impure air its disagreeable smell and contributes to its poisonous properties is given off by the skin.

SKIN CHAFING (*see* CHAFING OF THE SKIN).

SKIN DISEASES. — These form a large and important class. In number they are very extensive, owing to the varied forms of change which the skin texture may undergo, and to the different structures in the skin which may be specially affected. Further, classifications of very complex character have greatly multiplied their nomenclature. Skin diseases are of great importance, not only from the fact that they must have a powerful influence on the general health, but also because these diseases are frequently the expression of constitutional conditions, inherited or acquired, the recognition of which is essential to their effectual treatment. The following classification is to a certain extent open to the objection that it proceeds on several principles, and that therefore certain diseases might fall into more than one group. But this classification appears sufficient for the present purpose :

I. Disorders of the secreting apparatus (of the sebaceous and sweat glands).

II. Disorders specially relating to growth (hypertrophies; atrophies; new formations ; pigmentary changes).

III. Inflammatory affections (erythematous ; papular ; vesicular ; pustular ; squamous or scaly).

IV. Neuroses (nervous disorders).

V. Parasitic affections (animal; vegetable).

I. DISORDERS OF THE SECRETING APPARATUS.—(1) **Of the sweat-glands.**—The chief morbid conditions are excessive sweating (*hyperidrosis*) and fetid sweating (*bromidrosis*). Excessive sweating is a symptom observed in various diseases, such as phthisis and rheumatic fever, but it may exist apart from such conditions, and either be general, affecting the whole body, or confined to a part, such as the armpits, head, hands, feet, or, as in some rare instances, the one half of the body. Some persons habitually perspire, often to a great extent, on making any effort, yet never appear to suffer in health, although the discomfort is considerable. (*See* PERSPIRATION.)

(2) **Of the sebaceous glands.**—*Seborrhœa* is a term applied to describe an accumulation on the skin of excessive sebaceous secretion mixed up with dirt and forming scales or a distinct encrustation. On the head, where it is commonly seen, it may interfere with the nutrition of the hair and cause partial baldness. A form of this disease occurs in young infants. The main treatment is local, consisting in thorough cleansing of the parts. The crusts may be softened with oil and the affected skin regularly washed with superfatted soap. A weak ointment of salicylic acid in vaseline (3 grains to the ounce) also aids their disappearance. The fatty sebum frequently accumulates in the sebaceous ducts, giving rise to the minute black points so often noticed on the face, back, and chest in young adults, to which the terms *black-heads* and *comedones* are applied. A form of this disorder, but of larger size and white appearance, is termed *milium*. These affections may to a large extent be prevented by strict attention to ablution and brisk friction of the skin, which will also often remove them when they begin to appear. The retained secretion may be squeezed out and the skin treated with some simple application. *Acne* is an eruption produced by inflammation of the sebaceous glands and hair follicles. It usually occurs in connection with comedones and milium, but may be independent, and shows itself in the form of red pimples or papules, which may become pustular and be attended with considerable irritation of the surrounding skin. (*See* ACNE.) A variety of this malady, to which the name *acne rosacea* is given, is a more severe and troublesome disorder than that already mentioned. (*See* ACNE ROSACEA.)

Wens are small cysts produced by local retention of the sebaceous material and overgrowth of gland tissue. Their treatment consists in opening the cyst and removing or destroying its wall, so that it may not refill with secretion.

Moluscum contagiosum is a form of

skin disease resembling wens but rather warty, and popularly called 'water-warts'. It appears to be infectious and is often contracted through bathing costumes and towels at public baths.

II. DISORDERS AFFECTING GROWTH. — (1) **Hypertrophies.** — A *corn* (*clavus*) is a local thickening of the skin, generally occurring on the toes, and also on any part exposed to occasional friction and pressure. There is overgrowth of the cuticle, and in the centre of the corn is a still denser mass, which, pressing down upon the true skin beneath, causes pain and may give rise to inflammation and suppuration. When situated between the toes, the corn is softer than on the free surface of the foot. (*See* CORNS AND BUNIONS.)

A *wart* (*verruca*) is an excrescence from the surface of the skin due to hypertrophy of the papillary layer of the cutis and of the epidermis. This form of growth may also occur on mucous membranes. Warts occasionally disappear spontaneously, or they may be excised, or carefully touched with some strong caustic acid or alkali. (*See* WARTS.)

Ichthyosis or *xeroderma* consists of a general thickening of the whole skin and marked accumulation of the epidermic elements, with atrophy of the sebaceous glands, giving rise to a hard, dry, scaly condition. It generally first appears in infancy, and is probably congenital. It differs in intensity and in distribution in different cases, and is generally little amenable to any but palliative remedies, such as the regular application of oily substances, although it is not a fatal malady.

(2) **Atrophies.**—The chief of these relate to the hair. *Canities* or whitening of the hair consists in the non-formation of the pigmentary matter which is normally present in the substance of the hair, and occurs generally as a slow senile change. It may, however, take place prematurely, in which case it is often hereditary; or it may be associated with degenerative changes taking place in the system. It is occasionally seen to occur temporarily in very young persons in connection with some defective condition of the general health. Its development suddenly has not infrequently been observed as the result of some strong mental emotion.

Alopecia, or baldness, is the loss of hair, which is most commonly a senile change and irremediable, or on the other hand may be premature, occurring either hereditarily or in connection with some previous constitutional morbid state (*e.g.* after fevers or other blood poisons) in which latter case it may be only, although not always, temporary. It appears to depend upon atrophic changes affecting the hair follicle, including obliteration of the capillary vessels—the result of which is that strong hairs cease to be produced, and only feeble, short, and thin hair (*lanugo*) is formed, which soon falls off and is not reproduced. Usually the whole skin of the hairy scalp undergoes thinning and other atrophic changes as well as the hair follicle. Sometimes the loss of hair occurs in distinct circular patches (*alopecia areata*), which tend to spread until the whole scalp is denuded. (*See* BALDNESS.)

(3) **New formations.**— *Tumors* of various kinds form in the skin. They may be of a temporary nature, like wens and warts, or may be *simple tumors*, fatty, fibrous, etc., of the same characters as similar tumors elsewhere, or, especially when situated about the lips and other sites exposed to irritation, may be *epitheliomata* and *rodent ulcers* of malignant nature.

(4) **Pigmentary changes.**—*Chloasma* is an abnormal pigmentation, in the form of brown patches, either generally diffused or confined to one part, such as the forehead and face, and occasionally seen in women suffering from uterine ailments. *Addison's disease* consists in disease of the suprarenal glands, and is accompanied by general bronzing of the skin with increasing weakness. (*See* ADDISON'S DISEASE.) *Leucoderma* is a change in the pigmentation of the skin, whereby it becomes white in patches, with a tendency to spread and affect almost the whole surface, until a few dark areas alone remain to represent the original appearance of the skin. It is not of any special significance as regards the health. *Albinism* is an entire absence of pigment from the hair, skin, eyes, etc. The hair is usually white, and the skin exceedingly pale; and the eye has a pinkish appearance. This condition is congenital. It occasionally exists to a partial extent. (*See* ALBINISM.)

III. **INFLAMMATORY SKIN AFFECTIONS.** — They embrace the following chief varieties: (1) diffuse (dermatitis): (2) papular (lichen): (3) catarrhal (eczema); (4) local infective; (5) vesicular (herpes, pemphigus); (6) pustular (impetigo); and (7) scaly (psoriasis).

(1) **Diffuse inflammation** includes the varieties of *dermatitis* which may be due to sunburn, heat, various drugs such as belladonna, bromides, and iodides, poisonous plants, such as poison ivy and Chinese primrose, and irritating substances encountered in various trades. *Erythema*, particularly *erythema nodosum*, is occasionally a congestive condition and consists of spots and patches slightly elevated and of dark-red colour, appearing on the front of the legs and back of the arms in young persons, mostly females. This variety is supposed to be connected with rheumatism, joint-pains frequently accompanying it. (*See* ERYTHEMA.) *Erysipelas* is an inflammatory skin affection resembling erythema, though of far severer type. (*See* ERYSIPELAS.) *Urticaria* or *nettle-rash* is a diffuse redness of the skin, accompanied by wheals of raised and paler appearance, not unlike the effect produced by the sting of nettles or of insects, and attended with great irritation and itching. Certain kinds of food, such as special fruits, fish, meat, etc., produce this eruption in some persons. It is best treated by some soothing application, such as a solution of sal volatile to which a little chloral has been added, and by attention to the state of the alimentary canal. (*See* NETTLE-RASH.)

(2) **Papular.**—*Lichen*, an eruption consisting of small, thickly set, and slightly elevated red points, more or less widely distributed over the body, may result from digestive derangements, and it lasts but a short time. Some forms, however (*e.g. lichen ruber*), are of chronic character and difficult of treatment. The ordinary form requires little beyond attention to the digestive organs and the application of a soothing lotion or powder. The chronic forms are usually treated by the administration of arsenic or of perchloride of mercury.

(3) **Catarrhal.**—*Eczema*, one of the most common and important of all skin diseases, consists of an inflammation of the true skin, of catarrhal character together with the formation of papules vesicles, or pustules, attended with more or less discharge, and with itching and other symptoms of irritation. It cannot be regarded as a disease by itself but is really a symptom denoting the reaction of the skin to various forms of irritation. It may be either acute or chronic, and presents itself in a variety of forms. As regards causation, it appears impossible to assign any one condition as giving rise to this disease. It occurs frequently in persons to all appearance in perfect health, and it may in such cases be a permanent or recurring affection during a whole lifetime. Again, it is undoubtedly found in persons who possess a morbid constitution, such as the gouty, or, more generally, in persons in whom the excretions of the bowels or kidneys are defective. Sometimes it is set up as the result of local or general irritation of the skin in certain occupations, such as in confectioners, whose skin is exposed to the constant irritation of sugar, and it may exist in connection with the presence of some other skin disease. It may even be due to the wearing of clothing containing irritating dyes. (*See* ANILINE.) It is much more common in men than in women. Numerous varieties of eczema are described, according to its site and duration: only the more important of these can be mentioned. *Acute eczema* shows itself by redness and swelling of the skin, with the formation of minute vesicles, and attended with severe heat and irritation. Should the vesicles rupture, a raw moist surface is formed, from which a colourless discharge oozes, which when it accumulates forms thin crusts. The attack may be general over the greater portion of the body, or it may be entirely localised to a limb or other part. It usually lasts for a few weeks and then passes off, leaving, however, a liability to recurrence. Such attacks may occur as a result of digestive derangements, or in persons of rheumatic or gouty tendency, and they tend to appear at certain seasons, such as springtime. They are usually best treated by attention to the general health, and by a simple and carefully regulated diet, while, locally, some soothing application, such as a weak lead or calamine

lotion, or a dusting powder composed of oxide of zinc, starch, and boracic acid, will be found of benefit. *Chronic eczema* shows itself in various forms, of which we note the most common. In *eczema rubrum* the disease affects a part, very often a limb, as a severe form of inflammation, with great redness, and weeping or oozing of serous matter from the raw surface. It gives rise to great irritation and pain, and may cause considerable disturbance of the general health. It may last for years, with intervals of partial recovery, but easily recurring. The skin of the limb becomes in time thickened and the limb itself much swollen. In *dry eczema* the skin, though irritable, remains dry and scaly. The treatment of chronic eczema depends in great measure upon the form it assumes. Where there exists much irritation, soothing lotions or applications similar to those required for acute eczema are necessary; but where irritation has subsided, stimulating ointments, such as those of zinc or white precipitate, are often of service. Lassar's paste, containing salicylic acid, starch, zinc oxide, and vaseline, is also a very valuable remedy. Constitutional remedies, such as iron, arsenic, etc., are an important and often essential part of successful treatment.

(4) **Local infective conditions.**—These include eruptions on the skin due to lupus, leprosy, syphilis, and some other diseases.

Lupus vulgaris is a disease characterised by the formation in the skin of tubercles or nodules consisting of new cell growth which has no tendency to further development, but to retrograde change, leading to ulceration and destruction of the skin and other tissues in which it exists, and the subsequent formation of permanent white scars. It is due to the tubercle bacillus, and is most commonly seen in early life, and occurs chiefly on the face, about the nose, cheeks, ears, etc., but it may also affect the skin of the body or limbs. It first shows itself in the form of small, slightly prominent nodules covered with thin crusts or scabs. These may be absorbed and removed at one point, but they tend to spread at another. They tend to ulcerate and leave a white permanent scar. The condition known as *lupus erythematosus* resembles this slightly, and appears as dark-red patches upon the nose and neighbouring parts of the cheeks, covered at places with scabs. It does not, however, produce the ulceration and disfigurement commonly due to lupus vulgaris. (*See* LUPUS.)

Leprosy (*elephantiasis graecorum*) may be regarded as belonging to this class of skin diseases, inasmuch as it consists, like lupus, in a new growth of cell material, but with a wider distribution affecting the skin, mucous membranes, nerves, etc., all over the body. Like lupus, too, it is due to a special bacillus. (*See* LEPROSY.)

Syphilis may produce eruptions of several kinds. The earliest is in the form of a faint rose-coloured rash; later, red patches covered with white scales may appear; but the chief eruption appearing in the late stage of the disease consists in thickened areas in the skin (gummata) which ulcerate, and on healing leave rounded scars with brown pigmented edges.

(5) **Vesicular.**—*Herpes* is an inflammation of the true skin, attended with the formation of isolated or grouped vesicles of various sizes upon a reddened base. They contain a clear fluid, and either rupture or dry up. Two well-marked varieties of herpes are frequently met with. (*a*) In *herpes labialis et nasalis* the eruption occurs about the lips and nose. It is seen in cases of certain acute febrile ailments, such as fevers, inflammation of the lungs, or even in a severe cold. It soon passes off. (*b*) In *herpes zoster*, *zona*, or *shingles*, the eruption occurs in the course of one or more cutaneous nerves, often on one side of the trunk, but it may be on the face, limbs, or other parts. It may occur at any age, but is probably more frequently met with in elderly people. The appearance of the eruption is usually preceded by severe stinging neuralgic pains for several days, and, not only during the continuance of the herpetic spots, but long after they have dried up and disappeared, these pains sometimes continue and give rise to great suffering. (*See* HERPES.)

Pemphigus consists in large blebs upon a red base. They contain clear or yellowish fluid. This disease appears to show itself most frequently on the bodies and limbs of unhealthy or

neglected children. The blebs give rise to much irritation, and, when they burst, leave raw ulcerated surfaces which are slow of healing. One variety of this malady (*pemphigus foliaceus*) affects the entire skin of the body, from which there exudes a constant discharge. This form is apt sooner or later to prove fatal from its exhausting effects. The treatment is mainly constitutional — by good nourishment, iron, etc.

(6) **Pustular.**— *Impetigo*, consisting of small pustules situated upon a reddened base, mostly occurs in children. There is a contagious form of this malady, which passes from child to child, not uncommonly breaking out as a sort of epidemic in schools. (*See* IMPETIGO.) *Ecthyma* consists of large pustules of similar character on the body and limbs. The treatment of these ailments requires special attention to nutrition, since they usually occur in low states of health. *Boils* may be single, but very often come in the form of a localised eruption of inflamed areas around the follicles of neighbouring hairs. (*See* BOILS.)

(7) **Squamous or scaly.**— *Psoriasis*, an inflammatory affection of the true skin, attended with the formation of red spots or patches, which are covered with white silvery scales, may affect any portion of the surface of the body, but is most common about the elbows and knees, and on the head. There is, as a rule, comparatively little irritation except at the outset, but there is an extensive shedding of the scales from the affected spots. Varieties of this disease are described in relation to the size and distribution of the patches. (*See* PSORIASIS.)

IV. NEUROSES (*Nervous affections*). —Various disorders of nutrition of the skin occur in persons suffering from organic nervous diseases, such as bed sores, atrophic changes, eruptions, etc., but these belong to the symptoms of the several diseases with which they are associated. The most common of the neuroses of the skin is probably *pruritus*, which is an ailment characterised by intense itching of the surface of the body. It may occur in connection with other morbid conditions, such as jaundice, diabetes, digestive disorders, etc., or as the result of the irritation produced by lice or other skin parasites. The most serious form is *pruritus senilis*, which affects old persons, and is often a cause of great suffering, depriving the patient of sleep (the malady being specially troublesome during the night). In such cases it is probably due to atrophic changes in the skin. No eruption is visible, except such marks as are produced by scratching. The treatment consists in the removal of any apparent cause, and measures to strengthen the system, such as the use of quinine, iron, etc. Soothing lotions composed of solutions of alkalies conjoined with chloral, opium, hydrocyanic acid, etc., may be applied to the affected skin at bed-time. (*See* ITCHING.)

V. PARASITIC AFFECTIONS.—(1) **Animal parasites.**—*Phthiriasis* is produced by the presence of lice (*pediculi*), of which there are three varieties, infesting respectively the head, body, and pubis. (*See* PARASITES.)

Scabies, or *Itch*, is a skin affection due to the *Acarus scabiei*, a species of mite. (*See* ITCH, PARASITES.)

(2) **Vegetable parasites** consist of fungous growths in the texture of the skin and hair, which are characterised microscopically by minute round bodies or spores, often coalesced into clusters or bead-like arrangements, and jointed filaments or *mycelium* of elongated and

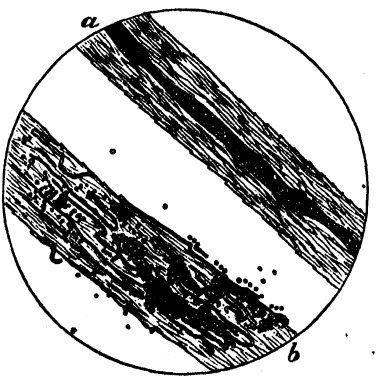


FIG. 402.—Microscopic appearance of a healthy hair, *a*, and of one infected with ringworm, *b*. The latter is disorganised by the growth of the mycelium and spores of the parasite.

branching form. The common name 'tinea' is applied to these parasitic affections. *Tinea tonsurans*, or *ringworm* (parasite *Trichophyton tonsurans*), is a

very common form of disease. (*See* RINGWORM.)

Tinea circinata is the name given to ringworm affecting the body. *Tinea favosa, favus*, or *honeycomb ringworm* is a rarer condition (parasite *Achorion schönleinii*), occurring on the scalp of unhealthy children, which it covers with yellow, cup-shaped crusts, of a peculiar 'mousy' odour. *Sycosis, Tinea sycosis*, or *Tinea barbæ*, a pustular condition of parasitic origin, affects the hairs on chin and cheeks. It is a very difficult condition to get rid of, and is usually attributed to infection from a barber's soap or brush.

Tinea versicolor, or *Pityriasis versicolor* (parasite *Microsporon furfur*), is a brown-coloured rash of scaly character occurring mostly in the form of spots or patches on the skin of the trunk, particularly on the front of the chest or between the shoulders, but sometimes also upon the arms and legs. It affects adults in whom the skin function is not sufficiently attended to, or those who are in ill-health. It is treated by careful washing and sponging twice or thrice daily with a solution of sodium sulphite or with sulphurous acid.

SKIN-GRAFTING is a minor operation in which large breaches of surface due to wounding or ulceration are closed by transplantation of skin from other parts. There are three methods by which this is done. Most frequently the epidermis only is transplanted, according to a method introduced by Reverdin and by Thiersch, and known by their names. For this purpose, a broad strip of epidermis some inches long is shaved off the thigh or upper arm, after the part has been carefully purified, and is transferred bodily to the raw or ulcerated surface, or is cut into smaller strips and laid upon it. By a second method, small pieces of the skin in its whole thickness are removed from the arm and thigh, or even from other people, and are implanted and bound upon the raw surface. This method has the disadvantage that the true skin must contract at the spot from which the graft is taken leaving an unsightly scar. When very large areas require to be covered, a third method is sometimes adopted, as follows. A large flap of skin, amply sufficient to cover the gap, is raised from a neighbouring or distant part of the body, in such a way that it remains attached along one margin, so that blood-vessels can still enter and nourish it. It is then turned so as to cover the gap; or, if it be situated on a distant part, the two parts are brought together and fixed in this position till the flap grows firmly to its new bed. The old connection of the flap is then severed, leaving it growing in its new place.

SKULL is the collection of flat and irregularly shaped bones which protect the brain and form the face. These number in all twenty-two, and the names of the individual bones composing the skull are given under BONE.

Arrangement of the bones.—In early life the brain and organs of special sense are enclosed in a case which is partly formed of cartilage, partly of fibrous membrane. At various parts of this investment, ossification begins early in life, and the bone gradually spreads outwards from each of these centres. Certain of the bones so formed fuse together in early childhood, thus constituting the twenty-two bones of the adult skull which maintain their independence throughout the greater part of life. In old age, however, the bones fuse so completely that the cranium comes to be a solid bony case. Even before this happens, the bones are fastened to one another by 'sutures' so tightly that their separation without breaking is very difficult: The sutures are joints in which each edge is locked with the edges of neighbouring bones by exactly fitting projections and depressions, resembling a complicated mortise-work. Occasionally small bones develop in the sutures between the ordinary, named ones, these extra bones being known as 'Wormian bones'.

The growth of the bones spreads outwards, as already stated, from certain centres, and at the time of birth the growth of several bones has not been quite completed, so that an infant's head presents six soft spots or 'fontanelles' where the brain is covered only by skin and membranes, and at some of which the pulsations of its blood-vessels can be seen. One of these spots, the anterior fontanelle, situated on the top of the head, does not completely close till the child is nearly two years old. Another

change takes place as age advances, consisting in the development of an outer and inner hard 'table' in each of the cranial bones, the tables being separated by a layer of cancellous bone (diploë), and in some positions by spaces containing air, which communicate with the respiratory passages. This change begins at the age of ten years, and leads to great thickening and increased strength in the skull.

Parts of the skull.—The skull consists of two distinct parts: the 'cranium', which encloses the brain and consists of eight bones; and the 'face', which forms a bony framework for the eyes, nose, and mouth, and is composed of fourteen bones. These two parts can be detached from one another. The lower jaw is connected with the base of the cranium by a movable joint on each side, and when the bones are bare of soft parts there is no union between them. The ear, which lies just behind and above this joint, is enclosed in the substance of the temporal bone, lying beneath the brain and separated from it in places only by a very thin shell of bone. The interior of the cranium is moulded so as to form an admirable support for the brain. Its base is divided by bony ridges into three 'fossæ', which from before back support the frontal lobes, the temporo-sphenoidal lobes, and the cerebellum. Further, the inner surface of the bone shows grooves and hollows corresponding to the convolutions and blood-vessels of the brain. The bones, especially on the base of the skull, are pierced by many small canals (foramina) which transmit nerves, vessels, etc. Of these the largest is the 'foramen magnum', through which the medulla oblongata and the spinal cord are continuous with one another.

Shape of the skull.—In the lower animals, the cranium is placed in the back part of the head, and the face looks upwards to a great extent as well as forwards. In man, as a consequence of the great development of the cerebral hemispheres of the brain, in connection with his mental activity, the cranium extends above, as well as behind, the face, which therefore looks straight forwards. A modified type of the lower class of skull is, however, found in the lower races of mankind, in whom the forehead is low and sloping and the jaws prominent. This feature of the skull (prognathism) has been made, by the anatomist Camper and others, a basis for classification of the different races of mankind. The facial angle (*i.e.* the angle between a line touching the most prominent points on the front of the face and the line on which the skull rests, when the lower jaw is removed) varies from an obtuse angle in the ancient Greeks, whose statues show an overhanging forehead, through a right angle in Romans and some of the higher Teuton types, to an acute angle in negroes and Australian blacks, and a still acuter angle in the

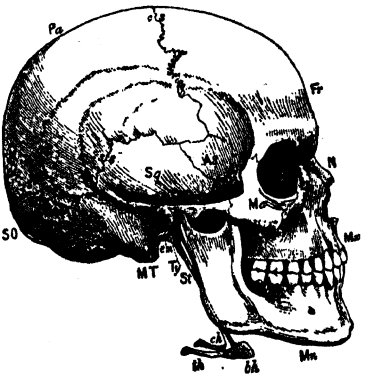


FIG. 403.—Profile view of the skull. *Fr*, Frontal bone; *Pa*, parietal; *SO*, upper part of occipital bone; *Sq*, squamous part of temporal bone; *MT*, mastoid process of temporal bone; *Ty*, tympanic bone enclosing *em*, the entrance to ear; *St*, styloid process of temporal; *As* alisphenoid; *E*, part of ethmoid; *L*, lachrymal; *N*, nasal; *Ma*, malar; *Mx*, upper, and *Mn*, lower jaw; *hh*, *th*, *ch*, parts of hyoid bone; *cs*, *ls*, *ss*, sutures between the bones. (Turner's *Anatomy*.)

man-like apes. Another method of classification is obtained by taking what is known as the 'cephalic index', *i.e.* the percentage that the skull's breadth forms of its length. Long-headed peoples, like the Australian blacks, are known as *dolichocephalic*; peoples with rounded heads, like most European races, are called *mesaticephalic*; while races with broad heads, like some American Indians, are said to be *brachycephalic*.

Age makes considerable changes in the skull. The persistence of soft spots in the skull during the first two years of life, as well as the gradual obliteration of the sutures in later life, have been already mentioned. In children the

size of the cranium is large compared with that of the face, which measures only one-eighth of the whole head, but increases till in adult life cranium and face are of almost equal proportions. In old age once more the face decreases, owing largely to loss of the teeth and consequent absorption of their bony sockets, which allows the cheeks to sink inwards and gives the appearance known as ' nut-cracker ' jaws. A similar result is produced earlier in life by premature extraction of the teeth. The child's head is gently rounded, and does not show the prominences above the eye-

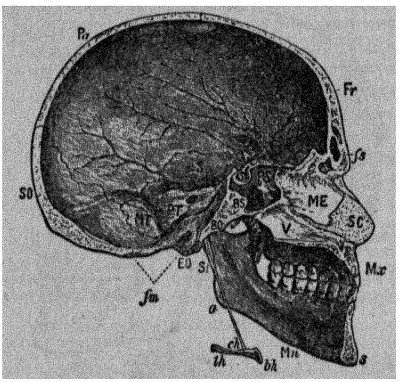


FIG. 404.—Section through the skull immediately to the right of the middle line. The letters indicate the same bones as in Fig. 403, with, in addition, *BO*, basi-occipital; *BS*, basi-sphenoid; *EO*, ex-occipital; *PT*, petrous part of temporal bone containing the ear; *ME*, middle plate of ethmoid; *SC*, septal cartilage of nose; *V*, vomer, forming with the last two the septum of the nose; *Pl*, palate; *Pt*, pterygoid; *fs*, frontal, and *PS*, sphenoidal sinuses or air-spaces; *fm*, foramen magnum through which passes the spinal cord; *a*, angle, and *s*, symphysis of lower jaw. (Turner's *Anatomy*.)

brows and behind the ears, due to the presence of air-cells at these localities in the full-grown skull. Further, the skull is thinner in childhood, does not show the heavy ridges for attachment of muscles displayed in later life, and is more vertical on the front and sides.

Sex also makes some differences, so that, as a rule, though not invariably, the skull of a woman can be told from that of a man. In the woman the characters resemble those of the child, the skull being lighter, smoother, and having less marked prominences. Further, the woman's skull has on an average only nine-tenths the capacity of the male skull.

Deformities result from various causes. The head is rarely symmetrical, one side bulging almost always much more than the other. Premature closure of one of the sutures leads to increased growth at other sutures Thus if the suture running from before backwards on the vertex of the head (sagittal suture) close too early, the result is a very long ' boat-shaped ' head. Some

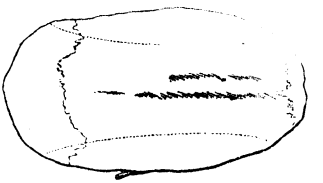


FIG. 405.—Scapho-cephalic or boat-shaped head seen from above. (Turner's *Anatomy*.)

races, as, for example, the ' flat-head ' Indians of North America, show striking deformities of the head produced by applying boards and bandages in infant life. The natives in some parts of Southern France also show a curiously shaped head owing to the wearing of a peculiar cap with tight strings in early life.

SLEEP is a periodic resting condition of the body, and especially of the nervous system. The nature and cause of sleep is a question that has excited discussion for many centuries, especially as to the part played by the mind in this resting condition.

Causes of sleep.—There is a natural rotation of sleeping and waking every twenty-four hours, and sleep comes on commonly during the night when little work can be done. Sleep is not, however, a necessary consequence of darkness, as is proved by those persons who have to work in the night and sleep by day, and who speedily adapt themselves to this condition. Many persons too, such as sailors, gain the power of sleeping as soon as they turn in, and for them short four-hourly periods of sleep and work become natural.

Many theories have been advanced as to the cause of sleep. One theory depends upon the well-known fact that the brain receives a much smaller blood supply during the sleeping than in the

waking state. This fact has been demonstrated in various ways, as, for example, in the case of persons who have lost part of the skull as the result of disease or by operation, and in whom changes in the volume of the brain can be readily observed. Sudden anæmia of the brain is certainly capable of causing loss of consciousness, as in fainting, but it seems more likely that the gradual and slight anæmia of healthy sleep is the effect, not the cause of sleep, since the same change takes place during rest in the blood-vessels of any other part, as, for example, in the muscles of the arm or leg. Nevertheless, a certain amount of anæmia is necessary for quiet sleep, and if the brain be hyperæmic, as after great excitement, or too anæmic, as in aged persons, sleeplessness often ensues. Another theory is the chemical one that sleep is due to want of oxygen in the nerve centres. Pettenkofer and Voit have shown that, of the oxygen taken in during the twenty-four hours, 67 per cent is taken in during the twelve hours of day and 33 per cent during the twelve hours of night, while of the carbonic acid gas given off, 58 per cent is the amount by day and 42 per cent by night. It is also well known that vitiated air containing an excess of carbonic acid gas is capable, like many other substances, of causing drowsiness followed by unconsciousness. But these facts, while making it plain that want of oxygen or the presence of carbonic acid gas and other products of activity in the tissues may cause sleep, do not explain why sleep comes on regularly in persons who are not exhausted by their day's work, nor why many people are able to compose themselves and fall asleep at any time they find convenient. A third theory raises the question as to whether the mind remains active during the period of sleep. This theory brings forward the fact that all sensations, volitions, and other acts of consciousness are accompanied by chemical disturbances in the brain-cells that stimulate the mind to activity, just as bursting bubbles of gas escaping from the bottom of a pond agitate the surface of the water. When external impressions are cut off by closing the eyes and otherwise composing oneself for sleep, the mind ceases to be stimulated, and tranquil sleep ensues, just as the surface of the water becomes calm when the bubbles get few in number. None of these theories explains the direct cause of sleep, though each probably accounts for the main cause in different circumstances.

When sleep comes on, the eyes are closed, as a rule, though in man, even when they are left open, the sense of sight is quickly lost as the sleep deepens. The pupils contract also during sleep, and dilate widely as the person wakens. Hearing is lost more slowly, and a person can be wakened even from deep sleep by a loud noise. In natural sleep, touch remains the least affected of the senses, and even the lightest touch will awaken many people from deep sleep. This does not hold good for sleep caused by drugs, many of which have a special effect in dulling general sensation, though much less effect upon the sense of hearing. With regard to the onset of sleep as it affects the mind, will-power is the first faculty to go and the last to appear in wakening. The association of ideas and power of reasoning next disappear, and people are often worried in light sleep by some simple idea which they cannot explain or understand. Memory and imagination remain longest, and, in dreams, the mind is presented with a series of bright, unconnected pictures, all jumbled together, which it does not attempt to explain. Finally, the person sinks into a sound, dreamless slumber, which grows quickly deeper during the first hour of sleep, after which the person sleeps more lightly. The part of the brain which regulates the power of movement is late in falling asleep, sleeps only lightly,—since people may turn and make various other movements without waking,—and usually wakens before the intellectual faculties and the special senses.

Other parts of the body, as well as the brain, rest during sleep. Thus the kidneys secrete less urine, and the liver secretes less bile, the heart beats much less strongly, and the respirations are slower and shallower than in the waking state. The skin becomes flushed with blood, so that it is specially necessary to keep the surface well covered during sleep in order to avoid chills. Some parts of the body never have a continued rest throughout life. Thus the heart,

during the course of the two to three thousand million beats which it makes throughout an average life, never ceases longer than the fraction of a second that intervenes between each pair of beats, and, in each of these brief intervals, it recuperates itself for its next effort. Similarly the vital centres in the brain may be said never to sleep.

The amount of sleep suitable at different ages is mentioned under CHILDREN, PECULIARITIES OF. It must be remembered that too much sleep is unhealthy, as well as too little sleep.

Dreams.—The mind, like the vital centres, is probably never completely inactive during sleep, but is constantly receiving slight impressions which produce only a faint and quickly forgotten sensation. This is borne out by the fact that a sleeper may be awakened, not only by a loud sound or light touch, but by the ceasing of a continuous sound, as when machinery stops. A sleeper is also especially easily awakened by some sound or other sensation that he expects, and, in further proof of this constant wakefulness of the mind, may be mentioned the fact that many people have the power of wakening after having slept for a period which they have previously determined. It has been already stated that the different parts of the brain and the different faculties of the mind go to sleep usually in a certain order. When the higher intellectual faculties of will and reason have become dulled, but deeper sleep does not at once come on, memory and imagination become increasingly vivid, so that brilliant pictures are presented to the mind. Often these are mingled with misinterpreted sensations from the surface of the body or from disordered internal organs, which serve to give them an unpleasant tinge. For example, dyspepsia following upon a late and heavy meal may give rise to sensations of falling over precipices, of vague depression, or of other unpleasant experiences which are in part memories of past events. Again, a wakeful memory and imagination may be associated with wakefulness of the motor portion of the brain, as when the person dreams that he is making desperate efforts to achieve some object or to escape pursuit, and his limbs go through movements associated with the ideas presented in his dream. Any sensation received from the surface of the body or from a disordered organ may suffice to produce the condition of partial sleep in which dreams occur, or it may become sufficiently strong to awaken the sleeper altogether. Again, the impression of the dream may produce so great an effect upon consciousness that the dream is remembered on waking, or it may fade so completely that only a sense of something forgotten is present, and a feeling that the slumber has been unrefreshing to the weary mind. Dreaming is really a form of partial insomnia, and is to be similarly treated. Much attention has of late been paid to dreams with the object of finding out repressed memories responsible for mental unrest in the person concerned. These often become more evident during sleep than in the waking hours, and, if the dreams are remembered, they give a guide to the identity of the disturbing memories. Appearances seen and things felt or heard in dreams often have a symbolic meaning; and the interpretation of this by those who practise psychotherapy often plays an important part in treatment.

Night terrors occur in nervous children and are allied to dreaming. The child goes to sleep after a day of unusual excitement or fatigue, or perhaps after partaking of some indigestible material, and in a short time, when sleep should be sound and dreamless, he awakens with a start and in a state of terror. Frequently the child screams with fear, cannot be pacified, and for several minutes does not seem to recognise those near him. When quieted, he can often give no reason for his fear, or he may attribute his behaviour to a dream. Children who suffer in this way should be guarded from excitement and fatigue, and may well be taken to a child-guidance clinic or to a child psychologist. Proper treatment in childhood will prevent mental breakdown in later life.

Somnambulism, or sleep-walking, is also an imperfect form of sleep, in which the muscular apparatus, and the portion of brain controlling it, remain awake though the intellectual faculties are buried in slumber. It is of various grades, some persons singing, talking, or even shouting in their sleep, others

flinging about the arms or sitting up, and others, who suffer in the most aggravated form, rising from bed and going through complicated movements, such as that of climbing from a window. In many cases, some of the sense organs are also awake, and the somnambulist may see and avoid objects in his path, or may hear and answer questions, though seldom with coherence. These active dreams are, as a rule, totally forgotten on awakening. The condition known as artificial somnambulism or hypnotism is treated under HYPNOTISM.

Paralysed wakefulness is a condition of which people sometimes complain. This is the converse of somnambulism, the person waking from sleep to full consciousness and finding himself unable to make any movement for several seconds or minutes. In this condition the motor part of the brain seems to lag behind the intellectual and sensory part in waking up, but the condition is a transitory and unimportant one.

Insomnia, or sleeplessness, is a condition that often causes annoyance, and by depriving the person of natural rest produces interference with the full activity during the day-time. When it becomes a habit, it may form a serious menace to the health.

It may be due to a variety of causes, and these may act so effectively as to keep the person awake altogether, or they may serve, when present in a less degree, to produce one of the forms of dreaming and unrefreshing slumber mentioned above. In the first place, there are some persons of a nervous temperament whose sleep is much more liable to be interrupted by trivial causes than that of their more phlegmatic neighbours. In temporary cases of sleeplessness or dreaming, in which the affected person suffers from a disturbed night now and then, the cause is usually to be sought in some external source of irritation. A slight degree of pain, too light a bed-covering leading to general coldness, or even the presence of cold feet may be quite enough to prevent the brain from attaining the necessary degree of repose. Indigestion, due to eating a heavy meal shortly before retiring to rest, or some other internal disorder may act in a similar manner, even although there be no severe pain. In cases of habitual sleeplessness, a voluntary limitation of the hours of sleep, combined with overstudy, worry, or grief, is often instrumental in forming a bad habit which it is exceedingly hard to break. The brain in these cases remains hyperæmic and fully active, despite the best endeavours of the sleepless person to compose himself for rest. A similar state of matters is often set up by poisonous materials circulating in the blood, as in fevers, malaria, gout, intemperance, and over-indulgence in tobacco. Another cause of sleeplessness or dreaming is found in persons suffering from neurasthenia, and these persons are frequently affected in such a way that they fall asleep on retiring to rest, enjoy only a light and partial slumber for an hour or two, and then lie wide awake till morning.

Treatment of disordered sleep.—This varies greatly, depending indeed entirely upon the cause. A warm foot-bath immediately before retiring, a greater amount of exercise during the day, and care with regard to the diet may be sufficient in some of the slighter cases to remedy insomnia. Where any known cause of pain or irritation exists, this must of course be remedied. Headache is not uncommonly a cause of sleeplessness, and the relief of this condition is then requisite, and often sufficient to restore natural sleep. (*See* HEADACHE.) When a mental cause is at the root of the condition, the habit of overstudy, business worry, etc., which was originally responsible for the want of sleep, must be abandoned. Some change of occupation in the later part of the evening, such as reading some simple book or engaging in conversation, often helps to quiet the overworked brain and to deplete its over-filled blood-vessels. In these cases also some easy mental effort, like counting imaginary sheep as one lies awake in bed, is similarly helpful. Cases which resist these simple means often yield to hypnotics. (*See* HYPNOTICS.) In cases where the nervous system is thoroughly run down, treatment of a bracing nature is required. (*See* NEURASTHENIA.) Finally, any constitutional states, like gout and malaria, or any bad habits like intemperance and excessive smoking, require appropriate treatment.

Coma is the name applied to a state

of deep sleep in which the person is very near to death. (*See* COMA.) The condition may be due to apoplexy, compression or concussion of the brain, and to poisoning by excess of alcohol or by narcotic poisons such as opium. (*See* OPIUM.)

Apparent death is a condition deeper than coma, in which persons are to all appearance dead. Cases have occurred of supposed death, in which the person has been in a deep sleep or trance, from which some sudden shock has awakened him after several hours or even days. In all such cases, however, careful examination would reveal signs of life. (*See* CATALEPSY *and* DEATH, SIGNS OF.)

SLEEPING SICKNESS is a disease occurring among natives and to a less extent among Europeans resident in West and Central Africa, along the Niger and Congo basins, on the shores of Lake Victoria Nyanza, the Upper Nile basin, Uganda, Rhodesia, etc., characterised by increasing weakness, lethargy, and a constant tendency to sleep, with gradual emaciation and finally death. It is one of the group of diseases caused by the presence in the blood of minute parasites known as *trypanosomes*. The discovery of these parasites in the blood in cases of sleeping sickness was first made by Castellani in 1902. Later it was shown that this parasite is transmitted by various forms of the tsetse fly, in the body of which the parasite undergoes a stage of its development. In certain parts of Africa a form of parasite known as *Trypanosoma gambiense* is conveyed from the blood of animals, especially cattle, to that of man by the bite of a tsetse fly known as *Glossina palpalis*; and further south another variety of trypanosome, *Trypanosoma rhodesiense*, is similarly transmitted by another tsetse fly, *Glossina morsitans*. Other forms of the disease transmitted by other insects are also known, such as a disease occurring in Brazil called *American trypanosomiasis*, or Chagas's disease. The parasite, when introduced into the blood, produces its effects by developing in the small blood-vessels and in the lymphatic glands, around which its presence causes inflammation. The disease only occurs in limited regions where both the parasite and the fly are found, but there is reason to believe that it is becoming gradually more prevalent in Africa with the more widespread occurrence of the tsetse fly.

Symptoms.—A few days after the person has been bitten by the fly, fever accompanied by a slight rash develops. This fever subsides but recurs at irregular intervals of a few days or weeks. Gradually the fever becomes more pronounced, and in time the patient becomes weakened and anæmic. The glands of the neck and other parts of the body become enlarged and tender, and this state may last for months or even for years. Some cases appear to recover at this stage even after an illness of many months, and the parasite may disappear altogether from the blood. In most cases, however, the stage known as sleeping sickness gradually appears, though the lethargy may not set in for as long as seven years after the original infection. The patient now becomes disinclined for exertion, is slow mentally and weak physically, often complains of headache, and has an increasing tendency to sleep, although at first he is able to engage in conversation and to take his food. As time goes on, the weakness increases and the patient becomes more and more emaciated, bed sores form, and death finally takes place from weakness or from some intercurrent disease. The later symptoms appear to be due to the development of the parasites in the minute blood-vessels of the brain, around which, in consequence, inflammatory changes take place with disorganisation of the proper nervous tissues.

Treatment.—For the prevention of sleeping sickness the chief essential is the avoidance of the flies which carry the disease. Fortunately, the occurrence of the flies is very definitely localised to certain regions, and, when such regions have to be traversed, the journey is made during the night-time when the flies do not feed. Those who live in fly-infested regions should have their houses and persons carefully protected against the fly. As the flies are mostly found close to streams, much has been done in certain localities by clearing the neighbourhood of streams in infested districts of all vegetation which would shelter the flies. By avoiding the neighbourhood of streams in infested districts, by wearing white clothing, and by removal

of natives already infected from such infested districts, people may safeguard themselves from this disease.

In the earlier stages of the disease it is believed that a cure can be effected by the administration of various compounds of arsenic and antimony. Among the substances in this class which have been used with favourable results are atoxyl, Bayer 205 or Germanin, tryparsamide, and especially tartar emetic. The greatest advance in the treatment of this disease was announced in 1940 by a description of the action of the aromatic diamidines on the trypanosome organism: of these the most active was diamidino-stilbene.

SLEEPY SICKNESS is a popular name for encephalitis lethargica. (*See* ENCEPHALITIS.)

SLING means a hanging bandage for the support of injured or diseased parts. Slings are generally applied for support of the upper limb, in which case the limb is suspended from the neck. The lower limb is also frequently supported in a sling from an iron cage placed upon the bed on which the patient lies. In the latter case the object of slinging the limb is usually to aid the circulation, and so quicken the healing of ulcers on the leg.

In the case of the upper limb, the sling is made from Esmarch's triangular handkerchief bandage, formed by cutting a yard of calico diagonally from corner to corner into two triangular pieces. There are four varieties of sling.

Sling for the wrist is made by folding the bandage up into a narrow cravat, laying the wrist upon the centre, and carrying one end up each side of the neck, behind which the two are tied.

Sling for the forearm is applied as follows: The unfolded triangle is laid with one end over the shoulder of the sound side, the centre of the base at the wrist of the injured limb, and the point of the bandage at the elbow of the injured limb. The other end is carried up in front of the injured limb, over the shoulder, and the two ends are tied behind the neck. The point is finally pinned neatly round the elbow.

Sling for the elbow is applied in much the same way, with this exception, that the point of the triangle is placed under the wrist, while the centre of the base supports the elbow. The bandage is completed by turning the point up over

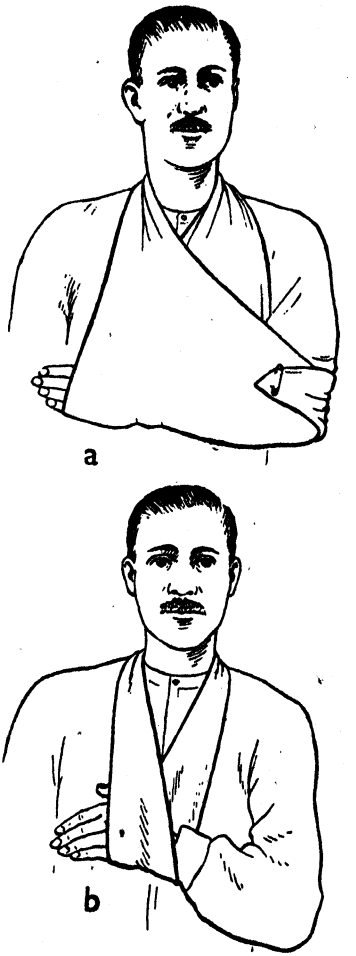


FIG. 406.—*a*, Sling for forearm; *b*, sling for wrist.

the wrist and pinning it to the part of the bandage above.

Sling for the shoulder is applied, as in the case of the sling for the elbow, with the centre of the base at the elbow, and the front end is carried over the opposite shoulder. The other end passes up behind the upper arm and across the back, the two ends being tied upon the sound shoulder. The object of this sling is to

support, while avoiding pressure on the injured shoulder, as in fracture of the collar-bone. (*See* FRACTURES.)

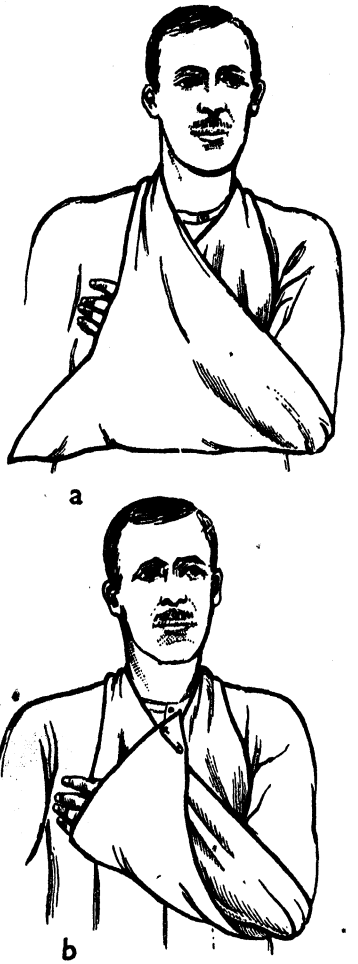


FIG. 407.—Sling for elbow: a, first stage; b, finished.

SLOUGH means a dead part separated by natural processes from the living body. The term is applied to hard external parts which the lower animals cast off naturally in the course of growth, like the skin of snakes or the shell of crabs. In man, however, the process is generally associated with disease, and is then known as 'gangrene'. (*See* GANGRENE.) Sloughs may be of very small size, as in the case of the 'core' of a boil, or they may include a whole limb, but in general a slough involves a limited area of skin or of the underlying tissues. The process of separation of a slough is described under gangrene.

SMALLPOX, or VARIOLA (*varus*, a pimple), is an acute infectious disease characterised by fever and by the appearance on the surface of the body of an eruption which, after passing through various stages, dries up, leaving more or less distinct scars. Few diseases have been so destructive to human life as smallpox, and it has ever been regarded with horror, alike from its fatality, its loathsome accompaniments and disfiguring effects, and from the fact that no age or condition of life is exempt from liability to its occurrence. Although in most civilised countries its ravages have greatly decreased since the introduction of vaccination, yet epidemic outbreaks are far from uncommon, affecting especially those who are unprotected, or whose protection has become weakened by lapse of time.

Much obscurity surrounds the early history of smallpox. It appears to have been imported into Europe from Asia, where it had been known and recognised from remote antiquity. The earliest accounts of its existence reach back to the middle and end of the sixth century, when it was described by Procopius and Gregory of Tours as occurring in epidemic form in Arabia, Egypt, and the south of Europe. The most reliable statements as to the early existence of the disease are found in Rhazes (*c.* A.D. 900), by whom its symptoms were clearly described, its pathology explained by a fermentation theory, and directions given for its treatment. During the period of the crusades, smallpox appears to have spread extensively through Europe, and hospitals for its treatment were erected in many countries. Smallpox was known in England as early as the thirteenth century, and had probably existed there before. It appears to have been introduced into America shortly after the discovery of that continent, and there, as in Europe and throughout the known world, destructive epidemics were of frequent occurrence during succeeding centuries.

Causes.—The only known factor in

the origin of smallpox is contagion, this malady being probably the most contagious of all diseases. It is due to infection with a virus. Its outbreak in epidemic form in a locality may frequently be traced to the introduction of a single case from a distance. By far the most common cause of conveyance of the disease is contact with the persons or the immediate surroundings of those already affected, but infection can also be carried by the clothes of third persons not themselves infected. The most infectious period extends from the appearance of the eruption till the drying up of the pustules. No age is exempt from susceptibility to smallpox. Dark-skinned races are said to suffer more readily and severely than whites. One attack of smallpox, as a rule, confers immunity from any recurrence. Overcrowding and all insanitary surroundings favour the spread of smallpox where it has broken out; but the most influential condition of all is the amount of protection afforded to a community by previous attacks and especially, in the present day, by vaccination. Such protection, although for a time most effectual, tends to become exhausted, unless renewed. Hence in a large population there is always likely to be an increasing number of individuals who have become susceptible to smallpox. This probably explains its occasional and even apparently periodic epidemic outbreaks in large centres, and the well-known fact that the most severe cases occur at the commencement—those least protected being necessarily more liable to be first and most seriously attacked.

Symptoms.—The onset of the symptoms is preceded by a period of incubation, during which the patient may or may not complain. This period is from about ten to fourteen (usually twelve) days. The invasion is sudden and severe, in the form of a rigor followed by fever (the *primary fever*), in which the temperature rises to 103° or 104° Fahr. or higher, notwithstanding that perspiration may be going on. A quick pulse is present, together with thirst and constipation, while intense headache, vomiting, and pain in the back are among the most characteristic of the initial symptoms. Occasionally the disease is ushered in by convulsions. These symptoms continue with greater or less intensity throughout two days, and during their course there may occasionally be noticed on various parts of the body, especially on the lower part of the abdomen and inner sides of the thighs, a diffuse redness accompanied by slight spots of extravasation (*petechiæ*), the appearance somewhat resembling that of scarlet fever. These 'prodromal rashes', as they are termed, appear to be more frequent in some epidemics than in others, and they do not seem to have any special significance. On the third day the characteristic eruption begins to make its appearance. It is almost always first seen on the face, particularly about the forehead and roots of the hair, in the form of a general redness; but upon this surface there may be felt by the finger numerous elevated points more or less thickly set together. The eruption, which is accompanied by heat and itching, spreads over the face, trunk, and extremities in the course of a few hours—continuing, however, to come out more abundantly for one or two days. It is always most marked on the exposed parts; but in such a case as that now described the individual 'pocks' are separated from each other (discrete). On the second or third day after its appearance the eruption undergoes a change—the pocks becoming vesicles filled with a clear fluid. These vesicles attain to about the size of a pea, and in their centre there is a slight depression, giving the characteristic umbilicated appearance to the pock. The clear contents of these vesicles gradually become turbid, and by the eighth or ninth day of the disease they are changed into 'pustules' containing yellow matter, while at the same time they increase still further in size and lose the central depression. Accompanying this change, there are great surrounding inflammation and swelling of the skin, which, where the eruption is thickly set, produce much disfigurement and render the features unrecognisable, while the affected parts emit an offensive odour, particularly if, as often happens, the pustules break. The eruption is present not only on the skin but on mucous membranes, that of the mouth and throat being affected at an early period; and the swelling produced here is not only a source of great discomfort but even of danger

from the obstruction thus occasioned in the upper portion of the air passages. The mucous membrane of the nostrils is similarly affected, while that of the eyes may also be involved, to the danger of permanent impairment of sight. The febrile symptoms, which ushered in the disease, undergo marked abatement on the appearance of the eruption on the third day, but on the eighth or ninth, when the vesicles become converted into pustules, there is a return of the fever (*secondary* or *suppurative fever*), often to a severe extent, and frequently accompanied by nervous symptoms, such as great restlessness, delirium, or coma. On the eleventh or twelfth day the pustules show signs of drying up (desiccation), and along with this the fever abates. Great itching of the skin attends this stage. The scabs produced by the dried pustules gradually fall off and reddish-brown spots remain, which, according to the depth of skin involved in the disease, leave a permanent, white, depressed scar—this 'pitting', so characteristic of smallpox, being specially marked on the face. Convalescence in this form of the disease is, as a rule, uninterrupted.

In some outbreaks the type of the disease is much more severe than in others, and the mortality consequently greater. Smallpox is most fatal at the extremes of life, except in the case of vaccinated infants, in whom there is an immunity from the disease. Numerous and often dangerous complications are apt to occur at or after the supervention of the secondary fever. The most important are inflammatory affections of the respiratory organs, such as bronchitis, pleurisy, pneumonia, suppurative conditions of the throat, and swelling of the mucous membrane of the larynx and windpipe. Destructive ulceration affecting the eyes or ears is a well-known and formidable danger, while various affections of the skin, in the form of erysipelas, abscess, or carbuncles, are of occasional occurrence. Persons of enfeebled health, and those whose constitution is impaired by intemperance, readily succumb to attacks of smallpox, even of comparatively mild character, as do also pregnant women, to whom this disease is peculiarly dangerous.

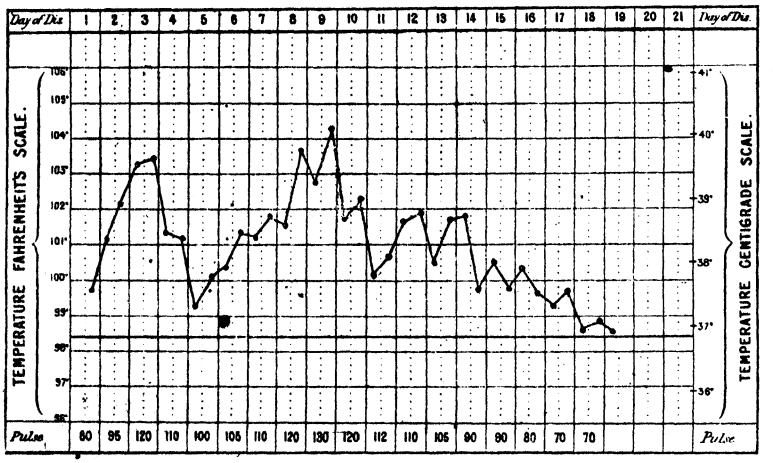


FIG. 408.—Temperature chart of a case of smallpox, showing the primary and secondary fevers.

Varieties.—*Confluent smallpox* shows much severer symptoms from the onset than those just described, and the eruption, instead of showing itself in isolated pocks, appears in large patches run together, giving a blistered appearance to the skin. This confluent condition is almost entirely confined to the face, and produces shocking disfigurement, and deep scars. The mortality in these cases is very high, and it is generally estimated that at least 50 per cent of the cases of confluent smallpox prove fatal, while in those that survive, convalescence is apt to be slow and inter-

rupted. *Hæmorrhagic smallpox* is a form in which bleeding takes place into the pocks after they are formed. This is apt to be accompanied by bleeding from various mucous surfaces (particularly in the case of females), occasionally to a dangerous degree. Many of such cases also prove fatal. *Malignant smallpox* is a still more serious form, in which, as in the malignant forms of other infectious diseases (*see* MEASLES and SCARLATINA), the patient is from the outset overwhelmed with the poison and quickly succumbs — the rash scarcely appearing at all. Such cases are, however, rare. *Varioloid*, or *modified smallpox*, is the term applied to those cases which occur in people who are little susceptible to the disease, or in whom the protective influence of vaccination or of a previous attack of smallpox still to some extent exists. Cases of this mild kind are of common occurrence.

Treatment.—In the prevention of smallpox, with regard to the safety both of the individual and of the community, no measure has been so effectual as vaccination. (*See* VACCINATION.)

The treatment of cases of smallpox is conducted upon the same general principles as that for the other infectious diseases. (*See* CHOLERA, DIPHTHERIA, MEASLES, SCARLET FEVER.) The establishment of smallpox hospitals separated as far as possible from populous localities, and the prompt removal of cases of the disease where practicable, as well as the diligent prosecution of vaccination and re-vaccination, are among the first requirements. The patient should lie on a soft bed in a well-ventilated but somewhat darkened room, and be fed with the lighter forms of nutriment, such as milk, soups, etc. The skin should be sponged occasionally with tepid water, and the mouth and throat washed or sprayed with a solution of chlorate of potash, permanganate of potassium, or other safe disinfectant. In a severe case, with evidence of much prostration, stimulants are required. The patient should be always carefully watched, and special vigilance is called for when delirium exists. This symptom may sometimes be lessened by sedatives, such as opium, bromides, or chloral. With the view of preventing pitting, many applications have been proposed, but probably the best are cold or tepid compresses of light weight kept constantly applied over the face and eyes. The fluid out of which these are wrung may be a weak lotion of boracic acid, with which the eyes should also be frequently irrigated. When the pustules have dried up, the itching thus produced may be much relieved by the application of carbolised vaseline. Complications are to be dealt with as they arise, and the severer forms of the disease treated with reference to the special symptoms presented. Ventilation should be free, and all clothing, etc., should be afterwards burnt.

SMEGMA (σμῆγμα, soap) is a thick, cheesy secretion formed by the sebaceous glands of the glans penis. A bacillus closely resembling the tubercle bacillus develops readily in this secretion.

SMELL (*see* NOSE, DISEASES OF; for bad smell, *see* DEODORANTS, EUCALYPTUS, PERMANGANATE OF POTASSIUM, etc.).

SMOKING (*see* TOBACCO).

SNAKE-BITE (*see* BITES, etc.).

SNAKE-ROOT is a popular term for several plants, including senega and serpentaria. Black snake-root is the name applied to *cimicifuga*, which is used in extract or tincture in treatment of chronic rheumatism.

SNARE is a wire loop used by the ear, nose, and throat surgeon for removing polypi from the nose.

SNEEZING means a sudden expulsion of air through the nose, designed to expel irritating materials from the upper air passages. In sneezing, a powerful expiratory effort is made, the vocal cords are kept shut till the pressure in the chest has risen high, and air is then suddenly allowed to escape upward, being directed into the back of the nose by the soft palate.

Sneezing may be caused by the presence of irritating particles in the nose, such as snuff, the pollen of grasses and flowers, etc. It is also an early symptom of colds, influenza, measles, and hay-fever, being then accompanied or followed by running at the nose.

SNORING (*see* STERTOR).

SNUFFLES is the name applied to noisy breathing in children due to the constant presence of nasal discharge. (For treatment see NOSE DISEASES.)

SOAP is a substance made by boiling a fat or oil with an alkali. The most commonly used oil is olive oil, and the most frequent alkali is caustic soda. In the process of manufacture the fatty acids of the oil unite with the alkali, glycerin separating out. In soft soap or green soap, caustic potash is used in place of soda; marine soap is made with cocoanut oil; curd soap has tallow for its fat; while many toilet soaps have palm oil or almond oil. Barilla soap is made from soda got by burning plants; in superfatted soaps care is taken that the fatty part is in excess, so that no crude alkali is left to irritate the skin; while glycerin soaps have a specially emollient action. Medicated soaps of various kinds are prepared, the chief drugs added to soap being of an antiseptic nature, such as carbolic acid, coal-tar, formalin, ether, terebene.

Uses.—The chief use of soap is, mixed with water, as a cleansing agent. Internally, hard soap is often used to make up the bulk of pills containing very active ingredients. As a purgative enema, soap is used made up into a strong solution in warm water. Soap liniment, better known as 'opodeldoc', is widely used as a popular remedy for stiffness or sprains.

SODA (*see* ALKALI, SODIUM).

SODIUM is a metal whose salts are white, crystalline, and very soluble. The fluids of the body contain naturally a considerable quantity of sodium chloride or common salt, and therefore the salts of sodium, when used as drugs, have little effect depending upon their metallic base. They act similarly to the corresponding salts of potassium. (*See* POTASSIUM.)

SODIUM CARBONATE, commonly known as SODA or WASHING SODA, has a powerful softening action upon the tissues.

SODIUM BICARBONATE, or BAKING SODA, is largely used as an 'antacid' in acidity of the stomach, gout, rheumatism, and other diseases. It is taken in doses of 10 or 20 grains, as a rule. (*See* ACIDITY.) The citrate, or acetate of sodium, is used in a similar manner, though the corresponding potassium salts are more frequently employed.

SOFTENING OF THE BRAIN (*see* APOPLEXY; BRAIN, DISEASES OF).

SOFT SORE, or CHANCROID, is an infective venereal ulceration due specially to the bacillus of Ducrey, and probably to other organisms as well. It is a local condition not spreading beyond the glands in the neighbourhood of the original ulcer, although there is always a possibility that syphilis may be contracted along with this disease and may show itself later. The condition begins within a few hours after inoculation as a pimple which enlarges rapidly and ulcerates. The glands in the groin speedily become affected, and as these may soften and ulcerate, the condition sometimes results in a tedious illness.

Treatment consists in careful cleansing of the surrounding parts, and the destruction of the infected tissues by caustics as soon as possible. For this purpose it is usual to apply nitric acid to the edges and floor of the ulcers. The enlarged glands are either excised when abscesses threaten to form in them, or are opened, scraped out, and treated as ordinary poisoned wounds.

SOLARIUM is the term applied to a room enclosed by glass in which sun baths are taken while protection is afforded from the weather. This form of treatment is especially used against tuberculosis.

SOLDIER'S HEART, or DISORDERED ACTION OF THE HEART (D.A.H.), or EFFORT SYNDROME, is a term applied to a set of symptoms arising under conditions of great anxiety and unusual physical strain, and consisting of palpitation, shortness of breath, speedy exhaustion, depression, and irritability. The condition also occurs in civil life, but received its name on account of the frequency with which it was noticed during the Great War. (*See* HEART DISEASES.)

SOLOMON'S SEAL is a popular name for *Polygonatum officinale*. The fluid

extract has astringent properties and is used as an application to bruises.

SOMATIC (*σωματικός*) means anything belonging to the framework of the body as distinguished from the internal organs.

SOMNAMBULISM (*somnus*, sleep; *ambulo*, I walk) means sleep-walking. (*See* SLEEP.)

SOMNOFORM is a mixture of ethyl chloride, methyl chloride, and ethyl bromide, used as an anæsthetic for minor operations.

SOPORIFICS (*sopor*, heavy sleep; *facio*, I make) are measures which induce sleep. (*See* HYPNOTICS.)

SORDES (*sordes*, filth) is the name applied to the thick offensive material which gathers on the lips, teeth, and tongue of persons who are very weak from fever or other cause. The constant movements of the tongue and lips in healthy people serve to keep them free of growing bacteria, remnants of food, and cells cast off from the mucous membrane of the mouth, which in the enfeebled state collect and form a brown or black putrefying deposit.

Treatment.—The lips, tongue, and teeth should be wiped occasionally with a rag dipped in borax and honey, or glycerin of borax, and the rag then burned. Syringing out the mouth with bicarbonate of soda solution, one teaspoonful to a tumblerful of warm water, is also helpful in very weak persons. If the person be strong enough, he may rinse his mouth with weak solution of permanganate of potassium in water, diluted to a pale pink colour.

SORE is a popular term for ulcer (*see* ULCER).

SORE THROAT (*see* THROAT, DISEASES OF; *and* TONSILLITIS).

SOUND is a rod with a curve at one end, for passing into the bladder to determine whether a stone is present or not. (*See* BLADDER, DISEASES OF.)

SOUR MILK (*see* LACTIC ACID BACILLI).

SOUTHEY'S TUBES are long, fine tubes for drawing off water slowly from cases of dropsy. (*See* ASPIRATION.)

SOYA BEAN is the bean of *Glycine hispida* or *Soja max*, a leguminous plant related to peas and beans. The outstanding characteristic of the soya bean is its very high protein and fat content. There is an almost complete absence of starch. There is a large amount of mineral matter. Soya flour contains 40 per cent of protein and 20 per cent of fat. It yields 470 calories per 100 grammes as compared with 370 calories for white wheat flour. Soya flour contains 0·2 per cent of calcium (about ten times as much as in white flour). It also contains a variable but large amount of iron—6·7 to 30 mg. per 100 grammes of soya flour compared with 1 mg. in white flour and 3 mg. in 100 grammes of wholemeal flour. It is a good source of vitamin B1 and riboflavin, and of vitamin A in the form of carotene. As a concentrated food it was much used by the German armed forces in the war which began in September 1939.

SPANISH FLY is a popular term for cantharides, which is used as a blistering agent and as an aphrodisiac. (*See* CANTHARIDES.)

SPASM (*σπάσμα*, a convulsion) means an involuntary, and, in severe cases, painful contraction of a muscle or of a hollow organ with a muscular wall. Spasm may be due to affections in the muscle where the spasm takes place, or it may originate in some disturbance of that part of the nervous system which controls the spasmodically acting muscles. Spasms of a general nature are usually spoken of as 'convulsions', spasms of a painful nature are known as 'cramp' when they affect the muscles of the limbs, and as 'colic' when they are situated in the stomach, bowels, or other organs of the abdomen. Spasm of the heart receives the name of 'breast-pang' or 'angina pectoris', and is both a serious and an agonising condition. When the spasm is a prolonged firm contraction, it is spoken of as 'tonic' spasm; when it consists of a series of twitches or quick alternate contractions and relaxations, it is known as 'clonic' spasm. Spasm is a symptom of many diseases.

SPASMODIC TORTICOLLIS, or WRY-NECK, is the term applied to a condition in which there is continuous

or interrupted spasm of the muscles of one side or of both sides of the neck, the head being held or jerked either backwards or to one side. It is a nervous disorder.

SPASMOPHILIA (σπασμός, spasm ; φιλέω, I love) is a term applied to a condition affecting certain persons, especially in childhood, in which the motor nerves are unusually sensitive to irritation. Such patients show an abnormal tendency to convulsions and spasms on very slight cause.

SPASMUS NUTANS is the term for describing the rhythmic nodding of the head sometimes seen in infants during the first year of life.

SPASTIC (σπαστικός, drawing) is a term applied to any condition showing a tendency to spasm, *e.g.* spastic gait. This is specially associated with some disease affecting the upper part of the nervous system connected with movement (upper neurone), so that its controlling influence is lost and the muscles are in a state of over-excitability.

SPATULA is the name of a flat, knife-like instrument used for spreading plasters and ointments.

SPECIFIC (*species*, a particular kind ; *facio*, I make) is a term used in various ways. It is applied to remedies which appear to have a definitely curative effect in certain diseases, as, for example, to salicylate of soda, which is said to be specific in rheumatism, or to quinine, which is a specific for ague. Again, it is applied to bacteria and other agents which form the chief cause of certain diseases, though there may be other minor contributing causes; for example, the comma bacillus is the specific cause of cholera, the acarus parasite is the specific cause of the itch. The term is also used to designate diseases that have an identity of their own, have a definite cause, and do not consist merely of a group of symptoms ; for example, scarlet fever, measles, typhoid fever are specific as compared with vague ailments such as enlargement of the glands in the neck, diarrhœa, or dyspepsia. The word specific is also sometimes used as a euphemism for venereal disease.

SPECTACLES are worn on account of some defect in the refractive (*i.e.* focussing) power of the eye, or owing to the axis of the eye being misdirected (*i.e.* squinting), or simply as a protection from bright light, wind, or dust.

Refractive errors consist of four types: (1) SHORT-SIGHT, in which the refractive power of the eye is too strong or the globe of the eye too long from before backwards, so that rays of light from distant objects are brought to a focus in front of the retina, upon which blurred images are therefore formed. Spectacles containing concave lenses are used in order to correct this in viewing distant objects. Children with short-sight have difficulty in following their lessons, because they cannot see clearly maps, figures on blackboards, and other objects at a distance. They should therefore be early provided with appropriate glasses, since the error, if uncorrected, is liable to become more pronounced.

(2) LONG-SIGHT, in which the globe of the eye is so short from before backwards, that rays of light from objects close at hand would come to a focus behind the retina and therefore produce blurred images, although the vision for distant objects may be perfect. In this case, convex spectacles are used for near work in order to increase the converging power of the lens of the eyes. Long-sighted eyes in school children and students are apt to be inflamed and productive of headache in consequence of the constant overstrain required to focus near objects, such as a printed page, upon the retina. The condition is very apt to pass unnoticed, since, except in extreme degrees of this malformation, the child or student has good vision for distant things. Constantly inflamed eyes, headache, and especially occasional blurring of the print after the eyes have been used for some hours in reading, should attract attention to this condition.

(3) ASTIGMATISM, in which the curvature of the cornea is not symmetrical, so that the rays of light in one plane cannot be focussed upon the retina along with those in the plane at right angles to it. Such an eye, accordingly, sees objects, whether they be near at hand or far off, in a distorted manner ; a circle, for example, being seen as an ellipse and blurred at two points opposite one

another. For the correction of this error extreme care is necessary. Spectacles have to be fitted in which the glasses, instead of being lens-shaped, consist of a slice from the side of a cylinder. That is to say, the glasses are flat in one direction and curved in the axis at right angles to it. The axis of the cylinder must be set with great care in the spectacle frame at right angles to the axis of astigmatism. Astigmatism may occur in long-sighted or in short-sighted eyes, or, the eye may be long-sighted in one meridian, short-sighted in the meridian at right angles to it (mixed astigmatism).

(4) PRESBYOPIA, or the condition which is a natural consequence of increasing age, in which the lens of the eye gradually hardens and so loses its power to become more convex and thus accommodate itself for the vision of near objects. This condition necessitates that reading, sewing, etc., shall be carried on, after the age of forty or forty-five, at an inconvenient distance, if the details of the work are to be sharply focussed on the retina. The condition is treated by wearing convex glasses for near work, though the eyes remain perfectly good for viewing objects at a distance. Thus it becomes possible for elderly people, aided by spectacles, whose strength is proportioned to their age, to read, sew, etc.. at the convenient distance of 12 or 14 inches. One sometimes hears it said that a certain person has required no glasses for reading even in advanced old age, but this is simply equivalent to stating that the person has had short-sight all his days and has never had perfect vision for distant objects. In these persons the length of the eye is well adapted for focussing near objects, without artificial aid. Also in cases of commencing cataract in old people the vision for near objects improves a little at first. People of normal sight are usually benefited by spectacles for near work after passing the age of forty-five, and certainly after fifty, since the effort to accommodate for near vision after this age fatigues the eyes and is productive of headache.

Squinting is usually caused by the excessive efforts made by long-sighted children to accommodate their eyes for near vision. In squints due to this cause the squint is remedied by convex glasses. Many other cases of squint (latent squint) are remedied by wearing prismatic glasses. (*See* SQUINTING.)

Protection of the eyes is afforded usually by glass, tinted grey or black according to the degree of protection from light that is required. The disease in which protection is specially required is iritis.

The forms of spectacles then are concave and convex lenses, cylinders, prisms, and plane glasses. In many cases a cylinder has to be combined with a lens, and then the lens shape is usually ground upon one side of the glass, the cylinder upon the other. The nature of the glass can be told by holding it close to the eye and moving from side to side. If the lens be convex, the objects seen through it appear to move in the opposite direction to that in which the glass travels. If it be concave, they move with the glass. If the glass contain a cylinder, the rate at which objects travel varies as the glass is moved up and down or from side to side. Often a person has to wear one pair of glasses for near, and another pair for distant work, and it is usual to combine these by making the upper half of each glass the lens suitable for distant work, and adapting the lower half of each for near work. For the method of testing for spectacles see under VISION.

The frame in which lenses are set is important. It should be light, and, for persons who use glasses constantly, the spectacle form is best. For occasional use, some *pince-nez* form of frame is usually more convenient, but great care must be taken, especially if the lenses are strong, that the centre of each lens comes before the centre of the eye. For this reason the best form of eyeglasses

FIG. 409.—One good form of rigid *pince-nez* frame in which the lenses cannot become tilted round.

is one in which the frame has a rigid bridge and is supported by springs that do not alter the position of the lenses.

SPECULUM (*speculum*) is an instrument designed to aid the examination

of the various openings on the surface of the body. Many specula are provided with small electric lamps so placed as to light up the cavity brilliantly.

SPEECH (*see* VOICE AND SPEECH).

SPERMATIC is the name applied to the blood-vessels and other structures associated with the testicle.

SPES PHTHISICA is the term applied to the curious mental condition sometimes observed in a patient with advanced pulmonary tuberculosis wherein he becomes hopeful of recovery and mildly exalted, and has a false sense of well-being. It appears to be a compensatory reaction to an inner knowledge of impending dissolution.

SPHACELUS (*σφάκελος*) is another name for gangrene. (*See* GANGRENE.)

SPHENOID (*σφήν*, a wedge; *εἶδος*, form) is a bone lying in the centre of the base of the skull, and supporting the others like a wedge or keystone.

SPHINCTER (*σφιγκτήρ*) means a circular muscle which surrounds the opening from an organ, and by maintaining constantly a state of moderate contraction prevents the escape of the contents of the organ. Sphincters close the outlet from the bladder and rectum, and in certain nervous diseases their action is interfered with, so that the power to relax or to keep moderately contracted is lost, and retention or incontinence of the evacuations results.

SPHYGMOGRAPH (*σφυγμός*, the pulse; *γράφω*, I write) is an instrument for recording the pulse. (*See* PULSE.)

SPHYGMOMANOMETER (*σφυγμός*, pulse; *μανός*, thin; *μέτρον*, measure) is the name of an instrument for measuring blood-pressure in the arteries. It usually consists of a pneumatic armlet, the interior of which communicates by a rubber tube with an air-pressure pump and a gauge. The armlet is bound about the upper arm and pumped up sufficiently to obliterate the pulse as felt at the wrist or as heard in the artery at the bend of the elbow. The pressure registered on the gauge at this point is regarded as the pressure of the blood at each heart-beat (systolic pressure). The pressure at which the sound heard in the artery suddenly changes its character marks the diastolic pressure.

SPICA BANDAGE (*spica*, a head of grain) is a method of applying the ordinary roller bandage in order to cover a joint. When it is finished the overlapping turns of bandage give it the appearance of a head of wheat. (*See* BANDAGES.)

SPINAL COLUMN, also known as the SPINE, CHINE, BACKBONE, and VERTEBRAL COLUMN, forms an important part

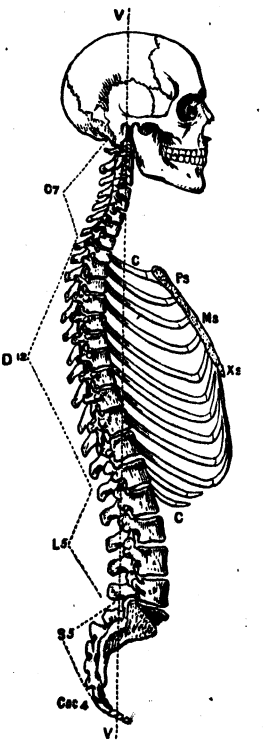


FIG. 410.—The spinal column. *C7*, Cervical; *D12*, dorsal; *L5*, lumbar vertebræ; *S5*, sacrum; *Coc4*, coccyx; *C, C*, the twelve ribs of the left side; *Ps, Ms, Xs*, three parts of the sternum; *V, V*, vertical axis of the spine showing its four curves. (Turner's *Anatomy*.)

of the skeleton, acting both as the rigid pillar which supports the upper parts of the body and as a protection to the spinal cord and nerves arising from it.

The spinal column is built up of a number of bones placed one upon another, which, in consequence of having a slight degree of turning-movement, are known as the 'vertebræ'. The possession of a spinal cord supported by a vertebral column distinguishes the higher animals from the lower types, and gains for them the general name of 'vertebrates'. Of the vertebrates, man alone stands absolutely erect, and this erect carriage of the body gives to the skull and vertebral column certain distinctive characters.

The human backbone is about 28 inches in length, and varies little in full-grown persons, differences in height depending mainly upon the length of the lower limbs. The number of vertebræ is 33 in children, though in adult life 5 of these fuse together to form the sacrum, and the lowest 4 unite in the coccyx, so that the number of separate bones is reduced to 26. Of these there are 7 in the neck, known therefore as *cervical vertebræ*; 12 with ribs attached, in the region of the thorax, and known as *thoracic* or *dorsal vertebræ*; 5 in the loins called *lumbar vertebræ*; 5 fused to form the *sacrum*; and 4 joined in the *coccyx*. These numbers are expressed in a formula thus: C7, D12,

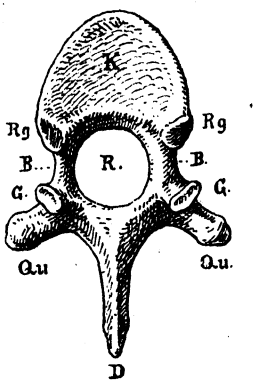


FIG. 411.—Human dorsal vertebra seen from above. *K*, Body of vertebra; *R*, neural ring enclosing the spinal cord; *B*, *B*, notches by which the nerves emerge; *D*, spinous process; *Qu*, *Qu*, transverse processes; *G*, *G*, articular processes for the vertebra above; *Rg*, *Rg*, those for the head of the corresponding ribs. (Schmeil's *Zoology*.)

L5, S5, Coc4 = 33. The formulæ in different animals varies considerably, but throughout the class of mammalia

the number of cervical vertebræ is almost constantly seven, even in long-necked animals like the giraffe and short-necked animals like the whale. Though the vertebræ in each of these regions have distinguishing features, all the vertebræ are constructed on the same general plan. Each has a thick, rounded, bony part in front, known as the 'body', and these bodies form the main thickness of the column. Behind the body of each is a ring of bone, the 'neural ring', these rings placed one above another forming the 'spinal canal' of bone which lodges the spinal cord. From each side of the ring a short process of bone known as the 'transverse process' stands out, and from the back of the ring a larger process, the 'spine', projects. These processes give attachment to the strong ligaments and muscles which unite, support, and bend the column. The 'spines' can be seen or felt beneath the skin of the back lying in the centre of a groove between the muscular masses of the two sides, and they give to the column its name of the 'spinal' column. One of these spines, viz. that of the 7th cervical vertebra, is especially large and forms a distinct bony prominence, where the neck joins the back. Between the bodies of the vertebræ lies a series of thick discs of fibro-cartilage, and to these 23 discs the upper part of the spine owes much of its pliability, as well as a great deal of its resiliency and power of diminishing the effect of jars and blows communicated through the feet or head. There is also a small joint at each side upon the ring of the vertebra so that each vertebra comes in contact with the one above and the one beneath in three places.

The first and second cervical vertebræ are modified in a very special manner. The first vertebra is devoid of a 'body', but has a specially large and strong ring with two hollows upon which the skull rests, thus permitting of nodding movements. The second vertebra has a pivot upon its body which fits into the first vertebra and thus permits of free rotation of the head from side to side.

A very important feature of the spinal column, and one which is especially marked in human beings, consists in the presence of four curves from behind

forwards. Thus the cervical vertebræ are arranged with a curve whose hollow looks backwards, the dorsal vertebræ have a marked curve with the hollow forwards; in the lumbar region the hollow is directed backwards, while the sacrum and coccyx form a marked hollow to the front. The effect of the dorsal and sacral curves is greatly to increase the size of the cavities of chest and pelvis, while the compensating curves of the neck and loins serve to keep the general axis of the spinal column in a vertical line. The curves have further an action very similar to that of the springs of a vehicle, in minimising jolting and jarring of the internal organs. There is usually a very slight curve to one side in the upper dorsal region, resulting from the greater development and use of the right arm.

The neural rings placed one above another form a canal, which is wide in the neck, smaller and almost round in the dorsal region, and wide again in the lumbar vertebræ. This canal lodges the spinal cord, and the nerves that issue from the cord pass out from the canal by openings between the vertebræ which are produced by notches on the upper and lower margins of each ring. The ' intervertebral foramina ' formed by these notches are so large in comparison with the nerves passing through them that there is no chance of pressure upon the latter, except in very serious injuries which dislocate and fracture the spine.

SPINAL CORD is the lower portion of the central nervous system which is situated within the spinal column. Above, it forms the direct continuation of the medulla oblongata, this part of the brain changing its name to spinal cord at the *foramen magnum*, the large opening in the base of the skull through which it passes into the spinal canal. Below, the spinal cord extends to about the upper border of the second lumbar vertebra, where it tapers off into a fine thread known as the ' filum terminale ', that is attached to the coccyx at the lower end of the spine. The spinal cord is thus considerably shorter than the spinal column, being only 15 to 18 inches in length. In its course from the base of the skull to the lumbar region the cord gives off thirty-one nerves on each side, each of which arises by an anterior and a posterior root that join before the nerve emerges from the spinal canal. The openings for the nerves formed by notches on the ring of each vertebra have been mentioned under SPINAL COLUMN. To reach these openings the upper nerves pass almost directly outwards, while lower in the series their obliquity increases, until below the point where the cord terminates there is a sheaf of nerves, known as the 'cauda equina', running downwards to leave the spinal canal at their appropriate openings. In shape the cord is a cylinder, about the thickness of the little finger, and slightly flattened from before backwards. It has two slightly enlarged portions, one in the lower part of the neck, the other at the last dorsal vertebra, and from these thickenings arise the nerves that pass to the upper and lower limbs. (*See* NERVES.) The spinal cord, like the brain, is surrounded by three membranes, the dura mater, arachnoid mater, and pia mater, from without inwards. The arrangement of the dura and arachnoid is much looser in the case of the cord than their application to the brain. The dura especially forms a wide tube which is separated from the cord by fluid and from the vertebral canal by blood-vessels, fat, etc., this arrangement protecting the cord from pressure in any ordinary movements of the spine.

IN SECTION, the spinal cord is found to consist partly of grey, but mainly of white matter. It differs from the upper parts of the brain in this fact that the white matter in the cord is arranged on the surface, surrounding a mass of grey matter, while in the brain the grey matter is superficial. The arrangement of grey matter, as seen in a section across the cord, resembles the letter H, each half of the cord possessing an anterior and a posterior ' horn ', and the masses of the two sides being joined by a wide posterior grey ' commissure '. In the middle of this commissure lies the ' central canal ' of the cord, a small tube which is the continuation of the ventricles in the brain. The horns of grey matter reach almost to the surface of the cord, and from their ends arise the roots of the nerves that leave the cord, but elsewhere the grey is completely sur-

rounded by white matter. The white matter is divided almost completely into two halves by a posterior septum and anterior fissure that project inwards from the back and front surfaces, the posterior septum reaching down to the

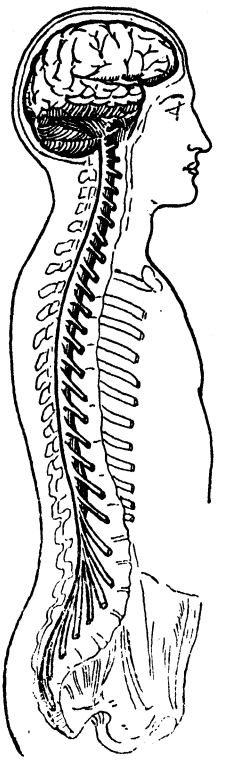


FIG. 412.—Diagram showing position of spinal cord in spinal canal.

roots passing from them to the surface, these three being known as the anterior lateral, and posterior columns.

Minute structure.—The *grey matter* is found upon microscopic examination to consist largely of 'neuroglia', the

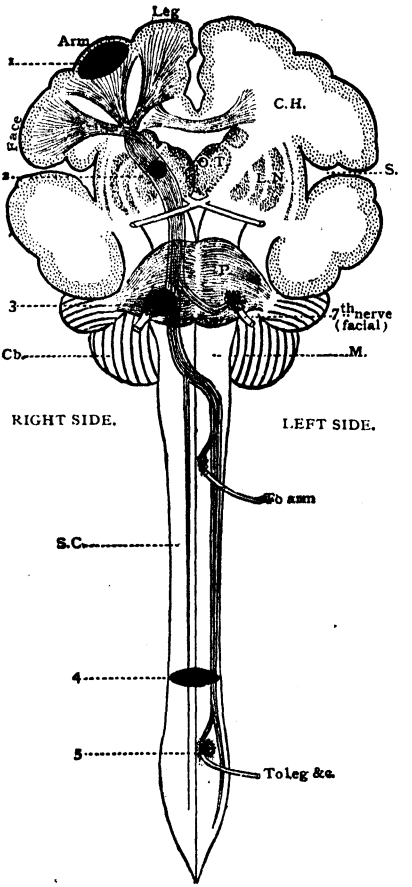


FIG. 413.—Diagram showing the course of the motor tracts through the brain and spinal cord. The front half of the brain is supposed to have been removed, and the reader is looking at its interior. *CH*, Cerebral hemisphere; *Cb*, cerebellum; *OT*, optic thalamus; *LN*, lenticular nucleus; *M*, medulla; *P*, pons; *SC*, spinal cord. Note that the great majority of nerve-fibres cross over in the medulla from the right side to form the crossed pyramidal tract on the left side of the cord, while a smaller number continue straight down as the anterior pyramidal tract on the right side. For the numbers see under PARALYSIS.

grey commissure, but the anterior fissure being separated from it by a small anterior white commissure that joins the white matter of the two sides together. The white matter is further divided into three columns, on each side, by the horns of grey matter and the nerve

peculiar connective tissue of the central nervous system, which is made up of small cells with long branching processes. This neuroglia forms a sort of felt-work, in whose meshes lie numbers of multipolar nerve-cells and the nerve-fibres that spring from them and unite one cell

to another or pass out into the nerves. The *white matter* consists almost entirely of bundles of nerve-fibres provided in general with a medullary sheath, the white colour being due to the collective appearance of these sheaths. (*See* NERVES.) There is also in the white matter a small quantity of supporting connective tissue. Most of the nerve-fibres run vertically, so that a cross-section of the cord shows them as a collection of dots, each surrounded by a clear space. Blood-vessels are found in the cord both in grey and in white matter.

Functions.—The cord is in part a receiver and originator of nerve impulses, and in part merely a conductor

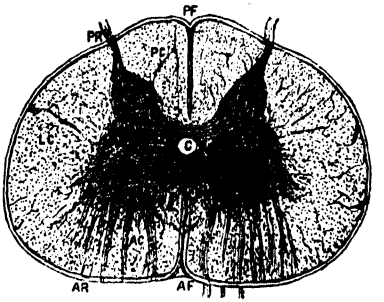


FIG. 414.—Transverse section of the spinal cord in the lumbar region. *AF*, *PF*, Anterior and posterior fissures; *AR*, *PR*, anterior and posterior nerve roots; *AC*, *LC*, *PC*, anterior, lateral, and posterior columns; *C*, central canal of the cord. The dark mass in the interior of the cord is the grey matter. Magnified about 3 times. (Turner's *Anatomy*.)

of such impulses along fibres which pass through it to the brain. The presence of centres in the cord, capable of receiving sensory impressions and originating motor impulses, is proved by several facts. For example, it has been calculated that the number of nerve-fibres entering or leaving the cord by the spinal nerves is twice as great as the number of fibres contained in the upper end of the cord, where it is continued into the brain. Again, if the cord be severed in the dorsal region, as by a fracture of the spine, the centres which govern the evacuation of the bladder and bowel do not lose their power of controlling these organs immediately upon being severed from the brain. Many of these centres are known to exist in the cord, such as centres for

regulating the size of the blood-vessels, for altering the size of the pupil of the

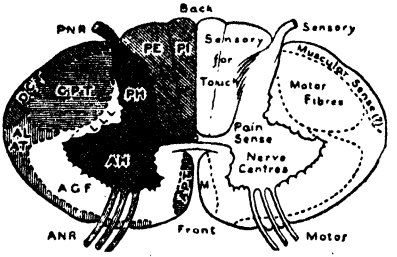


FIG. 415.—Diagram of a section of the cord in the region of the neck. On one side the chief nerve tracts are shown, on the other side the function of these is indicated. *PE*, *PI*, Postero-external and postero-internal tracts; *CPT*, crossed pyramidal tract; *DCT*, direct cerebellar tract; *LLL*, lateral limiting layer; *ALAT*, antero-lateral ascending tract; *AGF*, anterior ground fibres; *APT*, anterior pyramidal tract; *PH*, posterior horn, and *AH*, anterior horn of grey matter; *ANR*, anterior nerve root; *PNR*, posterior nerve root.

eye, for sweating, for breathing, etc., and the position of several has been ascertained. Over most, if not all, of these centres, however, the brain exerts a controlling influence, and before any incoming sensation can produce an effect upon consciousness, it is in all probability necessary that it should obtain a free passage up to the brain.

Many of these centres act in a rhythmical or *automatic* way. Other cells of the cord are capable of originating movements in response to impulses brought direct to them through sensory nerves, such activity being known as *reflex* action. For a fuller description of the activities of the spinal cord see NERVES.

By observing the process of degeneration that takes place when nerve-fibres are cut off by disease or injury from the cells to which they belong, and by observing also the manner in which the fibres in different portions of the cord develop, it has been found possible to divide the three white columns of the cord into a number of 'tracts', in each of which the fibres have a special function. Thus the posterior column consists of a postero-internal and a postero-external tract, both conveying sensory impressions upwards. The lateral column contains the direct cerebellar tract passing to the cerebellum, the crossed pyramidal tract of motor fibres carrying outgoing impulses down-

wards, together with the lateral limiting, antero-lateral ascending, and lateral mixed tracts. And, finally, the anterior column contains the direct pyramidal tract of motor fibres and an anterior mixed zone. Of these the pyramidal tracts have the best-known course. Starting from cells near the fissure of Rolando on the brain (*see* BRAIN), the motor nerve-fibres run down through the internal capsule, pons, and medulla, in the lower part of which many of those coming from the right side of the brain cross to the left side of the spinal cord, and *vice versa*. Thence the fibres run down in the crossed pyramidal tract to end beside nerve-cells in the anterior horn of the cord. From these nerve-cells other fibres pass outwards to form the nerves that go direct to the muscles. Thus the motor nerve path from brain to muscle is divided into two sections or 'neurons', of which the upper exerts a controlling influence upon the lower, while the lower is concerned in maintaining the muscle in a state of health and good nutrition, and in directly calling it into action.

SPINE AND SPINAL CORD, DISEASES AND INJURIES OF.—These are considered together, because the chief danger of interference with the spinal column lies in the risk of injury to the spinal cord and nerves. Only some of the chief diseases will be dealt with.

LATERAL CURVATURE OF THE SPINE, or SCOLIOSIS, consists chiefly in bending of the spine over to one side, though, in consequence of the vertebræ being broader in front than behind, this is accompanied by a certain amount of twisting of the vertebræ round their vertical axis. The shape of the chest becomes in consequence markedly altered, the ribs on one side projecting behind at their angles, and causing the shoulder-blade to be very prominent, while on the other side the chest is flattened. (*See* CHEST DEFORMITIES.) The shoulder of the bulging side is usually considerably elevated. This condition may be started by slight injuries of the spine, by rickets in early life, or by diseases in the chest, such as pleurisy, which cause partial collapse of one side. But by far its most common occurrence is in young persons of feeble muscular power, especially in rapidly growing girls from about twelve to sixteen years of age, who adopt some bad habit of posture. Such a habit may consist in crossing one leg over the other always in sitting, leaning constantly on the same elbow at lessons, standing habitually with the weight of the body on one foot, or frequently carrying a heavy burden on one arm.

The consequences of this deformity are a bad carriage and awkward gait, while, if it be very marked, the lungs and other internal organs are liable to be attacked by various diseases, though there is no tendency for the spinal cord to suffer any damage.

Treatment consists in avoiding the bad postures mentioned above, and in making sure that the general health is maintained as high as possible by tonics, fresh air, and exercise. Above all, some special form of gymnastics, combined sometimes with massage, is advisable in order to strengthen the feeble muscles of the back. It is only in extremely marked cases that the strait-jackets and other mechanical supports, formerly so much in vogue, are needed to prevent increase in the deformity.

ANGULAR CURVATURE OF THE SPINE is a very much more serious

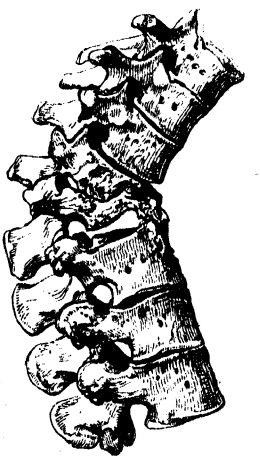


FIG. 416.—Caries of the spine, producing angular curvature. (Miller's *Surgery*, after Liston.)

condition. It not only produces more evident deformity, but many cases are

SPINE, DISEASES AND INJURIES OF

accompanied by a certain degree of pressure upon the spinal cord. The condition was described by the famous surgeon Percival Pott (1713–88), after whom it is also called *Pott's curvature*. This deformity is produced in the great majority of cases by caries of the vertebræ, the result of tuberculosis; and, the body of one or more vertebræ crumbling away, the spinal column curves sharply forwards, so that the spinous processes stand out very prominently at the site of the disease. A similar condition occasionally comes on after a fall in the case of a young child, or a severe blow upon the back of an older person. The symptoms are not at all well marked in the early stages. There is a general loss of health and strength, and the person becomes easily tired. The affected part of the spine is tender when pressure is made on the back, and the child holds himself stiffly. If the neck be diseased the head is not turned from side to side, and the child often supports the chin on his hand. If the back be the part concerned, the child holds himself very erect, and when he wishes to pick something off the floor goes down upon his knees rather than bend the back. When the lumbar region of the spine is diseased a frequent result is the formation of a psoas abscess which burrows towards the back or into the groin.

Treatment applicable to tuberculous disease affecting any other organ, *e.g.* good food, tonics, and fresh air, is most important. In an early case, the patient must rest for many months, and in more advanced cases some form of mechanical support is in addition necessary. The region of the thorax, where the condition is commonest, is often supported by a jacket of poroplastic felt or of plaster of Paris; and when the disease attacks the neck, a padded collar or a jury-mast is used to support the head. Good results are often obtained by an operation in which diseased bone is scraped away and new bone transplanted, *e.g.* from a leg to the back of the spine. After the disease has been arrested and the bone has healed up, a considerable amount of permanent stiffness and deformity result.

Excellent results have lately been obtained from heliotherapy. The back is exposed for several hours daily to the sun's rays, while the patient lies supported on a pillow under the stomach and upon his elbows. Not only does this position relieve pressure upon the diseased part of the spine and gradually correct the deformity, but it allows the patient, during the long period necessary for treatment, to carry on light forms of work in perfect comfort.

CARIES OF THE SPINE is the condition of tuberculous disease leading to angular curvature (*see above*).

COMPRESSION OF THE CORD may arise from various causes. The

FIG. 417.—Fracture of the spinal column, causing compression of the cord. (Miller's *Surgery*.)

seriousness of most diseases affecting the spine is, in fact, measured by their tendency to interfere with the spinal cord. This condition may be caused suddenly by a severe crush or blow upon the back, which produces a fracture of the spine with displacement of the fragments. Or it may come on slowly, and is then in the great majority of cases due to Pott's disease (*see above*). Compression of the cord in the neck is speedily fatal as a rule, owing to the involvement of important vital centres; but when it occurs in the region of the chest, the person may live a long time as a more or less helpless invalid.

Symptoms comprise interference with sensation below the level of compression, and, in chronic cases, pain round the body at this level; rigidity and paralysis of the lower limbs more or less complete; interference with the functions of the bladder and rectum, and a special

tendency to bed sores in the paralysed parts.

Treatment, in cases due to accident, is not as a rule hopeful, since the spinal cord is generally lacerated, as well as compressed, by the damage to the spine. But cases which come on slowly, for example as the result of Pott's disease, very frequently yield to treatment. This consists in the prolonged rest and support to the spine mentioned above; while brilliant results are often obtained even after several months of complete paralysis by an operation designed to remove the bone or inflammatory product which is pressing upon the cord. Apart from the question of recovery, these cases require special care and watchfulness in nursing because of the great tendency that is present to the formation of bed sores, and because the patient loses to a great extent the power of voluntary control over the bladder and bowels, so that septic inflammation of the bladder and kidneys is very apt to ensue and to terminate the patient's life.

MENINGITIS, or inflammation of the membranes surrounding the cord, is treated under MENINGITIS.

MYELITIS, or inflammation situated in the spinal cord itself, may be of an acute or chronic nature, and gives rise to symptoms much resembling those of compression though unaccompanied by pain. (*See* MYELITIS.) A special form of myelitis (polio-myelitis), affecting only the grey matter of the cord, is a frequent disease of young children, and causes the symptoms known as 'infantile paralysis'. (*See* PARALYSIS.)

SCLEROSIS is a very chronic condition of the cord in which certain parts become increasingly hard in consequence of a disappearance of the white nerve-fibres and their replacement by an overgrowth of the connective tissue of the cord. This change is due to various causes, and the symptoms which it produces depend mainly upon the particular tracts of fibres that are affected. Sclerosis in the posterior part of the cord, for example, produces the disease known as 'locomotor ataxia' (*see* LOCOMOTOR ATAXIA); while another disease, known as 'disseminated sclerosis', in which the degenerated patches are scattered through the nervous system, affects mainly the lateral portions of the cord. (*See* DISSEMINATED SCLEROSIS.)

PROGRESSIVE MUSCULAR ATROPHY is the chief member of a group of diseases whose main characteristic is loss of power and muscular wasting, due to a gradual degeneration in the grey matter of the spinal cord and brain. (*See* PARALYSIS.)

SYRINGOMYELIA is a disease in which fissures and cavities exist in the cord together with an overgrowth of the supporting neuroglia. (*See* SYRINGOMYELIA.)

SPINA BIFIDA is a defect in development affecting the spinal column, and in severe cases also the spinal cord, in the lumbar region. Children with this disease are born with a gap in the ring of some of the lumbar vertebræ so that the spinal canal in this region is protected only by the skin. The membranes surrounding the cord bulge out and produce a swelling in the small of the back, which may be the size of a hen's egg or even larger. Surgical treatment is in some cases very satisfactory in its results; though the majority of children thus affected are liable to convulsions and do not reach mature years.

INJURIES TO THE SPINE AND CORD are of various grades of severity. *Sprains* of the back due to a twist and leading to tearing of muscles, ligaments, etc., and to deep-seated effusion of blood, may be productive of long-continued pain and even of a considerable amount of paralysis. This is probably in most cases due to some injury of the spinal nerves, but the symptoms pass off in general with rest and time. *Fracture of the spine* has been mentioned above under the heading of Compression. *Concussion of the cord* is a term which includes a number of possible injuries that may have been inflicted upon the cord by severe jarring or shaking of the body. Owing to the frequency with which this condition follows upon railway accidents, it has also received the name of 'Railway Spine'. (*See* NEURASTHENIA.)

SPIRILLUM (diminutive of *spira*, a twist) is a form of micro-organism of wavy shape. (*See* BACTERIOLOGY.)

SPIRIT is a strong solution of alcohol in water. The term includes those beverages which contain sufficient alcohol to be inflammable, viz. brandy, whisky, rum, etc. (*See* ALCOHOL.) Proof spirit is one containing 57 per

cent of alcohol by volume or 49 per cent by weight, and is so named because it can stand the proof of just catching fire. Rectified spirit contains 90 per cent of alcohol by volume or over 85 per cent by weight. Proof spirit is generally used in the preparation of tinctures. Spirits of various drugs contain a solution of any given drug in rectified spirit. Among the most commonly used spirits are spirit of chloroform (also known as chloric ether), sweet spirit of nitre (spiritus etheris nitrosi), aromatic spirit of ammonia (sal volatile), spirit of ether, spirit of Cologne (eau-de-Cologne), spirit of camphor, and spirit of various volatile oils. Methylated spirit (also known as wood naphtha or wood spirit) is distilled from wood. When taken internally, the latter is a dangerous poison producing neuritis with great readiness, and especially neuritis of the optic nerves which may result in blindness. Mineralised or denatured methylated spirit is one to which crude pyridine and mineral naphtha have been added in small proportions, together with a minute quantity of methyl violet for colouring, in order to prevent its being drunk.

The term spirit is also used popularly in a loose application to various active substances, *e.g.* 'spirit of turpentine' (oil of turpentine), 'spirit of hartshorn' (ammonia in water), 'spirit of nitre' (nitric acid), 'Mindererus spirit' (liquor ammonii acetatis), and 'spirit of salt' (hydrochloric acid).

Uses.—For the internal uses of plain spirit see ALCOHOL. Externally, plain spirit or eau-de-Cologne is used to sprinkle on the skin or to apply on lint, as an evaporating lotion for its cooling and soothing effect. (*See* LOTIONS.) Spirit is also used to harden the skin for the prevention of bed sores and foot soreness. The spirits of the various oils form a convenient method of administering these oils as expectorants, or for colic, flatulence, etc. (*See* OILS.)

SPIROCHÆTE (*σπεῖρα*, coil; *χαίτη*, hair) is the name given to a form of flexile protozoan of microscopic size.

SPIROCHÆTOSIS ICTERO-HÆMORRHAGICA, or WEIL'S DISEASE, or INFECTIOUS JAUNDICE, is the term applied to an acute infection with the *Spirochæta icterohæmorrhagiæ* which is transmitted to man by rats, these animals excreting the organism in their urine; hence the liability of sewer workers to the disease. The condition is characterised by fever, jaundice, enlarged liver, nephritis, and bleeding from mucous membranes.

SPLANCHNIC (*σπλαγχνικός*) means anything belonging to the internal organs of the body as distinguished from its framework.

SPLEEN is an organ deeply placed in the abdomen. Its disorders attract

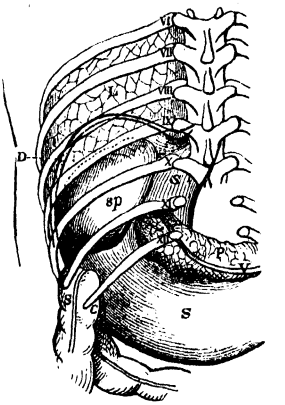


FIG. 418.—View of the spleen from behind after the removal of the muscles from the back. *L*, Left lung; *SS*, stomach; *Sp*, spleen; *P*, pancreas; *SC*, large intestine; *D*, diaphragm; VI-XII, the lower seven ribs. (Turner's *Anatomy*, after Luschka.)

comparatively little attention, either because they are rare or because the difficulty of examining the organ allows them to pass unrecognised.

Position and size.—The spleen lies behind the stomach, high up on the left side of the abdomen, and corresponds to the position of the 9th, 10th, and 11th ribs, from which it is separated by the diaphragm. It is a soft, highly vascular, plum-coloured organ, and has a smooth surface, being almost completely covered by peritoneum. There are two wide peritoneal ligaments that support the spleen, the one attaching it to the stomach, the other to the kidney. Through the latter ligament, the large vessels that supply the spleen with blood make their way. The size of the

spleen varies widely. It is usually about 5 to 6 inches in length, and weighs about 6 ounces or more, but these dimensions depend upon the amount of blood contained in it, for it contracts from time to time, and after meals is much smaller than at other times. In diseased conditions the organ may reach a weight of 18 to 20 pounds.

Structure.—The spleen is enveloped by peritoneal membrane like the stomach and intestines, and this smooth coat greatly facilitates its movements. Beneath the peritoneum is a strong elastic tunic, composed partly of fibrous tissue containing many elastic fibres, and partly of unstriped muscle. This elastic coat allows of the free expansion and contraction of the organ according to the varying amount of blood present in it. From the inner surface of the membrane fibrous partitions known as 'trabeculæ' run down into the substance and form a network in which the dark spleen 'pulp' is contained. If the spleen be cut open and the pulp washed away, these trabeculæ stand out as shaggy projections on the cut surface. The 'pulp' consists of delicate connective tissue fibres passing between the various trabeculæ, and of white and red blood corpuscles lying in this meshwork. Round the smaller arteries there are condensed areas of this pulp formed of developing white blood corpuscles, and known as Malpighian bodies.

VESSELS pass to the spleen, and are of so large a size compared with the size which would be necessary in order simply to carry nutritive material to the spleen as to render it clear that the organ has some important action connected with the maintenance of the blood. The arteries which enter the spleen at the 'hilum' become smaller and smaller till they end in capillaries, which open freely into the pulp. The blood thus escapes readily into the substance of the spleen, and, after passing through its meshwork, is collected by veins that unite into larger trunks till they form the splenic vein, which leaves the organ and joins the portal vein. There are also numerous lymphatics in the organ, which run in the trabeculæ or surround the veins.

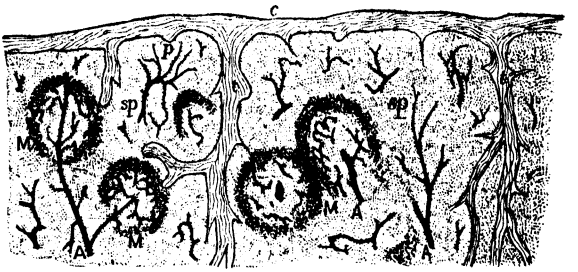


FIG. 419.—Vertical section through a small portion of the spleen. *c*, The outer coat, from which run inwards *tt*, the trabeculæ; *MMM*, Malpighian bodies upon the course of *AA*, the arteries; *sp*, *sp*, spleen pulp. Magnified by 80. (Turner's *Anatomy*.)

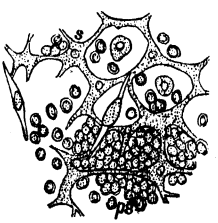


FIG. 420.—Portion of the spleen pulp more highly magnified. *s*, Connective tissue network covered by cells; *ps*, corpuscles in its meshes. Magnified by 450. (Turner's *Anatomy*.)

Functions.—These are at best only vaguely known. The organ certainly plays some part in the formation of the white corpuscles of the blood, because a great number of these is to be found in blood drawn from the splenic vein, and because, if the spleen be stimulated to contract by an application of electricity to the surface overlying it, the number of white corpuscles in the blood is found much increased. In some animals the spleen also forms red blood corpuscles, and it appears to do this in the human fœtus, though not after birth. There

are reasons for supposing that in human beings useless or worn-out red blood corpuscles are broken up by this organ. Nevertheless the spleen does not appear to be absolutely essential to life, since its removal is followed by increase in size of the lymphatic glands all over the body, and does not necessarily cause death.

SPLEEN, DISEASES OF.—Since the functions of the spleen are hardly known at all, it is natural that little has been discovered regarding the diseases to which it is liable. In certain diseases associated with marked changes in the blood, such as leucocythæmia, waxy disease, and malaria, the organ becomes chronically enlarged. In some of the acute infectious diseases, the spleen becomes congested and acutely enlarged; for example, in typhoid fever, anthrax, and plague. The condition, however, which most frequently attracts attention is rupture of the spleen. This accident may occur, like rupture of other internal organs, in consequence of extreme violence, but in malarious countries, where many people have the spleen greatly enlarged and softened as the result of malaria, rupture of this organ occurs now and then as the result of some very trivial blow upon the left side. The spleen, in consequence of its structure, bleeds excessively when torn, so that this accident is generally followed by collapse, signs of internal hæmorrhage, and death.

SPLENOMEGALY means enlargement of the spleen beyond its normal size.

SPLINTS are supports for an injured or wounded part. They are most commonly employed in cases where a bone is fractured, and consist then of some rigid substance designed to take the place of the broken bone in maintaining the shape of the limb, as well as to keep the broken ends at rest and in contact, and thus to ensure their union. Splints are most commonly made of wood either shaped to the limb or consisting merely of strips of wood about the width of the injured limb, and carefully padded with wool or similar soft material. Splints are also made of metal, poroplastic felt, leather, and cotton stiffened with plaster of Paris, as well as other materials. Splints may be improvised for first-aid out of walking-sticks, rifles, broom-handles, branches, folded-up newspapers, and in fact anything of suitable length and rigidity. (*See* FRACTURES.)

SPONDYLITIS (σπόνδυλος, a vertebra) is another name applied to caries of the spine. (*See* SPINAL DISEASES.)

SPONGES are animals of lowly organisation which develop on the bottom of shallow seas, and are gathered chiefly in the Levant and the West Indies. Small sponges which have been steeped in some antiseptic are still sometimes used by surgeons for wiping up blood at operations, but their place is generally taken by swabs of sterilised gauze. A domestic sponge should not be used to wash a wound, because the animal tissue it contains is likely to swarm with microbes. As a medicinal agent, burnt sponge was used for some time in treating goitre. (*See* GOITRE.)

SPORADIC (σποραδικός, scattered) is the term applied to cases of disease occurring here and there as opposed to epidemic outbreaks.

SPOTTED FEVER (*see* MENINGITIS, EPIDEMIC CEREBRO-SPINAL; *also* TYPHUS FEVER).

SPRAINS are injuries in the neighbourhood of joints, consisting usually in tearing of a ligament with effusion of blood. (*See* JOINTS, DISEASES OF.)

SPRAYS (*see* INHALATIONS).

SPRUE, or PSILOSIS, is a dangerous form of chronic catarrh or inflammation of the mucous membrane of the alimentary canal. It is found throughout the greater part of the Tropics, but is especially common in South China, the Straits Settlements, Ceylon, the West Indies, and Southern United States.

Causes.—Prolonged residence in a locality where sprue is prevalent, together with the occurrence of some exhausting disease such as dysentery, is apt to pass gradually into sprue. The actual cause is not certain, but the stools in well-developed cases are found full of yeast fungus which is generally believed to be largely responsible for

maintaining the catarrh in the bowels. Some authorities believe that food poor in vitamins is in part at least responsible for the development of this condition.

Symptoms.—The chief symptoms of the condition are soreness of the mouth, with an inflamed bare condition of the tongue, dyspeptic distension of the abdomen, and looseness of the bowels. The patient gradually becomes weak and develops symptoms of neurasthenia. The stools are copious, pale, fermenting, evil-smelling, and full of minute gas bubbles. There is no abdominal pain, however, as in dysentery. The duration of a case of sprue as well as its mode of onset is very variable. In some cases the disorder is intermittent for ten or fifteen years. In other cases it runs a fairly acute course in a year or two. The symptoms generally abate when the affected person leaves the Tropics for a temperate climate. If death occurs, changes are found in the organs corresponding to the symptoms. The tissues are unusually dry, anæmic, and emaciated. The pancreas is sometimes found diseased. In the alimentary canal the muscular and mucous coats are greatly thinned, and there are erosions of the mucous membrane.

Treatment.—The greatest success in treating this disease appears to be derived from taking a milk diet. Three pints are allowed in the twenty-four hours, the patient remaining in bed. The amount is gradually increased, but for about six weeks the patient takes no other food. Later, whipped eggs, arrowroot, bread and butter, and, later still, fish and chicken are gradually added. Fruit appears to be very beneficial to the condition, bananas and apples, and particularly strawberries, being added gradually to the diet. In some cases, meat and meat juice suit better than milk, and in serious cases it may be necessary to treat the patient by nutrient enemata. Change of residence to a temperate climate and warm clothing are of great importance. Anæmia and other complications are treated as in other conditions.

SPUTUM (*sputum*) means material spat out of the mouth. It may consist of saliva from the mouth, of mucous secretions from the throat or back of the nose, but is generally expectorated by coughing from the lower air passages. (*See* EXPECTORATION.)

SQUILL is the sliced bulb of *Scilla maritima*, a plant from the shores of the Mediterranean. It contains several substances which exert an irritating, or, in small doses, a stimulating effect upon the kidneys and the mucous membrane of the stomach and bronchial tubes.

Uses. — The tincture, syrup, and vinegar of squills are much used as a stimulant to the kidneys in cases of dropsy, and to the bronchial mucous membrane, when advisable, in bronchitis. The syrup and oxymel of squills are used in doses of one-half to one teaspoonful, the other preparations in rather smaller quantities.

SQUINTING is a condition in which the two eyes do not look in the same direction at one time. The movements of the eyeballs depend upon the action of six muscles, four being straight and two oblique. (*See* EYE.) Of these muscles the outer and inner straight (*recti*) muscles turn the eye from side to side and enable the two eyes to act together. The external rectus muscle and the internal rectus muscle are therefore the most important of the six, and defects connected with them produce inward or outward squint. Other squints upwards or downwards are occasionally, though only rarely, met with, and will not be further referred to.

Causes.—A squint which appears in early childhood is very often due to some optical error in the eye, generally in the direction of LONG-SIGHTEDNESS. Such a defect causes squinting inwards of one or both eyes, especially when the child looks at something close at hand. The reason for this is that the person with the long-sighted (hypermetropic) eye makes an excessive effort in accommodating his vision for near objects. The muscle of accommodation is supplied by the same nerve (third cranial) as the internal rectus muscle, and the excessive effort also affects the muscles which pull the eye inwards. The two eyes when thus directed across one another cannot act together, and the person therefore uses only one at a time, directing it straight forward and turning the other still farther inwards. If the eyes are

equally good, the person adopts a habit of looking straight forward first with one eye, then with the other, and is said to have an 'alternating squint'. If, however, the refractive error in one eye be much greater than that in the other, the better eye is always used, and the squint in the other becomes a 'permanent squint'. The power of vision may be so little developed in the brain centre corresponding to a permanently squinting eye that even at an early age it may be almost lost, though the person is unaware of the fact till careful examination reveals it.

SHORT-SIGHT is also productive of a squint which is usually outwards in persons who are not provided with proper spectacles. In reading, writing, and other near work such people bring their work much closer up to the eyes than is natural, and the internal recti muscles of the two eyes get a disproportionate amount of work in constantly making the eyes converge. These muscles increase in power therefore and produce the permanent degree of convergence which is occasionally seen in short-sighted students.

DEFECTIVE VISION in one eye is another, though much less frequent, cause of squinting. That is to say, there is, quite apart from mere refractive errors which can be corrected by spectacles, some defect in power of seeing. In such a case the defective eye is not controlled by its muscles, as no attempt is made to use the eyes together, and it has a great tendency to roll outwards at times.

PARALYSIS caused by some affection of the brain or of the nerves supplying the eye muscles is the usual cause of a squint which suddenly appears after the person has passed the years of childhood. The sixth nerve, which has a long course over the base of the skull and supplies the external rectus muscle, is specially liable to suffer in this way. This produces a strong inward squint of one eye, when the glance is directed towards the side to which the eye belongs, since the eye cannot be turned outwards.

Treatment.—It is highly important that children who show a squint should have the eyes examined, for, as already stated, the great cause is an error of refraction remediable by glasses. As soon as an occasional squint appears, treatment is required, but if the squint becomes limited to one eye permanently, that eye has already deteriorated in power of vision. The squint can often be remedied by glasses, but if it has lasted a long time, it is generally necessary to perform an operation for the division or shortening of one of the muscles. This operation is very slight and almost painless, but it requires great nicety of judgement and execution. In squint due to short-sight the treatment is similar, consisting of the use of proper spectacles in the early stages or of a small operation later on.

Squint due to paralysis of the sixth nerve requires general medicinal treatment, not an application to the eyes.

STABS (*see* WOUNDS).

STAMMERING is a condition in which a person hesitates in the act of speaking, being unable for a time to pronounce certain syllables or repeating the same syllable over and over. For example, in pronouncing such a word as 'Peter' the person may at the beginning of the word be unable to sound the 'P' for a time, remaining with the mouth open, or with the lips compressed, and often making vigorous movements with the hands or feet in the fruitless endeavour. Or he may repeat this sound, pronouncing 'Pe-pe-peter', and being unable for a time to pass off the 'P' to the rest of the word. The latter variety of stammering is generally called 'stuttering'.

Causes.—Stammering is not due to any defect in the brain or in the speech organs, and may be described as a functional disease, or a bad habit, or a sign of diffidence. It begins usually in childhood, and is a practice which one child readily learns from another, just as any peculiarity of speech in one person is liable to be unconsciously mimicked by those around. The actual cause of the stammering is a want of co-ordination between the various parts concerned in speech. The speech mechanism consists of three parts, and may be roughly compared to an organ. The chest corresponds to the bellows of the organ, the larynx, where the voice sounds are produced, to the keyboard and pipes of the organ by which the different notes are sounded, and the changes in the mouth effected by the tongue, palate, lips, etc., resemble the stops of the organ

which modulate the notes. Just as these three parts of the organ must be worked in unison for the production of perfect music, so the three parts of the speech apparatus must work together. In stammering there is some error; either the mouth does not shape itself at once to produce the necessary consonants when the stream of air is turned on and the larynx thrown into action, or the mouth is rigidly held in the proper attitude but no laryngeal note is sounded.

Treatment.—This consists of education in proper voice and speech production, and of psychological treatment. The importance of the psychological element is becoming more and more recognised. The stammerer, if a child, should in the first instance be removed from the others from whom he is learning to stammer. Later on, the cure depends upon the amount of care with which the person strives to regulate his vocal organs. (*See* VOICE AND SPEECH.) One of the most important points for the stammerer to recognise is the difference between those syllables and letters which are produced with full voice and those which have little voice. For example, in the words 'Peter' and 'Beater' the initial letter is hardly sounded in the first, the stress being thrown upon the *e*, while in 'Beater' the *B* receives its full sound. The stammerer's difficulty in many cases arises from a reversal of this process, and disappears when he learns to recognise this difference. Sometimes, before commencing a course of treatment with a view to cure, the stammerer does well to remain absolutely silent for a week, with the view of losing his faulty method of speech.

STAPHYLOCOCCUS (σταφυλή, a bunch of grapes; κόκκος, a kernel) is the name given to a bacterium which under the microscope appears in small masses very like bunches of grapes. The organism is found in the pus discharged from acute abscesses, ulcers, boils, etc.

STARCH is a substance belonging to that group of carbohydrates known as the amyloses. It is converted into sugar when treated with heat in presence of a dilute acid. It is changed largely into dextrin when exposed to a considerable degree of dry heat, as in toasting bread; and a similar change into dextrin and malt sugar takes place under the action of various ferments such as the ptyalin of the saliva. Starch forms the chief constituent of the carbohydrate foods (*see* DIET *and* FARINACEOUS FOODS), and in the process of digestion the above-mentioned change takes place in order to prepare it for absorption.

Starch is used externally to form a poultice for softening the skin in skin diseases. (*See* POULTICES.) It is also used as a constituent of dusting powders for application to chafed or irritable areas of the skin. (*See* CHAFING.) Starch enema is administered in inflammatory conditions of the bowel, and is made by boiling two tablespoonfuls of

FIG. 421. — Potato, unboiled, showing starch granules enclosed in a meshwork of cellulose. The cellulose is torn and the starch granules burst open by boiling. (Magnified 500 times.)

starch in a pint of water and then adding hot water till the mixture is reduced to a syrupy consistency. This starch enema is used as the basis for several kinds of soothing enema. For example, a teaspoonful of laudanum may be added to the starch. (*See* ENEMA.)

STARVATION (*see* FASTING). Partial starvation, as a method of treatment, is used in certain diseases associated with previous excess of food, particularly obesity and diabetes. (*See* CORPULENCE *and* DIABETES.) When a person is completely deprived of food for a time, not only is there very great loss of weight but the chemical processes of the body are altered, and a poisoning effect is produced by the formation of acetone and other ketone bodies. In cases of slow starvation, the vitality of the tissues is reduced and they become

more liable to the attack of tuberculosis and other diseases.

STASIS (*στάσις*, halt) is a term applied to stoppage of the flow of blood in the vessels or of the food materials down the intestinal canal. (For Blood Stasis see CIRCULATION, DISORDERS OF.) Intestinal stasis, which may be due to weakness of the muscle of the bowel or to the presence of adhesions, kinks, and other similar conditions, results in constipation and is often blamed for a variety of symptoms of ill-health attributed to poisoning with substances resulting from decomposition, which are absorbed into the blood.

STATUS LYMPHATICUS is another name for lymphatism.

STAVESACRE is the seeds of *Delphinum staphisagria*, which are crushed and made into an ointment for use as a parasiticide. Applied to the skin or hair, it is very effective in killing lice and other animal parasites.

STENOSIS (*στενός*, narrow) is a term applied to a condition of unnatural narrowing in any passage or orifice of the body. The word is specially used in connection with the four openings of the heart at which the valves are situated. (*See* HEART DISEASES.)

STEPPAGE GAIT is the name given to the peculiar walk characteristic of neuritis affecting the muscles of the leg and causing drop-foot. The feet are lifted high so that the toes may clear the ground.

STEREOGNOSIS (*στερεός*, solid; *γνῶσις*, knowledge) means the faculty of recognising the solidity of objects, and thus their nature, by handling them.

STERILISATION means the process of rendering various objects which come in contact with wounds, various foods, etc., free from microbes. This may be effected in many ways, and different methods are used in different cases, for it is evident that processes applicable to clothing or to a room may be quite unsuited for the sterilisation of food.

The manner of sterilising bedding, furniture, etc., after contact with a case of infectious disease, is given under DISINFECTION, while the sterilisation of instruments, dressings, and skin surfaces, necessary before surgical procedures, is mentioned in the same article and also under ANTISEPTICS, ASEPSIS, and WOUNDS. For general purposes, one of the cheapest and most effective agents is boiling water or steam.

Use of sterilisation.—Milk is the chief article of food that calls for special sterilisation. With regard to other foods, ordinary cooking has this for one of its chief objects. Milk, even from healthy cows, is contaminated by the hands of milkers and by organisms that fall into it from the surrounding air, so that an ounce of milk may be found to contain as many as 2,800,000 bacteria within a short time after milking. Further, milk may be drawn from tuberculous cows, and the insanitary conditions under which modern dairy farms are only too often conducted admit readily of contamination of the milk by all sorts of organisms. For healthy adults these impurities may not be of such great importance as they undoubtedly are in the case of children liable to tuberculosis, those suffering from summer diarrhœa, and persons of weak digestive powers. The origin of epidemics, too, is frequently traced back to a dairy, especially in the case of typhoid fever and scarlatina.

For all these reasons it is necessary at some times and for some people to sterilise cow's milk. In the case of infants the milk is often 'humanised' by the addition of water, sugar, and cream (*see* INFANT-FEEDING) before it is sterilised; and for dyspeptics it is a common practice to peptonise it (*see* PEPTONISED FOODS) prior to sterilisation.

Method of sterilisation.—One of the most effective modes is simply to boil the milk for a prolonged period in a covered pan; but this changes its taste considerably, and is therefore unsuitable for children and invalids.

Another method is to place the milk in a flask or bottle of which the neck is closed by a plug of cotton-wool, and set it in a pot of water, from the bottom of which it is separated by a triangle of wire or other means. The pot is placed upon the fire and the water boiled for three-quarters of an hour, by which

time the milk is sufficiently sterilised without appreciably affecting its taste. Many forms of steriliser, among which may be mentioned those of Aymard and Soxhlet, are on the market at a small cost, but all depend upon this principle of having an inner vessel or set of bottles suspended within an outer pot containing water, which is boiled for three-quarters of an hour to one hour. Care must be taken that the milk is not uncovered, after being sterilised, until just before it is to be used.

Pasteurisation is a slightly different method of treatment, which seems to be sufficient to destroy the microbes that

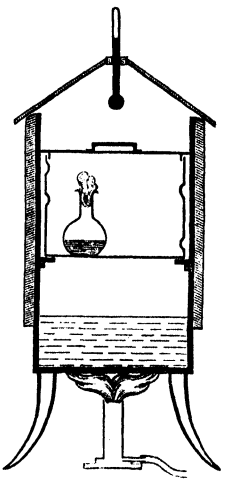


FIG. 422.—Diagrammatic section of a form of steriliser (Koch's), in which the articles to be sterilised are placed in a large metal box and exposed to the action of steam.

cause summer diarrhœa, as well as the infection of scarlet and typhoid fevers, while preserving the natural state of the milk. (*See* PASTEURISATION.)

Koch's method of sterilisation is used in bacteriological investigation where even the spores of bacteria must be destroyed. It is carried out by steaming the objects to be sterilised on three successive days. (*See* BACTERIOLOGY.)

STERNUM (*στέρνον*, the chest) is another name for the breast-bone.

STERNUTATORIES (*sternuto*, I sneeze) are substances that provoke sneezing.

STERTOR (*sterto*, I snore) is a term applied to noisy breathing resembling snoring. It is due usually to flapping of the soft palate between a stream of air entering by the nose and one entering by the mouth. In ordinary snoring this results simply from the habit of sleeping with the mouth open, and in certain serious disorders it arises from paralysis of the soft palate. Some of these conditions affecting the nervous system and thus leading to paralysis of the soft palate are—apoplexy, suffocation, concussion of the brain, drunkenness, poisoning by opium or by chloroform. For the means of distinguishing between these conditions see OPIUM POISONING. In some of these paralytic conditions the snoring is very loud, and the noise is due then, not to flapping of the soft palate, but to lolling back of the tongue against the back of the throat as the patient lies upon his back. In this case the breathing is at once relieved by pulling forward the lower jaw, by pulling the tongue out of the mouth, or by turning the patient upon one side, as is done, for example, in suffocation due to drowning or in chloroform poisoning.

Stertorous breathing is not to be confused with *sniffing* breathing produced by paralysis of the muscles that should hold the nostrils still and open; nor with *puffing* breathing due to paralysis of the muscles in the cheeks and lips; though all three conditions may be produced by the same causes. Nor must it be mistaken for *stridor*, or crowing breathing, due to spasmodic narrowing in the larynx (*see* LARYNGISMUS); nor for the prolonged, noisy, *wheezing* breathing of asthma produced by narrowing of the bronchial tubes.

STERULE is a term applied to a glass capsule containing sterile solution for hypodermic administration.

STETHOSCOPE (*στῆθος*, chest; *σκοπέω*, I examine) is an instrument used for listening to the sounds produced by the action of the lungs, heart, and other internal organs. (*See* AUSCULTATION.)

STHENIC (*σθένος*, strength) is a term applied to certain diseases, especially fevers, to indicate that they are not associated with prostration.

STIFFNESS is a condition which may be due to a change in the joints, ligaments, tendons, or muscles, or to the influence of the nervous system over the muscles of the part affected. Stiffness is associated with various forms of rheumatism. Stiffness of the neck muscles and of the hamstring muscles, causing difficulty in straightening the lower limbs, are signs of meningitis. Stiffness or spasticity also occurs in disease of the central nervous system.

STIGMA (*στίγμα*, mark) means any spot or impression upon the skin. The term 'stigmata of degeneration' is applied to physical defects that are found in mentally defective persons. (*See* MENTAL DEFECTIVENESS.)

STILBAMIDINE.—A proprietary term for diamidino-stilbene (*q.v.*).

STILBŒSTROL is the name given to a synthetic œstrogen discovered by E. C. Dodds and his co-workers. Its physiological actions are closely similar to those of the natural ovarian hormone, and it has the great merit of being active when taken by mouth. A curious property of stilbœstrol is seen in the relief it affords when given to patients suffering from cancer of the prostate, inducing in some cases, it appears, regression of the primary tumor and of secondary deposits in bone. (*See* HEXŒSTROL *and* ŒSTROGEN.)

STILET, or STILETTE, means the delicate probe or the wire used to clear a catheter or hollow needle.

STILL BIRTH (*see* BIRTH).

STILLINGIA, or QUEEN'S ROOT, is the root of *Stillingia sylvatica,* a plant of the United States which has an irritant action upon the bowels.

STILL'S DISEASE is a disease of childhood first described by Sir Frederic Still. It is characterised by inflammation of several joints (similar to the changes found in rheumatoid arthritis), enlarged spleen and lymph glands, and fever.

STIMULANTS (*stimulo,* I goad) are drugs and other agents employed to call forth special powers of the body or of individual organs in order to effect some special purpose or to offer resistance to some acute attack of disease. The use of stimulants presupposes a certain amount of reserve power on the part of the body or of the organ stimulated, which is lying dormant, and requires an appropriate stimulus before it can be brought into action. In its broadest sense, the term 'stimulant' includes all remedies which are not simply foods destined to supply the wear and tear of the body and to provide it with a store of energy-producing material. It also excludes remedies which have a sedative action upon the nervous system or other organs, and remedies which act directly upon the causes of disease without any reference to the body, such as antisèptics.

For drugs which stimulate the intestines see PURGATIVES; for those that stimulate the liver see CHOLAGOGUES; for those that stimulate the kidneys see DIURETICS; and for those that increase the activity of the skin secretion see DIAPHORETICS. Many substances, such as aromatics, spices, and bitters, stimulate the function of the stomach.

STINGS (*see* BITES, STINGS, etc.).

STIPP is a name formed of the initial letters of sodium tetriodophenolphthalein. (*See* IODOPHTHALEIN.)

STITCH is a popular name for a sharp pain in the side. It is generally due to cramp following unusually hard exertion (*see* CRAMP), but care must be taken that this trivial condition is not taken for pleurisy or for a fractured rib.

For the stitches used to unite the edges of wounds see WOUNDS.

STOKES-ADAMS SYNDROME is a term applied to a condition in which slowness of the pulse is associated with attacks of unconsciousness, and is due to a state of heart-block.

STOMACH.—The stomach is a dilated portion of the alimentary canal, which in man has a shape somewhat resembling that of a pear. The larger end, known as the 'fundus', lies in the hollow of the left side of the diaphragm, and at one side of this is the opening from the

gullet. The greater part of the stomach, into which the gullet opens, is known as the ' cardiac ' part, while the lower and

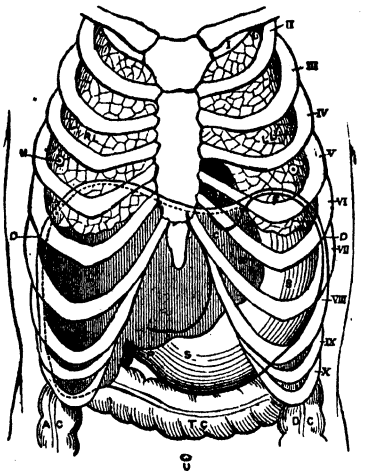


FIG. 423.—Diagram showing the position of the stomach with regard to the ribs and the other organs. *DD*, Diaphragm; *LL*, left, and *RL*, right lung; *P*, pericardium covering heart; *SS*, stomach with *F*, its fundus, *C*, its cardiac opening, and *P*, its pyloric opening; *L*, *L*, liver; *G*, gall-bladder; *AC*, *TC*, *DC*, part of the colon or large intestine; *U*, navel; *M*, nipple; I-X, upper ten ribs. (Turner's *Anatomy*, after Luschka.)

narrower portion is known as the ' pyloric ' part. The two openings into and out of the stomach are known as the cardia and the pylorus. The stomach

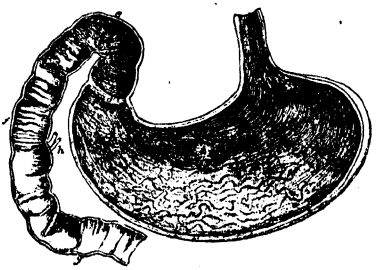


FIG. 424.—The stomach and duodenum, from which the front wall has been removed in order to show the interior. *a*, Gullet; *c*, cardiac end of stomach; *d*, pylorus or outlet of stomach; *e*, *f*, *g*, three parts of duodenum; *h*, bile-duct and pancreatic duct opening together into its second part. Note the folds into which the mucous membrane lining the stomach is thrown. (Turner's *Anatomy*.)

is slightly flattened from before backwards, and the two edges are known as the ' lesser curvature ', which runs from one opening to the other direct, and the ' greater curvature ', which sweeps round the fundus from the cardia to the pylorus.

Size and position. — The stomach hangs very freely suspended in the upper and left part of the abdomen, so that changes in its position and shape take place readily according to the amount of food it contains. On the surface, the stomach corresponds to the ribs on the left side from about the fifth to the ninth, and extends below their protecting margin about half-way down to the navel, whilst the person is recumbent, and slightly below the navel when he stands up. The fundus lies immediately below the heart and base of the left lung, separated from them only by the diaphragm and their enveloping membranes. This explains the embarrassment of the heart's action and of breathing sometimes experienced by dyspeptics. The stomach is attached at the cardiac opening to the gullet, and at this point it is further secured to the diaphragm by a ligament. A broad band of peritoneum (small omentum) attaches the lesser curvature to the under surface of the liver, and a similar peritoneal fold unites its hinder surface to the spleen. The pyloric end, like the cardiac opening, is to a great extent fixed in position, but the greater curvature is quite freely movable.

The greatest length of the stomach from the fundus to the greater curvature near the pylorus is about one foot, and the greatest breadth does not exceed 4 to 5 inches. The capacity varies greatly in different persons. The maximum capacity is about five pints, but the average person becomes very uncomfortable when more than two or three pints of fluid are poured into his stomach.

Structure.—The stomach possesses four coats similar to those of the intestine, which are, from within outwards, a mucous membrane, sub-mucous layer, muscular coat, and peritoneal coat.

MUCOUS MEMBRANE lines the interior of the stomach and is of smooth, soft texture, though raised up into ridges when the stomach is empty. The surface can be seen with the naked eye to be thickly covered by minute pits into each of which several tube-shaped glands are found, on microscopic section, to open.

The mucous membrane in fact consists almost entirely of these glands placed side by side, and supported by a small quantity of connective tissue and by fibres of unstriped muscle. The surface of the mucous membrane is composed of a single layer of columnar cells, and these also line the pits referred to above. Each gland is composed of large cubical cells so arranged as to form a tube, open at the upper end where it meets the pit, and closed beneath. These cells secrete the gastric juice which exudes from all the minute tubes as digestion is proceeding. In the cardiac end of the stomach there are other larger cells in addition,

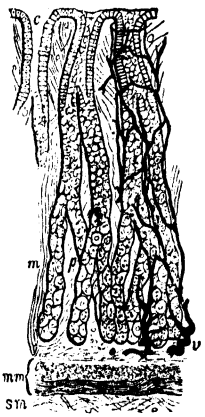


FIG. 425.—Vertical section of the stomach mucous membrane. *c*, Columnar epithelium covering the surface and lining the pits into which *p*, the glands, open; *mm*, muscular layer of mucous membrane sending up *m*, bands between the glands; *sm*, loose sub-mucous coat; *v*, vessels forming a network round the glands. Magnified about 100 times. (Turner's *Anatomy*.)

mingled with those just described, and the large cells are supposed to secrete the acid of the gastric juice. Between the tubular glands lies some supporting connective tissue in which run numerous blood-capillaries and lymph-vessels.

SUBMUCOUS COAT is a loose connective tissue layer which joins the mucous coat to the muscular coat, and in which the large blood-vessels of the stomach run. The loose arrangement of its fibres allows the mucous membrane to glide freely over the muscular coat in the movements and variations in size of the stomach.

MUSCULAR COAT is of considerable thickness in the stomach, and is of great

importance in varying the size of the organ according to the amount of food it contains, in making the 'peristaltic' movements which mix the food with the digestive juice, and finally in expelling the softened food from the stomach into the small intestine. This coat consists of three layers, an outer one in which the fibres run lengthwise, a middle one where they are circular, and an inner layer in which they run obliquely across the stomach.

PERITONEAL COAT is similar to the peritoneum covering the other organs of the abdomen. (*See* PERITONEUM.)

VESSELS. — The stomach is abundantly supplied with blood from the

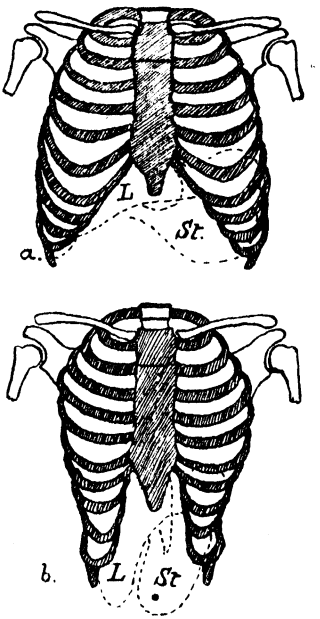


FIG. 426.—Diagram showing the effects of narrow chest upon the position and shape of abdominal organs. *a*, Normal, *b*, distorted, chest; *L*, liver; *St*, stomach.

cœliac axis, a short, wide artery which comes directly from the aorta and likewise gives branches to the liver, pancreas, and spleen. There is a large arterial arch round either curvature, and from these two arches smaller branches run into the wall of the stomach and reach the submucous coat, from which minute branches are distributed to the other coats. The blood is collected by veins

which ultimately return it to the portal vein.

NERVES.—The stomach is very richly supplied with nerves both from the brain and from the sympathetic system. The tenth cranial nerve (vagus) of each side has a long course down the side of the gullet, and after giving branches to the larynx, heart, lungs, and other organs, terminates in the stomach, which has therefore important nervous connections with these vital organs. Other branches come from the solar plexus of the sympathetic. These nerves form a plexus in the submucous coat and another in the muscular coat, which undoubtedly exert a powerful influence over the secretions and movements of the organ, though these functions are, in the main, carried out automatically.

Functions of the stomach.—The part played by the stomach in digestion consists in storing, warming, and softening the food, and then in passing it on in small quantities to the intestine, where the more important digestive processes that prepare it for absorption take place. The action of the gastric juice upon the food has been described under DIGESTION. The action of the muscular coat of the stomach is also very important. In birds, which have no teeth, the gizzard is a powerful muscular organ that grinds down the grain and other food into a pulp, but in man the muscular action is much gentler. This, together with other facts regarding the stomach, was first carefully observed between 1825 and 1833 by the American physician W. Beaumont in the case of a man named Alexis St. Martin, whose stomach had been so exposed by a gunshot wound that a large opening existed, through which its interior could be inspected. The movements, as seen by the aid of X-rays, consist of a series of waves, each of which takes about half a minute to pass along the stomach. These movements have also the effect of separating the more fluid parts from lumps still left in the later stages of digestion, which are retained in the cardiac part of the stomach, while the pylorus relaxes as each wave reaches it to allow some of the softened mass to pass through into the small intestine. This muscular movement takes place in health without causing any sensation, but in irritable conditions of the stomach when digestion is not proceeding naturally, it may increase in force and give rise to irregular spasms which come and go, and which are attended by much pain. (*See* DYSPEPSIA.)

STOMACH, DISEASES OF.—Only the more common and serious varieties of gastric disease can be here considered. The majority of them exhibit, as their most marked and sometimes their only feature, the symptoms of dyspepsia (*see* DYSPEPSIA). Hence the diagnosis of the forms of stomach disease is frequently a matter of much difficulty.

ACUTE GASTRITIS or ACUTE CATARRH.—**Causes.**—Of these the most important are—(1) constitutional conditions, such as gout or an inherited tendency to irritability of the digestive organs; (2) errors in diet, particularly excessive quantity, meals at too frequent intervals, indigestible quality, imperfect mastication, extremes of temperature of the food, poisonous agents, especially alcohol in excess or food in a state of decomposition; (3) atmospheric influences, as appears evident from its tendency to occur in very warm or very cold weather, or in the case of sudden temperature alterations; (4) a nervous type of this acute form of irritation also exists, and the condition is apt in many persons to come on periodically (*see below*).

Symptoms.—The chief change the stomach undergoes affects its mucous membrane, which is in a state of congestion, either throughout or in parts. The symptoms are those well known as characterising an acute 'bilious attack', consisting in loss of appetite, sickness or nausea, and headache, frontal or occipital, often accompanied with giddiness. The tongue is furred, the breath fœtid, and there is pain or discomfort in the region of the stomach, with sour eructations, and frequently vomiting, first of food and then of bilious matter. An attack of this kind tends to subside in a few days, especially if the exciting cause be removed. Sometimes, however, the symptoms recur with such frequency as to lead to the more serious chronic form of the disease.

Treatment.—The treatment bears reference, in the first place, to any known source of irritation, which, if it exist, may be expelled by an emetic or purgative.

STOMACH, DISEASES OF

For the relief of sickness, if it be excessive, and pain, the sucking of ice and counter-irritation by mustard leaves or hot fomentations over the region of the stomach are of service. Further, remedies which exercise a soothing effect upon an irritable mucous membrane, such as bismuth or weak alkaline fluids, and along with these entire abstinence from food for a day and afterwards the use of a light milk diet, are usually sufficient to remove the symptoms.

CHRONIC GASTRITIS or CHRONIC CATARRH may arise after repeated attacks of the acute form or may come on independently. It is of several types. The result of the chronic irritation of the gastric mucous membrane may be an excessively acid gastric juice, which gives rise to an acid dyspepsia. (*See* DYSPEPSIA.) After a long period of irritation an atrophy of the secreting structures of the stomach may be produced, and there is then little or no secretion of gastric juice, a condition known as *gastritis anacida*. In addition to this failure to secrete a proper gastric juice, the interior of the stomach becomes constantly coated with tough mucus, which further prevents digestion from proceeding normally. The mucous membrane is permanently in a state of congestion, it becomes thickened and thrown into deep ridges and furrows, and frequent hæmorrhages take place from its dilated veins. At a later stage, great thickening of the other coats may take place (cirrhosis), leading to still further impairment of digestion, since the stomach becomes small, its movements impeded, and the outlet often blocked by especial thickening in the region of the pylorus.

Causes.—Chronic catarrh is frequently associated with previous disease in other organs, such as the lungs, heart, liver, or kidneys, and it is specially common in persons addicted either to over-eating or to alcoholic excess.

Symptoms.—The symptoms are those of dyspepsia in an aggravated form (*see* DYSPEPSIA), of which discomfort and pain after food, with distension and frequent vomiting, are the chief.

Treatment must be conducted with reference to the causes giving rise to it. The careful regulation of the diet, alike as to the amount, the quality, and the intervals between meals, demands special attention. Of medicinal agents, bismuth, bitters, nux vomica, and the mineral acids are all used, and, in those forms which are characterised by defective formation of the gastric juice, pancreatic extract administered along with the meals, or peptonised food (*see* PEPTONISED FOODS), is often employed with benefit.

ULCER OF THE STOMACH, GASTRIC ULCER, PERFORATING ULCER, is of frequent occurrence, and is a disease of much gravity. It occurs much more frequently than is generally supposed, the result of autopsies showing that one person in every twenty or thereabout suffers from gastric ulcer at some period of life.

Causes.—These are not fully understood, yet the following points may be regarded as generally admitted: (1) that the disease is twice as common in females as in males; (2) that it occurs for the most part in early life, the period from twenty to thirty including the great majority of the cases; (3) that it may arise in connection with an impoverished state of the blood (anæmia).

It is held that when any degenerative change takes place in the mucous membrane of the stomach the part is less able to resist the action of the gastric juices upon it, and is apt to undergo disintegration all the more readily. Hence an ulcer is formed. This ulcer is usually of small size (¼ to 1 inch in diameter), of round or oval form, and tends to advance, not superficially, but to penetrate through the coats of the stomach. Its most usual site is upon the posterior wall towards the upper or lesser curvature of the stomach and near to the pyloric orifice. This is the point at which the mucous membrane is subjected to most friction by the food as it leaves the stomach. The ulcer may undergo a healing process at any stage, in which case it may leave but little trace of its existence; while, on the other hand, its scar may produce such an amount of contraction as to lead to narrowing of the pylorus, and later dilatation of the stomach. Also perforation may take place, which in most cases is quickly fatal, unless previously the stomach has become, as it may, adherent to another organ, by which the dangerous effects of this occurrence may be averted.

STOMACH, DISEASES OF

Usually there is only one ulcer, but sometimes there are more.

Symptoms.—The symptoms to which this disease gives rise are often exceedingly indefinite and obscure, and in some cases the diagnosis has been first made by the sudden occurrence of a fatal perforation. First among the symptoms is *pain*, which is in some measure present at all times, but is markedly increased after food. This pain is situated either in front, at the lower end of the breastbone, or frequently behind, about the middle of the back. It is often severe, and is usually accompanied with much tenderness to touch, and also with a sense of oppression and inability to wear tight clothing. The pain is largely due to the spasmodic contractions of the stomach set up by the presence of the food. Accompanying the pain there is frequently *vomiting*, either very soon after the food is swallowed or at a later period. This tends in some measure to relieve the pain and discomfort, and in many instances the patient rather encourages this act. *Vomiting of blood* (hæmatemesis) is a frequent symptom, and is most important diagnostically. It may show itself either to a slight extent, and in the form of a brown or coffee-like mixture, or as a copious discharge of pure blood of dark colour and containing clots. The source of the blood is some vessel or vessels which the ulcerative process has ruptured. Vomiting of blood, however, does not always indicate the presence of a gastric ulcer. Blood is also found mixed with the discharges from the bowels, rendering them dark and 'tarry'-looking. The general condition of a patient with gastric ulcer is as a rule that of ill-health, showing pallor, more or less emaciation, and debility. The tongue presents a red, irritable appearance, and there is usually constipation of the bowels. X-ray examination gives little evidence of the presence of an acute ulcer, beyond showing that there is much irritation near the pyloric opening with spasm of the rest of the stomach; but in very chronic cases the deep ulcer often fills up with the bismuth that has been administered for the examination, and its outline can then be readily seen.

The course of a case of gastric ulcer is very variable. In some instances it is acute, making rapid progress to a favourable or unfavourable termination. In others, however, the disease is chronic, lasting for months or years, and in those cases where the ulcers are multiple or of extensive size, incomplete healing may take place and relapses of the symptoms occur from time to time. Ulcers are sometimes present and yet give rise to no marked symptoms, and one occasionally meets with cases where fatal perforation has suddenly taken place and where *post-mortem* examination reveals the existence of a long-standing ulcer which has furnished little or no evidence of its presence during life. Again, an unsuspected ulcer may run a favourable course, and the contraction of its scar may, at a later period of life, cause interference with the exit of food by the pylorus and consequent dilatation of the organ, and thus give the only evidence that an ulcer has at one time been present.

While gastric ulcer is always to be regarded as a dangerous disease, its termination, in the great majority of cases, is in recovery. It frequently, however, leaves a delicate scar, necessitating the utmost care as regards diet. Occasionally, though rarely, the disease proves fatal by sudden hæmorrhage, or by perforation of the stomach and the escape of its contents into the peritoneal cavity setting up peritonitis or causing severe shock, and followed, as a rule, by death within two days unless operative measures be adopted immediately. Should the stomach become adherent to another organ, a permanent condition of dyspepsia may result, due to interference with the natural movements of the stomach during digestion; while the possibility of stricture of the pyloric opening with dilatation of the stomach as the result of the contraction of a healed ulcer has been already mentioned.

Duodenal ulcer, in which a condition similar to gastric ulcer is found just beyond the pyloric opening, has symptoms very like those of gastric ulcer, but occurs more frequently in middle age. (*See* DUODENAL ULCER.)

Treatment.—Most important is the careful adjustment of the diet. Milk forms the most suitable food, and while there may be instances in which it fails to agree, even when mixed with lime-water or previously boiled, these are comparatively few. Milk and cream

mixed in equal parts are particularly well borne and should form the staple of the patient's diet for several weeks or months. In the 'Sippy' method of treating gastric ulcer the patient is kept at rest in bed for two or three weeks, and for the first week takes 3 ounces of the milk and cream mixture every hour during the day. He also receives an alkaline powder composed either of magnesia and soda or of calcium carbonate and soda every half-hour during the day. Towards the end of the first week he receives in addition one soft-boiled egg in the forenoon and 3 ounces of porridge or boiled rice in the afternoon. Later another egg is added and 3 ounces of some cereal food are given three times in the day. About the end of the third week he is allowed food, such as eggs, toast, cream soups, mashed potatoes, custards, jellies, whipped cream, and cooked fruits. Subsequently creams of fish, chicken, etc., are allowed. Whatever food is given, the quantity, the intervals between the times of administration, and the temperature demand careful attention. In severe cases, where the presence of any food in the stomach gives rise to much suffering or to hæmorrhage, nourishment by the bowel is had recourse to, and if the food be given in this way for a period of three or four weeks, the complete rest thus afforded to the stomach is of the utmost value in allowing the ulcer to heal. The usual type of food given in this way consists of glucose in saline solution. Of medicinal remedies, the most serviceable are large doses of bismuth, with which it may be necessary to conjoin small doses of opium or of hydrocyanic acid for the relief of pain. When hæmorrhage occurs, it is relieved by sucking ice and by such styptics as tannic acid, ergot, and adrenaline. In the event of perforation, treatment is by an immediate operation in which the peritoneal cavity is cleansed and the opening in the stomach wall stitched together. Such an operation must be performed at the earliest possible moment in order to afford good hope of recovery.

CANCER OF THE STOMACH is by far the most common form of cancerous disease. It occurs for the most part in persons at or after middle life, about the age of fifty-two, and in both sexes almost equally, though at middle life it is more common in men. Hereditary tendency may sometimes be traced.

The most common varieties of cancer affecting the stomach are scirrhus, medullary, and colloid, and the parts affected are usually at the inlet or outlet; but the disease may spread widely in the stomach wall. When it is situated in the neighbourhood of the pylorus, a stricture is frequently produced as the disease advances. The cancerous growth usually commences in the submucous tissue, but as it progresses it tends to ulcerate through the mucous membrane, and in this process bleeding and vomiting of blood may occur. The symptoms of this disease are in many instances so indefinite as to render the diagnosis for a long time conjectural. They are mostly those of dyspepsia, with more or less pain, discomfort, and vomiting, particularly after meals. The vomited matters are often of coffee-ground appearance, due to admixture with blood, but copious hæmatemesis is less frequent than in cases of gastric ulcer. The patient loses flesh and strength, and soon comes to acquire the cachectic aspect commonly associated with cancer. (*See* CANCER.) The diagnosis is rendered all the more certain when, as is frequently the case, a tumor can be detected on examination over the region of the stomach, but where no such evidence is obtained, the nature of the disease is left to be made out by the age of the patient, by absence of free hydrochloric acid from the gastric juice, by progressive loss of weight, and by X-ray examination. Cases of cancer of the stomach advance with more or less rapidity to a fatal termination. In most instances death takes place in from six to twelve months. The treatment can often be only palliative, but much relief may be afforded by a careful attention to diet, by the treatment applicable to dilatation of the stomach, by the use of morphine and other drugs which relieve pain. In early cases an operation can sometimes be performed by which the disease is completely removed, or, when this cannot be carried out, vomiting, pain, and other symptoms of obstruction are relieved by making a communication between the stomach and a loop in the small intestine (gastro-enterostomy).

DILATATION OF THE STOMACH

STOMACH, DISEASES OF

may occur without giving rise to any symptoms, the person in question being simply possessed of a gastric organ of more than usual capacity, but in those cases where portions of the food are retained for a long time in the stomach, giving rise to fermentation, to spasmodic and ineffectual efforts of the muscular wall to empty the organ, or to great irritation of the mucous membrane, the condition is both painful and has a serious effect upon the general health.

Causes.—The condition may arise in consequence of weakness of the muscular wall of the stomach as the result of any chronic wasting disease, such as consumption or general enfeeblement of nervous energy brought on by overwork. The dilatation also may follow upon a downward displacement of the stomach which is an inborn peculiarity of certain persons aggravated by a bad habit of posture (*gastroptosis*). Such a defect gives rise to a minor degree of dilatation, the stomach being less active in its movements, and heavy meals being retained in it for many hours or even several days. More common as a cause, however, is narrowing of the outlet from the stomach in consequence of the scar of an old ulcer at the pylorus, or owing to a cancer in this position. Similarly, displacement of a neighbouring organ, such as a floating kidney, may block the outlet by pressure on the exterior of the stomach. The condition is also met in newly-born children as the result of a very narrow outlet from the stomach (*congenital pyloric stenosis*). In these conditions food collects in the lower part of the stomach, stretches the wall, and causes the dilatation to become permanent.

Symptoms.—The symptoms of dilatation have been to some extent mentioned under the heading of DYSPEPSIA. The condition gives rise to much discomfort, which is increased a few hours after meals when digestion should be in full progress. Heartburn and the feeling of a heavy load under the ribs are often complained of. As the stomach in advanced cases is never completely emptied between meals, only a portion of the food escaping into the small intestine, fermentation goes on in the residue, the vegetable growths of *sarcinæ* and *yeasts* being especially evident in the mass of fermenting material that is vomited up every few days. Various substances, such as lactic acid, butyric acid, and even sometimes explosive gases, are formed as the result of this fermentation, and, owing to the great disturbance of digestion, severe constipation is a very common symptom. Naturally the patient derives little benefit from his food, and becomes weak and thin, the condition for this reason being sometimes mistaken for cancer.

Treatment.—Washing out the stomach daily, and thus removing the fermenting residue, either at night or in the morning, is found to give great relief, and often to effect a complete cure. (*See* DYSPEPSIA.) Further relief is gained by the patient lying on his right side so as to permit of the more ready escape of the digested food from the stomach, and in some cases by wearing a special belt over the lower part of the abdomen which supports the dilated stomach. In those cases where the stomach has become so much distended, and its wall so weak that it has very little power left for expelling any of its contents through the pylorus, which is situated high up, the condition may sometimes be cured by the operation of gastro-enterostomy. This consists in opening the abdomen, making an aperture at the lowest part of the stomach and one in a coil of the small intestine, uniting the two by sutures, and closing the abdominal wound. The effect of this artificial outlet is satisfactory only in cases of dilatation which have been caused by the scar of an old ulcer.

NEUROSES OF THE STOMACH include those conditions which do not appear to be associated with any disease in the organ, but are due probably to defective action in some of its nervous connections. Under this heading may be mentioned spasm and other forms of pain referred to the stomach when that organ is apparently not the seat of ulcer, inflammation, or any other gross physical change; also, defective power in the muscular wall and defects of secretion brought about by wasting disease, neurasthenia, and other general conditions, as well as forms of over-action exemplified by sea-sickness and sick-headaches. Sometimes the gastric symptoms are produced by disease in other organs, *e.g.* in appendicitis. (*See under*

COLIC, HEADACHE, NEURALGIA, NEURASTHENIA, SEA-SICKNESS.)

Attacks of severe vomiting, called 'crises', also form a symptom of the disease known as locomotor ataxia, and fall under this heading.

STOMACH TUBE is a soft rubber tube with rounded end, and usually about 30 inches in length, which is used for drawing off the contents of the stomach with the view of chemically testing them, or in order to wash out the stomach when it contains some poisonous material, or when it is dilated and filled with fermenting food. For the purpose of washing out the stomach a long tube and funnel are attached to the stomach tube. For the method of its use see under DYSPEPSIA. A narrower

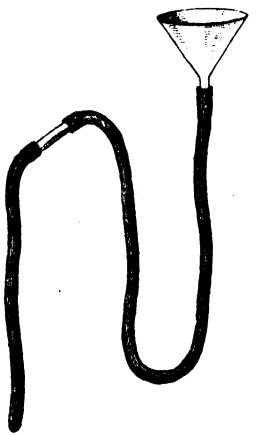


FIG. 427.—Stomach tube of india-rubber connected by glass junction with india-rubber tube and funnel.

rubber tube about the thickness of a quill and of some 36 or more inches in length is used for the purpose of examining the stomach throughout the digestion of a meal. By means of such a tube, which can be retained without discomfort by a patient for several hours, small samples of the gastric juice can be drawn off every quarter of an hour or thereabout and tested. Such a tube can also be allowed to pass out of the stomach into the duodenum so that the contents of the upper part of the small intestine are similarly obtained for analysis. Such an examination is known as 'fractional gastric analysis'.

STOMATITIS (*στόμα*, the mouth) means inflammation of the mouth. (*See* MOUTH, DISEASES OF.)

-STOMY (*στόμα*, mouth) is a suffix signifying formation of an opening in an organ by operation, *e.g.* gastrostomy and colostomy.

STONE (*see* CONCRETIONS; BLADDER DISEASES OF; GALL-STONES).

STOOLS consist of the remainder of the food after it has passed through the alimentary canal and been subjected to the action of the digestive juices, and after the nutritious parts have been absorbed by the intestinal mucous membrane. The stools also contain various other matters, such as pigment, derived from the bile, and large quantities of bacteria. The stools are passed once daily by most persons, but infants, who are fed frequently, have several evacuations of the bowels in twenty-four hours. To some persons the habit of opening the bowels only once or twice a week seems to be quite natural, though such cases are not common.

The *amount* of the stool passed varies considerably, being roughly about 5 ounces, or about one-eighth of the daily food, but when diarrhœa is present, and there is much fluid in the stool, it is increased in amount, whilst in constipation it is diminished and hardened, and when astringents such as iron or tannin are taken, their effect is still further to harden the stools. Though in a healthy condition the stool of grown persons is cylindrical, and forms a cast of the interior of the rectum, in young children it is a soft pultaceous mass. The appearance of the stools is also much modified when any tumor is present in the lower bowel. In this case, they may be very small or may be squeezed out into a flattened tape-like form. A similar appearance is caused by that form of constipation which is due to a spasmodic condition of the bowel.

The *colour* of the stools is naturally of a dark brown, due to a pigment known as stercobilin, derived from the bile. This colour may be changed to green by the action of certain bacteria when decomposition is proceeding to a greater extent than usual in the bowels, and a deep green colour is also produced by

some vegetables, such as spinach. White stools, having an appearance like that of clay or putty, are found in cases where the outlet of bile into the small intestine is stopped, and where jaundice is consequently present (acholic stools). When an excess of fat is taken in the food, as in the case of children fed on great quantities of cream, the digestive organs are unable to deal with it, and much of it is passed in the stools, giving the stools in these circumstances also a whitish colour. Black or slaty-grey stools are produced when certain drugs are taken, as, for example, iron and bismuth; and a tarry blackness known as 'melæna' is sometimes imparted to them when bleeding takes place from the stomach, the iron in the blood being acted upon by the sulphuretted hydrogen always present in the stools to produce the black sulphide of iron. Bright yellow stools are produced in diarrhœa, when the bile is passed almost unchanged, and a similar colour is caused by rhubarb, senna, and some other drugs. Mucus in the stools, whether in strings, or mixed with the food remnants, or in the form of membranes coating the hardened stools, is almost always a sign of irritation or inflammation in the mucous membrane low down in the bowel (colitis). Red blood in the stools signifies some diseased condition situated near the lower end of the bowel, such as an ulcer or piles. When the blood proceeds from a point higher up, such as an ulcer of the stomach, it is changed by the action of the digestive juices as already described.

Incontinence of the bowels, or inability to retain the stools, is found in several diseases of a prostrating nature in which the sphincter muscles, that naturally keep the bowel closed, relax. It is also a symptom of disease in or injury to the spinal cord.

Pain at stool is a very characteristic symptom of a 'fissure' at the anus or of inflamed piles, and in such cases is of a very sharp nature. Pain of a duller character associated with the movements of the bowels is often caused by inflammation in the other pelvic organs.

CONSTIPATION and DIARRHŒA have been considered under separate headings.

STORAX is the name of a balsam derived from the bark of *Liquidambar orientalis*, an Asiatic tree. It acts as a diuretic and is soothing to mucous surfaces. It is also used externally for chilblains and frost-bite.

STOUTNESS (*see* CORPULENCE).

STOVAINE, or AMYLOCAINE, is an alkaloidal substance resembling cocaine but prepared artificially. It has an anæsthetic action similar to that of cocaine, but has the great advantage over the latter that it is much less toxic and is therefore not so liable to cause headaches, sickness, and fainting. It is much used to produce anæsthesia for operations either by injection beneath the skin or by injection into the spinal canal. Anæsthetic solutions of stovaine usually contain glucose and adrenaline which prevent it being broken up in the tissues, increase its anæsthetic action, and diminish bleeding. When it is used for spinal anæsthesia, it is usually injected into the spinal canal in the lumbar region.

STRABISMUS (*στραβισμός*) is another name for squinting.

STRAMONIUM is the leaf of *Datura stramonium* or *Jamestown weed*. It contains an alkaloid named daturine, which is almost identical with atropine and upon which its action depends. Certain preparations of stramonium are used similarly to those of atropine or of belladonna for various conditions (*see* ATROPINE), but the best-known use of the drug is in asthma-powders intended for burning.

STRANGULATION (*strangulo*, I choke) is the term applied to the stoppage of circulation which sometimes occurs in a hernia, owing to the pressure caused by the edges of the opening through which the affected organ protrudes. A strangulated hernia must be operated on immediately.

STRANGURY (*στραγγουρία*) is the name given to a condition in which there is constant desire to pass water, accompanied by a straining sensation, though only a few drops can be voided. It is a symptom of inflammation situated in the kidneys, bladder, or urinary passages.

STRAPPING means the application of strips of adhesive plaster, one overlapping the other, so as to cover a part and make pressure upon it. This method of treatment is used in cases of injury or disease when it is desired to keep a part at rest; for example, strapping is applied to the chest in cases of pleurisy and fracture of the ribs. Also it is frequently used to prevent the movement of joints which are sprained or otherwise injured.

STREPTOCOCCUS (*στρεπτός*, a necklace; *κόκκος*, a kernel) is the name given to a variety of bacterium which under the microscope has much the appearance of a string of beads. It is responsible for erysipelas and other virulent forms of inflammation. (*See* BACTERIOLOGY.)

STREPTOTHRIX (*στρεπτός*, a necklace; *θρίξ*, hair) is the name of a group of micro-organisms closely allied to the moulds which occasionally produce diseases in the human body, *e.g.* a disease resembling consumption in the lungs.

STRETCHERS (*see* INJURED, REMOVAL OF).

STRIÆ ATROPHICÆ is the term applied to atrophied strips of skin where this has been excessively stretched, as, for example, in pregnancy, when the greyish atrophied strips are known as STRIÆ GRAVIDARUM.

STRICTURE (*strictura*) means a narrowing in any of the natural passages of the body such as the gullet, the bowel, or the urethra. It may be due to the development of some growth in the wall of the passage affected, or to pressure upon it by such a growth in some neighbouring organ, but, in the majority of cases, a stricture is the result of previous ulceration on the inner surface of the passage, followed by contraction of the scar. (*See* INTESTINE, DISEASES OF; THROAT, DISEASES OF; URETHRA, DISEASES OF, etc.)

STROKE is a popular name for any suddenly developed malady leaving permanent consequences behind it. The term is generally applied to apoplexy. (*See* APOPLEXY.)

STROMA (*στρῶμα*, a covering) is the name applied to the tissue which forms the framework and covering of an organ.

STRONTIUM BROMIDE is a substance occasionally used instead of potassium bromide, as it is credited with less depressing effects upon the muscular tissues of the body. and less tendency to produce indigestion.

STROPHANTHUS is the seed of an East African climbing plant, *Strophanthus kombé*, from which the natives made Kombé arrow-poison. From these seeds an active principle, strophanthin, can be separated, and upon this substance the activity of the drug depends. It increases the contractile power of all involuntary muscles throughout the body, but especially of the heart. Its action upon the heart is almost identical with that of digitalis (*see* DIGITALIS); but strophanthus may be given in sufficiently small doses to obtain its full beneficial effect upon the heart without contracting the blood-vessels and raising unduly the pressure of the blood, an effect which forms at times an objection to the use of digitalis. Further, strophanthus acts more speedily than digitalis, and is discharged from the body more quickly, so that there is not so great a risk that strophanthin will accumulate in the system and suddenly produce symptoms of poisoning.

Uses.—It is specially in cases of heart disease in which the heart is beating feebly and the pulse weak and irregular that strophanthus is used. The effects of this drug, like those of digitalis, are often remarkable in removing dropsy, breathlessness, dyspepsia, and various other painful symptoms due to some defect in the heart; and it is used over long periods as a cardiac tonic, and also in larger doses as a cardiac stimulant when the heart is showing signs of sudden failure. Strophanthus is most commonly administered in the form of a tincture, of which the dose is 2 to 5 minims, or strophanthin is injected hypodermically. (*See also* OUABAIN.)

STROPHULUS, or RED GUM, is a rash consisting of numerous small red

pimples, which appears in young children usually about teething-time, and is associated with a damp skin. It is relieved by careful attention to the diet, and by frequent use of some astringent dusting powder.

STRUMA (*struma*) is a term which is applied to swellings in the neck, either to tuberculous glands or to enlargement of the thyroid gland. In the former sense it is an old term equivalent to scrofula. (*See* SCROFULA.) For the second meaning see GOITRE. The term 'strumous' is equivalent to 'tuberculous'.

STRYCHNINE is an alkaloid derived from nux vomica, the seed of an East Indian tree, as well as from the seeds of several other closely allied trees and shrubs. It is a white crystalline body possessed of an intensely bitter taste, more bitter perhaps than that of any other substance, and it is not very soluble in water. Strychnine in small doses is one of the most widely used of stimulating drugs; although in larger amounts it is a dangerous poison.

Action.—This drug acts mainly on the nervous system. When taken in small doses over a considerable time, it sharpens the mental powers and increases sensibility so that sight and hearing are improved, and the sense of touch becomes more acute. The heart beats both more quickly and more strongly under its use, the breathing becomes deeper, and the movements of the bowels are rendered less sluggish. But it is chiefly upon the spinal cord that strychnine acts; all the functions of the cord are more quickly and more vigorously carried out, reflex action is increased, the muscles are kept in a state of greater 'tone', and there is a general sense of increased bodily well-being. When over-large doses are taken, however, this readiness of the spinal cord to produce muscular action becomes so great that convulsions result from slight sensory impressions, such as a loud noise or cold draught.

Uses.—Strychnine is used chiefly as a tonic combined with other remedies both during convalescence from weakening diseases, in fatigue brought on by overwork, and in various nervous conditions. Most tonic syrups with a bitter taste contain strychnine, and one of these is often prescribed during convalescence, or to tide an overworked person over a period of special strain. It must be observed, however, that it is a dangerous practice to have recourse to such stimulation, because the artificial feeling of well-being thus produced may lead the person to work on till a complete breakdown takes place. Another caution is that preparations containing strychnine, like preparations containing opium, are as a rule unsuited for children, upon whose delicate nervous system these drugs are apt to produce excessive and prejudicial effects. In certain nervous diseases also, associated with congestion or over-activity of the spinal cord, strychnine has a distinctly harmful effect.

Strychnine is also added to purgative medicines for its stimulating action on the bowels; it is used as a general stimulant when failure of the heart's action is imminent; it is much employed for relief of severe breathlessness; and small doses form also a useful bitter tonic taken after meals in cases of atonic dyspepsia.

STRYCHNINE POISONING is fortunately of rare occurrence. It shows itself, as stated above, in convulsions, which come on very speedily after the person has taken the poison. These convulsions are brought on by slight causes, and the sufferer becomes quite flaccid between them. The mental faculties remain unaffected, and the symptoms end in death or recovery within a few hours. These symptoms serve to distinguish strychnine poisoning from tetanus or lock-jaw, the only malady which it resembles. (*See* TETANUS.)

Treatment.—The patient should be kept quiet by himself in a darkened room, all noise and disturbance being reduced to a minimum. At the earliest moment a barbiturate is injected intravenously in a large enough dose to stop the convulsions and put the patient to sleep: sodium pentobarbital or sodium amytal can be used for this purpose. If the patient is seen early enough after taking the poisonous dose, potassium permanganate, tannic acid, or charcoal may be given by mouth. To wash out the stomach or to induce vomiting in a patient with convulsions

is not free from risk. If the muscles of respiration are fixed in spasm, artificial respiration is needed.

STUPE (*stuppa*, tow) is the name applied to a hot fomentation with turpentine sprinkled on it. (*See* FOMENTATIONS.)

STUTTERING (*see* STAMMERING).

STYE, or STY (*see* EYE, DISEASES OF).

STYPTICIN, or COTARNINE HYDROCHLORIDE, is an alkaloidal substance prepared from opium and used in checking hæmorrhage either by hypodermic injection or by direct application on a plug of cotton-wool. It is also used as an astringent in 5 per cent strength in ointment for erysipelas, shingles, and various ulcerative conditions.

STYPTICS (στυπτικός, astringent) are applications which check bleeding, either by making the blood-vessels contract more firmly or by causing rapid clotting in the blood. Some possess both modes of action.

Varieties.—Many substances have this action on account of their chemical or physical properties. Among them may be mentioned ice; hot water at 120° Fahr. if brought directly in contact with the bleeding surface; perchloride of iron; acetate of lead and Goulard's water; nitrate of silver; sulphate of copper; sulphate of zinc; alum; tannin; hazeline; ergot; adrenalin, and other extracts of the suprarenal glands.

Uses.—The use of styptics is mentioned under HÆMORRHAGE.

SUB- (*sub*, under) is a prefix signifying under, near, or moderately.

SUBCLAVIAN is the name applied to a large artery and vein which pass to the upper arm between the collar bone and the first rib.

SUBCONSCIOUS is the term applied to a state of being partially conscious, or to the condition in which mental processes occur and outside objects and events are perceived with the mind nearly or quite unconscious of them. Such subconscious impressions or events may be forgotten at the time and may nevertheless exert a continued influence over the conscious mind, or may at a subsequent time come fully into consciousness. Much importance is attached at the present time to the influence of painful or unpleasant experiences which, though forgotten, continue to influence the mind, and these are held to be largely responsible for neurasthenic and similar states. This injurious influence is removed when the subconscious impressions come fully into consciousness and are then remembered and clearly seen in their relative importance.

SUBCUTANEOUS (*sub*, under; *cutis*, the skin) means anything pertaining to the loose cellular tissue beneath the skin, as a subcutaneous injection. (*See* HYPODERMIC INJECTION.)

SUBINVOLUTION is a term used to indicate that the womb has failed to undergo the usual 'involution' or decrease in size, which naturally takes place within one month after a child is born.

SUBJECTIVE is a term applied to symptoms, sensations, etc., perceived only by the affected individual. For example, numbness is a purely subjective sensation, while the jerk given by the leg on tapping the tendon of the knee is an objective sign.

SUBLIMATION (*sublimatio*) is a term applied to the processes of converting a solid substance into a vapour and recondensing it. The term is also used in a mental sense for the process of converting instinctive sexual desires to new aims and objects of a higher type devoid of sexual significance.

SUBLUXATION (*sub*, under; *luxatio*, a dislocation) means a partial dislocation, and is a term sometimes applied to a sprain.

SUBMAXILLA is the Latin term for the lower jaw-bone.

SUBSTITUTION is a term used in pharmacy for the replacing of one substance by another, frequently in a fraudulent manner.

SUBSULTUS (*subsulto*, I leap) means the twitching of the muscles that sometimes occurs in weakening fevers.

SUCCINYLSULPHATHIAZOLE.—A sulphonamide drug which is absorbed only slowly from the intestine, and on that account used in the treatment of intestinal infections. Because of its efficacy in reducing the numbers of *B. coli* in the intestine, succinylsulphathiazole should be useful in preparing patients before operation on the intestines.

SUCCUSSION (*succussio*, a shaking) is a method of examination by shaking the body of a patient in order to elicit splashing sounds, with a view to determining the presence of gas and fluid in a cavity such as the interior of the stomach or the pleural cavity.

SUCKLING (*see* INFANT-FEEDING; BREASTS, DISEASES OF).

SUDAMINA (*sudo*, I sweat) are small vesicles which appear underneath the surface layer of the skin during diseases associated with constant perspiration, such as rheumatic fever.

SUDORIFICS (*sudor*, sweat; *facio*, I make) are drugs and other agents which produce copious perspiration. (*See* DIAPHORETICS.)

SUFFOCATION (*see* ASPHYXIA *and* CHOKING).

SUGAR is a substance containing the elements carbon, hydrogen, and oxygen, and belonging therefore to the chemical group of carbohydrates. This group includes three subdivisions as follows:

(1) Monosaccharides, or glucoses ($C_6H_{12}O_6$)
e.g. Dextrose or grape-sugar.
Levulose.
(2) Disaccharides, or sucroses ($C_{12}H_{22}O_{11}$)
e.g. Cane-sugar.
Lactose or milk-sugar.
Maltose or malt-sugar.
(3) Polysaccharides, or amyloses ($C_6H_{10}O_5$)
e.g. Starch.
Glycogen or animal starch.
Dextrin and other gums.

Grape-sugar is found in various kinds of fruit, and is the form of sugar produced by the tissues and excreted in large amount by the kidneys in diabetes.

Cane-sugar is very widely distributed through the vegetable kingdom, though it is specially plentiful in the juice of the sugar-cane, beet-root, and maple. When taken as a food, it is converted by the digestive juices into grape-sugar before it is absorbed, this process being known as 'inversion'. Cane-sugar is a valuable food, being utilised in the production of heat and energy, though it is also to a certain extent a tissue-builder so far as fat is concerned. It is to be avoided by persons who tend to corpulence, as well as by diabetics.

Milk-sugar is found in milk, and it is to the fermentation of this sugar and consequent production of lactic acid by certain bacteria that the souring of milk is due. The extent to which it is present in the milk of different animals is mentioned under INFANT-FEEDING. Milk-sugar has little sweetening power compared with cane-sugar, but it is used sometimes as a laxative.

Malt-sugar is produced by the action of the ferment diastase upon the starch contained in barley, and also by the ferments of the saliva and pancreatic juice, though it appears to be still further changed by the latter ferments into glucose before it is absorbed.

Invert sugar is a natural mixture of dextrose and levulose resulting from a chemical decomposition of cane-sugar or of starch.

Starch is mentioned under a separate heading, and its use as a food under DIET and FARINACEOUS FOODS.

The energy-producing value of sugars generally is taken as being on the average 4 calories for each gram of sugar.

SUGAR OF LEAD (*see* LEAD).

SUGGESTION TREATMENT (*see* PSYCHOTHERAPY).

SUICIDE (*see under* INSANITY).

SULCUS is the term applied to any groove or furrow but especially to a fissure of the brain.

SULPHADIAZINE, or 2-SULPHANILAMIDOPYRIMIDINE, bids fair to rival sulphanilamide and sulphapyridine in the treatment of bacterial infections. It is at least as effective as these two against such bacteria as the streptococcus, staphylococcus and pneumococcus. Its great merit is that it is

much less toxic, and a high concentration can be maintained in the blood.

SULPHAMEZATHINE.—A dimethyl derivative of sulphadiazine.

SULPHANILAMIDE, or PARA-AMINOBENZENESULPHONAMIDE, is a drug the discovery of which is one of the most important in medicine in the twentieth century. In 1935 the German chemist Domagk announced the discovery of the effect of prontosil on streptococci. It was later found that this action was due to conversion in the body of prontosil into sulphanilamide, which acts by inhibiting the growth of various bacteria, especially the ubiquitous and dangerous *Streptococcus hæmolyticus*. The introduction of this drug has, for example, much lowered the mortality of puerperal fever, and it has been extensively used in the prevention and treatment of infection of war wounds in the war beginning in September 1939. Various other related compounds have been tried and are often referred to as sulphonamide compounds.

SULPHANILYLGUANIDINE, or SULPHAGUANIDINE, is a new drug closely related to sulphanilamide which is especially effective in bacillary dysentery. This is due to the fact that sulphanilylguanidine is absorbed only slowly from the gut. It therefore can remain in contact for a long time with the bacteria causing the dysentery, and so prevent their growth.

SULPHAPYRIDINE, or M & B 693, a drug related to sulphanilamide, is of great importance because of its effect on the pneumococcus. The use of this drug has much lowered the mortality from pneumonia, and was of great value in the treatment of cerebro-spinal fever in the epidemic of the winter 1939–40. It has also been effectively used in the treatment of gonorrhœa.

SULPHARSPHENAMINE, or SULPHARSENOL, is an arsenical preparation used in the treatment of syphilis.

SULPHATES are salts of sulphuric acid, and their action and uses vary much according to the metal with which the acid is combined. The sulphates of the heavy metals, which are soluble in water, viz. the sulphates of iron (green vitriol), zinc (white vitriol), and copper (blue vitriol), have a powerful astringent action; while sulphates of the alkalies, viz. the sulphates of sodium, potassium, and magnesium (Epsom salts), are used as saline purgatives.

SULPHATHIAZOLE, another drug related to sulphanilamide, and discovered later than sulphapyridine (M & B 693), is effective against a variety of germs, but its chief claim is that it is effective against staphylococcal infections, such as boils and carbuncles, and in this is superior to either sulphanilamide or sulphapyridine.

SULPHONAL is an artificially prepared substance which is white, odourless, tasteless, and dissolves readily in warm water or in alcohol. It is used as a hypnotic in doses of 5 to 20 grains.

SULPHONAMIDE.—Having the sulphonamide grouping—SO_2NH_2. A drug having the sulphonamide grouping. Hence sulphonamide drug, or sulphonamide group of drugs. Sulphanilamide, sulphapyridine, sulphaguanidine, etc., are sulphonamide drugs.

SULPHUR is a non-metallic element widely used in medicine. The crude sulphur is obtained in volcanic districts, and from it 'sublimed sulphur' is prepared by heating. This sublimed sulphur is either run into moulds as 'rolled sulphur', or allowed to deposit as 'flowers of sulphur', which consists of a fine gritty powder and is the most commonly used form. The sublimed sulphur may be boiled with slaked lime and treated with hydrochloric acid, when the sulphur settles down in the form of a fine greyish-yellow powder—'precipitated sulphur'.

Action.—The action of sulphur depends partly upon the grittiness of the 'flowers of sulphur', and mainly upon the readiness with which sulphur enters into chemical combinations to form sulphides and sulphates. In consequence of this property, it is possessed of disinfectant and antiparasitic powers. When taken internally, the sulphides that are formed stimulate the action of the bowels, and, being excreted partly from the surface of the skin and mucous

membranes of the air passages, they also stimulate these.

Uses.—Sulphur is burned in order to produce sulphurous acid gas, which is widely used as a disinfectant (*see* DISINFECTION). Externally, sulphur ointment is one of the best remedies against the minute parasite that is responsible for the itch; and milk of sulphur is used in lotions for acne on the face. Sulphur is also used in baths for its stimulating action on the skin in cases of skin disease, rheumatism, etc. For this purpose either plain sulphur or, more commonly, sulphuret of potash is added in the amount of a quarter or half a pound to 30 gallons of hot water. Internally, sulphur is a time-honoured remedy for constipation, in doses of a teaspoonful or thereabout made into a paste with treacle. It may be used for the same purpose in the more palatable form of lozenges, several of these being taken at one time, and has a gentle laxative action. In old persons who suffer from rheumatism and who are liable to constipation and to bronchitis, sulphur is a specially useful remedy, and has been long used in combination with various anti-rheumatic drugs in the confection known as 'Chelsea Pensioner' (*see* CONFECTIONS). A similarly beneficial action is obtained from the use of vegetables containing large quantities of sulphur, such as lentil soup or boiled onions.

SULPHURET OF POTASH, also known on account of its appearance as 'liver of sulphur', is used in baths for the treatment of skin diseases. (*See* SULPHUR.)

SULPHURIC ACID, or OIL OF VITRIOL, is, in its undiluted state, one of the most powerful of the mineral acids. It is a heavy, colourless liquid of oily consistence and is largely used in various manufacturing operations, so that poisoning by sulphuric acid is not uncommon. It chars any organic substance with which it is brought in contact, and acts as a violent corrosive poison. The treatment of sulphuric acid poisoning is that for corrosive poisons generally, viz. to administer weak alkalies such as baking soda, whitening, magnesia, or soap in water, and to apply oil to the injured surfaces.

Uses.—Dilute sulphuric acid, or aromatic sulphuric acid containing cinnamon and ginger, and commonly known as 'elixir of vitriol', is used in cases of diarrhœa or of internal bleeding, for its astringent properties, in doses of 5 or 20 drops well diluted in water. A lemonade is also made, containing small quantities of sulphuric acid, for use by lead-workers; since it forms an insoluble sulphate with lead, and thus prevents absorption of any lead which may be accidentally swallowed at work.

SULPHURIC ETHER is a name frequently applied to the ether used for anæsthetic purposes, because sulphuric acid is employed in its preparation. (*See* ANÆSTHETICS, ETHER.)

SULPHUROUS ACID is a gas derived from burning sulphur. It has an extremely pungent odour and strong disinfectant power. Dissolved in water mixed with glycerin it is used for application to the skin in various parasitic skin diseases.

SUMAC is a general name applied to plants of the species *Rhus* (*see* RHUS *and* POISON IVY).

SUMMER DIARRHŒA (*see* DIARRHŒA *and* INFANT-FEEDING).

SUNBURN includes the various effects produced upon the skin by the sun's rays. Similar effects are produced by exposure to the heat of furnaces, and also on the skin of those who are exposed for long periods close to electric arc lamps or X-ray apparatus. The effect produced on the skin is attributed by some entirely to heat, by others to the chemically active rays at the higher end of the spectrum. The actual changes vary greatly in different individuals, fair-haired, delicate, thin-skinned people suffering to a much greater extent, as a rule, than the strong and swarthy.

Symptoms.—In its simplest form sunburn consists in the development of dark pigment in the deeper layer of the epithelium, which gives the skin a brown hue and acts as a natural protection from the heat rays. In a severer form there are marked flushing of the skin (erythema), tingling, itching, and finally peeling off of the cuticle in flakes. This

process may be very severe, painful, and accompanied by the formation of blisters. After long periods of sunburn, the skin is apt to become permanently dry and wrinkled as well as browned.

Treatment.—Mere tanning of the skin under the sun's rays is a healthy sign which requires no treatment, but the severer forms are not only unsightly but often very painful. Prevention may be effected by the use of sunshades, veils, etc., those of a brown colour being most effective. The redness may be relieved by dabbing on an evaporating fluid such as eau-de-Cologne, elder-flower water, or rose water. The effects of heat may also be to some extent prevented by sponging the exposed parts with an astringent such as Goulard's water or hazeline, or by the ancient practice of oiling the skin, or of applying an ointment such as cold cream after a bath.

SUNLIGHT (*see* LIGHT TREATMENT).

SUNSTROKE, HEAT-STROKE, INSOLATION, COUP DE SOLEIL, and THERMIC FEVER are terms applied to the effects produced upon the central nervous system, and through it upon other organs of the body, by exposure to the sun or to overheated air. Although most frequently observed in tropical regions, this disease occurs also in temperate climates during hot weather. A moist condition of the atmosphere, which interferes with cooling of the overheated body, greatly increases the liability to suffer from this ailment.

Causes.—Sunstroke has been chiefly observed and investigated as occurring among soldiers in India, where formerly, both in active service and in the routine of ordinary duty, cases of this disease constituted a considerable item of sickness and mortality. The increased attention now paid by military authorities to the personal health and comfort of the soldier, particularly as regards barrack accommodation and dress, together with the care taken in adjusting the time and mode of movement of troops, has done much to lessen the mortality from this cause. While any one exposed to the influence of strong solar heat may suffer from the symptoms of sunstroke, there are certain conditions which greatly predispose to it. Causes which depress the health, such as previous disease, particularly affections of the nervous system—anxiety, worry, or overwork, irregularities in food, and, in a marked degree, intemperance—have a powerful predisposing influence, while personal uncleanliness, which prevents among other things the healthy action of the skin, the wearing of tight garments, which impede the functions of heart and lungs, and living in overcrowded and insanitary dwellings have an equally hurtful tendency.

Cases are of frequent occurrence among soldiers in hot climates when there is overcrowding or bad ventilation in their barracks, and sometimes several will be attacked in the course of a single night. The same remark applies to similar conditions existing on shipboard. Further, persons whose occupation exposes them to excessive heat, such as stokers, laundry workers, etc., are apt to suffer, particularly in hot seasons. In the tropics, Europeans, especially those who have recently arrived, are more readily affected than natives. But natives are not exempt.

Symptoms.—The symptoms of heat-stroke, which obviously depend upon the disorganisation of the normal heat-regulating mechanism as well as of the functions of circulation and respiration, vary in their intensity and likewise to some extent in their form. Three chief types of the disease are usually described.

(1) HEAT SYNCOPE.—In this form the symptoms are those of exhaustion, with a tendency towards fainting or its actual occurrence. A fully developed attack of this description is usually preceded by sickness, giddiness, some amount of mental excitement followed by drowsiness, and then the passage into the fainting condition, in which there are pallor and coldness of the skin, a weak, quick, and intermittent pulse, and gasping or sighing respiration. The pupils are often contracted. Death may quickly occur; but, if timely treatment is available, recovery may take place.

(2) HEAT APOPLEXY or ASPHYXIA.—In this variety the attack, whether preceded or not by the premonitory symptoms already mentioned, is usually sudden, and occurs like an apoplectic seizure. There is usually insensibility, and convulsions are frequent. Death is often very sudden. This form, however, is also amenable to treatment.

(3) ARDENT THERMIC FEVER.—This variety is characterised chiefly by the excessive development of fever (hyperpyrexia), the temperature of the body rising at such times to from 108° to 110° Fahr. or more. Accompanying this are the other symptoms of high febrile disturbance, such as great thirst, quick, full pulse, pains throughout the body, headache, nausea and vomiting, together with breathlessness. After the attack has lasted for a variable period, often one or two days, death may ensue from collapse or from the case assuming the apoplectic form already described. But here, too, treatment may be successful if it is promptly applied.

Besides these, other varieties depending on the prominence of certain symptoms are occasionally met with. The chief changes found in the body after death from heat-stroke are anæmia of the brain and congestion of the lungs, together with softness of the heart and of the muscular tissues generally. The blood is dark and fluid and the blood corpuscles are somewhat altered in shape. Attacks of sunstroke are apt to leave traces of their effects upon the constitution, especially upon the nervous system. A liability to severe headache, which in many cases would seem to depend upon a condition of chronic meningitis, epileptic fits, mental irritability, and alterations in the disposition are among the more important. It is often observed that heat in any form is ever afterwards ill borne, while there also appears to be an abnormal susceptibility to the action of stimulants. The mortality from sunstroke is estimated at from 40 to 50 per cent of those attacked.

Treatment.—Means should be adopted to prevent attacks in the case of those who must necessarily be exposed to the sun. These consist in the wearing of loose clothing and of a suitable helmet with protection to the neck and back, in due attention to the function of the skin, and in the avoidance of alcoholic and other excesses. Cold water may be drunk in small quantities at frequent intervals. Sleeping in the open air in very hot seasons is recommended. The treatment of a patient suffering from an attack necessarily depends upon the form it has assumed. In all cases he should if possible be at once removed into a shaded or cool place. Where the symptoms are mostly those of syncope and there is a tendency to death from heart failure, rest in the recumbent position, the use of diffusible stimulants, such as sal volatile or ether, etc., together with friction applied to the extremities, are the means to be adopted. Where, on the other hand, the symptoms are those of apoplexy or of hyperpyrexia, by far the most successful results are obtained by the use of cold (by pumping cold water over the head, neck, and back, the cold affusion, rubbing the surface with ice, or enemata of ice-cold water). The effect is a marked lowering of the temperature, while at the same time a stimulus is given to the respiratory function. The subsequent treatment will depend upon the nature of the resulting symptoms, but change to a cool climate is often followed by marked benefit in cases which show chronic effects of the sunstroke.

SUPER- (*super*, above) is a prefix signifying above or implying excess.

SUPERFŒTATION is the term applied to the condition in which there is fertilisation of a second ovum in a woman already pregnant.

SUPERINVOLUTION is a term applied to the process by which the womb decreases in size after childbirth, when, instead of stopping at the point when the womb reaches its usual size, more or less complete wasting away of this organ takes place.

SUPINATION (*supinatio*) means the turning of the hand with the palm upwards.

SUPPOSITORY (*suppositorius*, something introduced beneath) is a small conical mass made of fat or glycerin-jelly, and containing drugs intended for introduction into the rectum. This method of using drugs may be chosen for various reasons. For example, the suppository, as in the case of soap or glycerin suppositories, is often used to produce an aperient action. Other suppositories, such as those of belladonna or morphia, are used to quiet pain and check the action of the bowels. Others are used for the sake of their influence on neighbouring organs.

The following official suppositories are those commonly employed: suppository of tannic acid, of belladonna, of iodoform, of morphine, of phenol, and of lead with opium.

Method of use.—The suppository is placed with its pointed end against the anus and with a firm but gentle screwing movement is pushed upwards. With the point of the forefinger, it must be pushed onwards for about 1 inch, past the sphincter muscle, otherwise it will not be retained. It must be quickly introduced, as the material of which it is composed rapidly softens when brought into contact with the body.

SUPPRESSION is the name applied to a failure on the part of the kidneys to secrete urine. This is sometimes a complication of fevers or of acute nervous affections, such as meningitis, but it is chiefly found in acute Bright's disease, and leads then to the dangerous condition known as uræmia. (*See* URÆMIA.) Sometimes in children during a feverish attack the urine is almost completely suppressed for some days with little ill result. The treatment consists in the administration of diuretics (*see* DIURETICS), and in the remedies appropriate to uræmia. (*See* URÆMIA.)

SUPPURATION (*suppuratio*) means the process of pus formation. When pus forms on a raw surface, the process is called 'ulceration', while a deep-seated collection of pus is known as an 'abscess'. For more detailed information see ABSCESS, INFLAMMATION, PHAGOCYTOSIS, ULCER, WOUNDS.

SUPRA- (*supra*, above) is a prefix signifying above or upon.

SUPRAPUBIC (*supra*, above; *pubes*, the private parts) operation is one in which the abdomen is opened in its lower part, immediately above the pubic bones. (*See* LITHOTOMY.)

SUPRARENAL GLANDS (*supra*, above; *renes*, the kidneys), also known as SUPRARENAL CAPSULES, or ADRENAL BODIES, are two organs situated one upon the upper end of each kidney. Each measures about 2 inches in length from above downwards, rather less than that from side to side; and each is about a quarter of an inch thick. The two together weigh about a quarter of an ounce.

Structure.—Each suprarenal gland has an enveloping layer of fibrous tissue. Within this the gland shows two distinct parts, an outer, firm, deep-yellow, *cortical* layer, and a central, soft, dark-brown, *medullary* portion. The cortical part consists of columns of cells running from the surface inwards, while in the medullary portion the cells are arranged irregularly and separated from one another by large capillary blood-vessels. Both the blood-vessels and the nerves of the suprarenal glands are very large and numerous, considering the small size of the organs.

Functions.—It has long been known that removal of the suprarenal glands in animals is speedily followed by great muscular prostration and death in a few days. In human beings, disease of the suprarenal glands is apt to bring on Addison's disease, in which the chief symptoms are increasing weakness and bronzing of the skin. The medulla of the glands produces a substance—adrenaline—the effects of which very closely resemble those brought about by activity of the sympathetic nervous system: dilated pupil, hair standing on end, quickening and strengthening of the heart beat, immobilisation of the gut, increased output of sugar from the liver into the blood-stream. From the cortex of the gland is produced a hormone—cortin—which appears to control the metabolism of sodium and of chlorides; it is essential to life; a synthetic substance, desoxycorticosterone, produces the same physiological effects. Other cortical hormones are concerned in the metabolism of carbohydrates, and with sexual physiology.

SURAMIN (*see* GERMANIN).

SURROGATE (*surrogatus*, substituted) is a term applied in medicine to a substance used as a substitute for another.

SUSPENDED ANIMATION (*see* DEATH, SIGNS OF; *and* SLEEP).

SUSPENSORY means anything serving to hold up a part, and is a term

specially applied to bandages for the breast, testicle, and other dependent parts.

SUTURE (*sutura*, a seam) is the name given either to the close union between two neighbouring bones of the skull, or to the series of stitches by which a wound is closed. (*See* WOUNDS.)

SWAB is a term applied to a small piece of gauze, lint, or similar material used for wiping out the mouth of a helpless patient or for drying out a wound. The term is also applied to a tuft of sterilised cotton-wool wrapped round a wire and enclosed in a sterile glass tube used for obtaining matter or membrane from the throat, from wounds, etc., in order that this may be subjected to bacteriological examination.

SWEAT (*see* PERSPIRATION).

SWEAT-GLANDS (*see* SKIN).

SWEATING SICKNESS was the name given to a malady that appeared in Europe and especially in England during the fifteenth and sixteenth centuries. It was named after its most prominent symptom, appears to have been a disease of very sudden onset which caused extreme prostration, and was very fatal. There were several epidemics during the centuries mentioned, and the disease seems to have been regarded with great dread, though it is difficult to identify it with any infectious malady at present known.

SWEETBREAD is a popular term applied to several glands used for food, including the thymus gland of young animals (neck sweetbread), the pancreas (stomach sweetbread), and the testis.

SWEET SPIRIT OF NITRE, also known as SPIRIT OF NITROUS ETHER, consists of a mixture of water, alcohol, aldehyde, and various nitrous bodies. It is prepared by a complicated process of distillation from nitric acid and rectified spirit. Like other drugs containing nitrites, sweet spirit of nitre has a powerful action in checking spasm of all sorts and in dilating the blood-vessels. (*See* NITROGLYCERIN.) In certain circumstances it is a diaphoretic, causing copious perspiration and thus reducing feverishness. In other circumstances it acts as a diuretic, markedly increasing the action of the kidneys. When kept in unstoppered bottles, however, it rapidly loses strength, and, therefore, to be of any value must be used fresh.

SYCOSIS (*σῦκον*, fig) is the name given to a skin disease in which the hair follicles, especially of the chin, are inflamed, forming pustules round the hairs surrounded by a swollen and reddened area of skin. The disease occurs in debilitated persons, and is directly due to infection of the hair follicles with *Staphylococcus* or ringworm parasite. The infection is generally attributed to a barber's utensils, and the condition is sometimes known as 'barber itch', 'foul shave', or 'ringworm of the beard'. (For treatment see RINGWORM.)

SYMPATHETIC is a term applied to certain diseases or symptoms which arise in one part of the body in consequence of disease in some distant part. Inflammation may arise in one eye, in consequence of injury to the other, by the spread of organisms along the lymphatic channels connecting the two, and is then known as sympathetic inflammation. Pain also may be of a sympathetic nature. (*See* PAIN.)

SYMPATHETIC SYSTEM is that part of the nervous system from which most of the nerves that connect and regulate the various internal organs appear to take their origin. It consists of scattered collections of grey matter known as ganglia, united by an irregular network of nerve-fibres, those portions where the ganglia are placed most closely and the network of fibres is specially dense being known as 'plexuses'. The chief part of the sympathetic system consists of two 'ganglionated cords' that run through the neck, chest, and abdomen lying close in front of the spine. For further details see NERVES.

SYMPTOM (*σύμπτωμα*) is a term applied to any evidence of disease. The term 'physical sign' is generally applied to symptoms of which the patient does not complain but which are elicited upon examination. For the symptoms indicative of the various diseases see under the headings of each disease.

SYN- (*σύν*, with) is a prefix signifying union.

SYNAPSE (*σύν*, with; *ἅπτω*, I touch) is the term applied to the anatomical relation of one nerve-cell with another which is effected at various points by contact of their branching processes. The state of shrinkage or relaxation at these points (synapses) is supposed in some cases to determine the readiness with which a nervous impulse is transmitted from one part of the nervous system to another. Many drugs also are supposed to act upon the nervous system through their effect in closing or widening these junctions.

SYNCOPE (*συγκοπή*) is another name for fainting. (*See* FAINTING.)

SYNDROME (*συνδρομή*, concurrence) is a term applied to a group of symptoms occurring together regularly and thus constituting a disease to which some particular name is given, *e.g. Stokes-Adams Syndrome* of slow pulse and giddiness, forming a sign of degeneration of the heart-muscle causing heart-block; *Korsakoff Syndrome* of loss of appreciation of time and place combined with talkativeness, forming signs of alcoholic delirium.

SYNECHIA (*συνέχεια*, continuity) is the term applied to adhesions between the iris and the cornea or lens.

SYNOSTOSIS (*σύν*, together; *ὀστέον*, bone) is the term applied to a union by bony material of adjacent bones usually separate.

SYNOVIAL MEMBRANE forms the lining of the soft parts that enclose the cavity of a joint. (*See* JOINTS.)

SYNOVITIS means inflammation of the membrane lining a joint. It is usually painful and accompanied by effusion of fluid within the synovial sac of the joint. It is found in acute rheumatism, various injuries and inflammations of joints, and in chronic form in tuberculosis.

SYNTHETIC is a term applied to substances produced by chemical processes in the laboratory or by artificial building up.

SYPHILIS is a contagious and inoculable disease of slow development, which, at its commencement, shows a peculiar sore at the site of infection, later brings on constitutional effects resembling those of other infectious diseases, and at a still later period produces certain changes resembling some of those caused by leprosy and tuberculosis. Owing to the circumstances which in the majority of cases attend the spread of syphilis from one person to another, it is generally classed as one of the three *venereal* diseases. This disease affects only human beings, though it has been experimentally grafted upon the skin of apes.

The disease seems to have first attracted public attention about or soon after the year 1494 in consequence of a severe and widespread outbreak among the French soldiers then occupied in the siege of Naples. For long it was known as the Neapolitan disease, French Pox, or Great Pox; and, in consequence, probably, of the licentiousness and the want of cleanliness that then prevailed in persons and dwellings, it spread in epidemic form. Later, it came to be called syphilis, the name being derived from that of the chief character in a Latin poem published by Fracastorius in 1536. It has been suggested that the disease existed in ancient times among the natives of America, and that the infection was brought to Europe by the followers of Columbus, but there are also grounds for supposing that the disease occurred among the Eastern races in ancient times, although it was most likely confounded with leprosy and tuberculosis.

Causes.—Various bacteria have been obtained from the sores; but, owing to the regularity with which the *Spirochæta pallida*, a long, thread-like, wavy organism, is found in the earlier sores and their discharges, and the possibility of causing symptoms in animals by inoculation of this organism, it is now proved to be the direct cause. This organism was discovered to be the cause of the disease in 1905.

Syphilis may be ACQUIRED from persons already suffering from the disease, or it may be INHERITED from one or both parents. The acquired form is usually got by contact with a sore upon another person through some wound or

abrasion. The epithelium covering the general surface of the skin seems to be an efficient protection, but the infective material apparently has the power of penetrating mucous membranes. Not only may the disease be spread as a venereal affection, but cups, spoons, towels, sponges, sheets, which have been used by the diseased, have been known to convey the contagion to others, although fortunately such inanimate articles appear to retain their infectiveness only for a short time. The acquired form of the disease is infectious from contact with sores, both in its primary and secondary stages; while infants suffering from the inherited form are also highly infectious. Accordingly any one acting as wet-nurse to, or even frequently handling, such an infant runs great risk of infection, although the mother may handle it with impunity (Colles's Law).

Symptoms.—The *acquired form* of the disease is commonly divided into three stages — PRIMARY, SECONDARY, and TERTIARY, although, in many cases, the tertiary stage is wanting, while in others there is no dividing-line between the secondary and tertiary symptoms. To certain late affections, which may appear after the lapse of several years such as locomotor ataxia and general paralysis, the terms parasyphilis and QUATERNARY syphilis are sometimes applied. The disease presents great variations of intensity, being occasionally of a 'malignant' type, in which widespread ulceration speedily comes on and even causes death; and in other cases showing little more than a slight skin eruption, though probably it exerts, even in such mild cases, a highly-prejudicial effect upon the constitution. In doubtful cases of the disease the Wassermann reaction is regarded as an almost certain diagnostic feature.

The incubation period ranges from a fortnight to six weeks, though most frequently it occupies about four weeks. Then a small ulcer appears at the site of infection, which is accompanied by a peculiar 'cartilaginous' hardness of the tissues immediately round and beneath it, and characterised by its resistance to all healing treatment. This, which is known as the PRIMARY SORE, may be very much inflamed, or it may be so small and occasion so little trouble as to pass almost or quite unnoticed. A few days after this sore has appeared, the lymphatic glands in its neighbourhood, and later those all over the body, become swollen and hard. This condition lasts for several weeks as a rule, and then the sore slowly heals and the glands subside. After a variable period, which, however, may in most cases be placed at about two months from the date of infection, the SECONDARY SYMPTOMS appear and resemble the symptoms of an ordinary fever in so far as they include rise of temperature and feverishness, loss of appetite, vague pains through the body, and a faint red rash seen best upon the front of the chest. The rash may also show other characters. The Wassermann test now gives a positive reaction. Other symptoms, very frequently present at this stage, are falling out of the hair, bloodlessness, the appearance of sores in the mouth and throat (mucous patches), headache with, occasionally, mental deterioration, and painful swellings on the bones due to periostitis. There is also general enlargement of the lymphatic glands. These symptoms last for about eighteen months, and then, in the majority of cases which have been efficiently treated, they subside and the disease comes to an end, though, as already stated, it may have a permanently prejudicial effect upon the constitution. A curious feature which some cases show is that at a subsequent period of life, when the health has been brought low by overwork or worry, symptoms reappear, even although the disease seemed to have been completely cured.

In a smaller number of cases, especially those which have not been treated, TERTIARY SYMPTOMS develop after the lapse of some months or years. These consist in the growth, here and there throughout the body, of masses of granulation tissue known as 'gummata'. These gummata may appear as hard nodules in the skin, or form tumor-like masses in the muscles, or cause great thickening of bones, or they may develop in the brain and spinal cord, where their presence causes very serious symptoms. Those which lie beneath the skin or a mucous membrane may break down and form deep ulcers with characteristic, thickened, sharply cut edges. These often leave rounded brownish

scars when they heal. These gummata yield readily, as a rule, to appropriate treatment, and generally disappear speedily when this is secured.

Still later effects are apt to follow at a subsequent period of life, such as disease of the arteries, leading to aneurysm (*see* ARTERIES, DISEASES OF, *and* ANEURYSM), to apoplexy, and to early mental failure (*see* INSANITY); also certain nervous diseases, of which locomotor ataxia and general paralysis are the chief.

The *inherited form* of syphilis may affect the child before birth, leading then as a rule to miscarriage, or to dead-birth of the child, if it be born at full time. Or it may show its first symptoms a few weeks after birth, the appearances then corresponding to the secondary manifestations of the acquired form. The child, apparently at first quite healthy, begins to waste, so that its skin appears loose and wrinkled. Eruptions develop and the breathing is of a 'snuffling' character, in consequence of inflammation in the mucous membrane of the mouth and nose. Deafness is also a common result of inflammation in the delicate structures of the inner ear. On the other hand, no symptoms may appear till later in life, when the nose becomes sunken and broad at the bridge, and the eyes are dull as the result of inflammation affecting the cornea (keratitis) or iris (iritis). These changes often appear about the age of 12 or 14, causing dimness of vision. When the permanent teeth appear the central incisors are frequently notched at the edge (Hutchinson's teeth). These children are specially liable to contract tuberculosis.

Treatment.—Any person who suffers from this disease forms a source of infection to those around, and it is his duty to take precautions that he may not spread it. He should bear in mind the fact that, while the natural secretions of the body are harmless, the discharge from any sore or abraded surface is highly contagious. He should, if suffering from any sore about the lips or mouth, be most careful not to drink from any public drinking utensil, and he should never allow any one else to use his sponge or towel or to wear any of his clothes. He must remember, too, the fact that the disease is transmissible to his offspring so long as he shows any manifestation of its presence; and in this relation it is usual for physicians to forbid a person suffering from syphilis to marry till at least two years have elapsed since any sign of the disease has been present, and then only if an energetic course of treatment has been carried out.

For the cure of the disease, the general health above all things requires attention, and the subject of the disease must live a regular and healthy life as regards exercise, diet, work, and avoidance of undue exposure. The drugs possessing a special influence upon the progress of the disease are salts of mercury, and arsenobenzol compounds, which seem to be most beneficial in the earlier stages, and salts of iodine, especially iodide of potassium, which are most useful in the tertiary stage of the disease.

Preparations of mercury are administered in various ways. Thus pills of grey powder, or of calomel in small doses, are given over prolonged periods. Inunction of mercurial ointment, which is one of the oldest methods, is also one of the most efficacious. Intramuscular injections of mercurial cream, containing finely divided metallic mercury in olive oil, are also administered. Bismuth suspended in oil has recently been used instead of mercury with good results.

Salvarsan, or '606', of which the chemical name is dioxydiamidoarsenobenzoldihydrochloride, was introduced by Ehrlich in 1910. It was followed by neo-salvarsan, a preparation with less irritating and less toxic properties, and this in turn by neo-kharsivan, novarsenobenzol, novarsenobillon, galyl, silver salvarsan, tryparsamid, etc. These are administered by injection either into a vein or muscle. (*See* ARSPHENAMINE and MAPHARSEN.)

The effect of these various remedies is controlled by performing the Wassermann reaction on the blood, and in the case of affections of the nervous system, by carrying out this reaction as well as the colloidal gold test and other observations upon the cerebro-spinal fluid.

SYRINGE (σῦριγξ) is the name of an instrument for injecting liquids into passages or cavities. Syringes vary considerably in shape and size according to the purpose for which they are used. For the method of using a hypodermic syringe see HYPODERMIC. For larger

syringes the important points in construction are that the syringe should have a bulbous or cone-shaped nozzle, so that its point cannot inflict injury on the passage through which it is used; also that the syringe should be capable of disinfection.

SYRINGOMYELIA (σῦριγξ, a pipe; μυελός, the marrow) is a rare disease affecting the spinal cord, in which are found irregular cavities surrounded by an excessive amount of the connective tissue of the central nervous system. These cavities encroach upon the nerve tracts in the cord, producing especially loss of the sense of pain or of that for heat and cold in parts of the limbs, although the sensation of touch is retained. Another symptom sometimes present is wasting of certain muscles in the limbs. Changes affecting outlying parts like the fingers are also found. On account of their insensitiveness to pain, the fingers, for example, are often burnt or wounded, and troublesome ulcers, or losses of parts of the fingers, result. The condition of the spinal cord is probably present at birth, though the symptoms do not usually appear till the period of youth is reached. The disease is slowly or hardly at all progressive, and the treatment consists simply in the maintenance of general good health.

SYRUP, formed of a mixture of sugar and water, is a fluid frequently used for the administration of drugs. It is employed partly on account of its pleasant taste, and largely also because it retards changes in drugs which deteriorate on exposure to the air. The dose of most syrups is about a teaspoonful.

SYSTOLE (συστολή) means the contraction of the heart, and alternates with the resting phase, known as diastole. The two occupy respectively about one-third and two-thirds of the cycle of cardiac action.

T

TABES (*tabes*) means, literally, a wasting disease, and is an old name applied to various diseases, such as consumption, locomotor ataxia, tuberculosis accompanied by enlargement of glands, etc. At present the name *tabes dorsalis* is used for locomotor ataxia (*see* LOCOMOTOR ATAXIA) and *tabes mesenterica* is used for tuberculosis affecting the glands in the abdomen, these two diseases being, however, totally different in their nature and cause.

TABLET is the name given to a solid disc-like preparation made by compression and containing drugs mixed usually with sugar and other indifferent material. Tablets are widely used because of their convenience and accurate dosage. The word ' tabloid ' indicates a proprietary preparation.

TACHE CÉRÉBRALE (Fr.) is a sign frequently observed in meningitis. The sign consists in the production of a bright-red line of congestion when the finger-nail is drawn across the patient's skin—for example, across his abdomen.

TACHYCARDIA (ταχύς, rapid ; καρδία, the heart) is the name applied to a disturbance of the heart's action which produces great acceleration of the pulse.

TACHYPNŒA means unusual quickness of breathing.

TÆNIA (*tænia*, a ribbon) means a tapeworm. (*See* PARASITES.)

TAKADIASTASE (*see* DIASTASE).

TALC is a soft mineral consisting of magnesium silicate, which in powder gives an oily sensation to the tongue. It is much used as an ingredient of dusting powders, and is also administered internally in ulcerative conditions of the bowels.

TALIPES (*talus*, the ankle ; *pes*, the foot) is the technical name for club-foot.

TAMARIND is the preserved pulp of the fruit of *Tamarindus indica*, a West Indian tree. It contains a large amount of vegetable acid, is eaten as a confection, and for some people forms an admirable laxative.

TANNIN, or TANNIC ACID, is an uncrystallisable white or yellowish-white powder, which is very soluble in water or glycerin. It is a complicated organic acid with the empirical formula of $C_{76}H_{52}O_{46}$. It is extracted from oak-galls in large amount, but it is also present in almost all vegetable infusions. Tannic acid, when brought in contact with any mucous membrane, constringes it and diminishes its secretion. It coagulates albuminous substances and thus hardens animal food with which it is mixed, and also leads to rapid clotting of blood with which it is brought in contact. When absorbed into the circulation, it is changed into gallic acid, a substance of similar but weaker properties.

Uses.—Tannin is used largely as a styptic to apply directly to bleeding wounds or surfaces with which it can be brought in contact, as the mouth, interior of the stomach, or of the rectum, and since its action in coagulating albumin is powerful, it speedily causes a clot to form. A solution is used in a spray for burns. (*See* BURNS.) It is applied to relaxed mucous membranes, employed, for instance, in lozenges when the throat is relaxed, or applied in ointment for piles. Glycerin of tannin is also a convenient method of applying this substance as an astringent, by painting, to the throat. Tannin is used to check diarrhœa, administered either in the form of some vegetable astringent infusion, or in a chemical combination which is not destroyed in the stomach, such as tannalbin, tannigen, or tanocol.

As tannin neutralises many poisonous alkaloids, it is often administered as an antidote to vegetable poisons.

In addition to lozenges, suppositories, ointments, and glycerin of tannic acid, many vegetable astringents owe their usefulness to the tannin they contain, as, for example, catechu, kino, and rhatany.

TANSY is a preparation made from the leaves and tops of *Tanacetum vulgare*, of which the fluid extract is used as a remedy for worms.

TAPEWORM (*see* PARASITES).

TAPPING is the popular name for the withdrawal of dropsical fluid from the cavities or the subcutaneous tissues of the body. (*See* ASPIRATION.)

TAR, or PIX LIQUIDA, is a thick, dark, oily substance obtained by the destructive distillation of several species of pine-tree. It is slightly soluble in water, more readily so in alcohol, oils, and strong alkaline solutions. Other tars of similar physical and medicinal properties are obtained from other woods, as well as from coal, shale, and peat; for example, birch-tar, well known for the aroma it imparts to Russian leather. Tar is a substance of very complex chemical composition, varying not only according to the source from which it is derived, but still more with the temperature at which it has been distilled. Generally speaking, wood-tar contains resin, creosote, and turpentine in considerable quantities, also benzol, carbolic acid, acetic acid, wood-spirit or methyl alcohol, methyl-acetate, acetone, and wood-naphtha. The aniline dyes, antipyrin bodies, saccharin, and various other medicinal substances and disinfectants are obtained indirectly from coal-tar.

Action.—In consequence of the numerous medicinally active bodies it contains, tar exerts many marked effects upon the body. By reason of the creosote, carbolic acid, and methyl alcohol that it contains, it possesses a high antiseptic and preservative power. Certain of its ingredients are of an irritating nature, and tar therefore stimulates powerfully the action of any skin surface with which it is brought in contact, as well as the respiratory and other mucous membranes by which it is excreted after being taken internally.

Uses. — Bishop Berkeley in 1744 published his *Siris*, a treatise upon the virtues of tar-water, in which he extolled this substance as an almost universal remedy.

Externally, tar is one of the most efficient preservatives of animal and vegetable tissues that we possess. For its germicidal action and stimulating properties it is largely used in chronic skin diseases, particularly psoriasis and dry eczema. To this end it is employed most commonly in the form of tar ointment, rubbed in night and morning, or smeared upon a cotton cloth and worn round the affected part. An alcoholic extract known as 'liquor picis carbonis' is also used to cleanse areas of skin affected by the disease.

Internally, its chief use is in chronic bronchitis as an expectorant. It both checks excessive expectoration and renders coughing easier, while in those who suffer habitually from 'winter-cough' it is said to diminish the liability to catch cold. For this purpose it is most commonly used in the form of *tar-water*, made by shaking up one part of tar with ten of water, allowing to settle, and decanting the clear liquid. This tar-water may be taken in wineglassful doses. Syrup of tar is tar-water sweetened with sugar.

TARAXACUM, or DANDELION, is a very old remedy for dyspepsia associated with torpidity of the liver. An extract and a fluid extract are prepared from the fresh leaves and roots, and used as ingredients of pills or tonic mixtures. The fresh milky juice of the flower-stalks is also sometimes used as a remedy for warts.

TARSUS (ταρσός) is the name applied to the region of the instep with its seven bones, the chief of which are the astragalus supporting the leg-bones and the calcaneum or heel-bone, the others being the scaphoid, cuboid, and three cuneiform bones.

TARTAR is a concretion that forms on the teeth near the margin of the gum, consisting chiefly of phosphate of lime deposited from the saliva. Mixed with this are food particles, and in it flourish numberless bacteria. It is important that it should be prevented from forming by regular brushing of the teeth, or removal after it has formed, because it gives rise to wasting of the gums and loosening of the teeth, as well as to dyspepsia, bad breath, and ill-health.

TARTAR EMETIC, TARTARATED ANTIMONY, or TARTRATE OF POTASSIUM AND ANTIMONY, is a white crystalline substance, which in minute doses acts as a diaphoretic and expectorant, in larger doses (1 to 2 grains) as an emetic, and in very large quantities or in small quantities administered over a long period as

an irritant poison. It must not be confounded with cream of tartar, which is another name for bi-tartrate of potassium, a harmless substance.

For the use of tartar emetic see ANTIMONY.

When this substance has been taken in poisonous amount, it produces a strong metallic taste and soreness of the mouth and throat, followed speedily by vomiting, pain in the abdomen, and purging, and at a later stage by great depression and collapse. The treatment of acute poisoning consists of encouraging the vomiting by copious draughts of warm water, milk, flour in water, or other mucilaginous substances which have the further benefit of soothing the irritated mucous membranes. Tannin acts as a direct antidote to this poison by forming a harmless tannate of antimony, and therefore a strong infusion of tea, coffee, oak-bark, or other substance containing much tannin should next be prepared and administered.

TARTARIC ACID is almost identical with citric acid in appearance, chemical properties, and medicinal uses. Tartaric acid is obtained from grapes, while citric acid is contained in many fruits like the lemon, lime, and orange. (*See* CITRIC ACID.)

TASTE (*see* TONGUE).

TAXIS (τάξις, an arranging) is the name given to the method of pushing back, into the abdominal cavity, a loop of bowel which has passed through the wall in consequence of a rupture. The procedure consists in fixing the part of the hernia situated near the opening with one hand, while with the other hand gentle pressure is made upon the swelling. Taxis is not of so great importance now as it was at a time when surgeons feared to risk an operation upon the abdominal cavity.

TEA (*see* COFFEE AND TEA).

TEARS (*see* EYE).

TEETH are hard organs developed in connection with the mucous membrane of the mouth and implanted in the jawbones. In man they serve for biting and grinding the food, as well as aiding in speech, while in many animals they are adapted as weapons.

Structure.—Each tooth is composed of four substances: dentine, enamel, cement or *crusta petrosa*, and pulp.

DENTINE, or IVORY, makes up the greater part of each tooth, both in the crown, where it is covered by a layer of enamel, and in the fang, where it is surrounded by cement; while in the centre of the tooth it is hollowed out to lodge the pulp. The dentine is composed of an intimate mixture of animal matter and earthy matter, chiefly lime salts, in the proportion of 72 per cent of earthy, and 28 per cent of animal. When examined in thin slices, the dentine is found to consist of a dense yellowish-white substance pierced by minute tubes that run in a wavy manner from the pulp cavity, giving off branches as they go, to end under the enamel and cement. At their widest part, these tubes are about $\frac{1}{1\,5\,0\,0}$ inch across, and each lodges a fine thread-like fibril that runs out through the tooth from the pulp. In some animals the dentine closely resembles bone in structure.

ENAMEL is a brilliant white layer forming a sort of cap to the tooth. It is thickest on the cutting or grinding

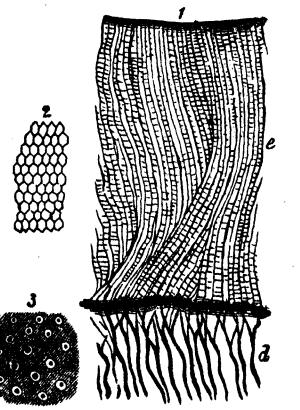


FIG. 428.—1, Vertical section through the enamel and dentine immediately beneath. *e*, Rods of enamel; *d*, ends of dentine tubes. 2, Cross-section through the enamel rods. 3, Cross-section through the dentine tubes and matrix. Magnified by 300. (Turner's *Anatomy*.)

surface and thins away towards the gum, disappearing at the neck of the tooth. It is the hardest tissue in the body and contains 96·5 per cent of earthy matter,

mainly phosphate of lime. It is composed of long rods or prisms placed side by side, with one end resting on the dentine, the other forming part of the surface of the tooth. When the tooth appears, there is a thin, horny layer,

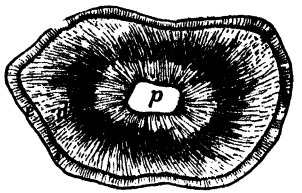


FIG. 429.—Transverse section across the crown of a tooth. *p*, Pulp cavity; *d*, dentine; *e*, enamel. Magnified by 6. (Turner's *Anatomy*.)

known as Nasmyth's membrane, or the skin of the tooth, covering the enamel, but this is speedily worn away when the teeth come into use. Indeed, in persons who live on very hard food the upper surface of the tooth may, in advanced years, be worn quite flat and the dentine exposed.

CEMENT, *crusta petrosa*, or tooth bone, is simply a thin layer of bone covering the dentine in the fang where enamel is absent.

PULP is one of the most important parts of the tooth. In structure it is soft, consisting of connective tissue, the cells which form the dentine, the blood-vessels, and the nerve-fibres derived from the fifth cranial nerve, that enter by the tip of the fang and nourish the tooth. From its cells spring the fibrils that run into the tubes of the dentine, and upon this connection the sensitiveness of the tooth depends.

Arrangement and form.—Teeth are present in most mammals and nearly all have two sets—temporary or milk teeth in early life, and permanent or adult teeth developed later. In some animals, like the toothed whales, all the teeth are similar, but in most mammals and in man there are four different shapes of teeth, viz. incisors, canines or eye-teeth, premolars or bicuspids, and molars or grinders. Each tooth possesses a *crown* which projects into the cavity of the mouth and a root or *fang* which is embedded in a socket in the jaw-bone; at the point where crown and fang join, there is usually a constriction known as the *neck*.

The shape of the teeth is adapted very much to the habits and character of their owner. Thus in rodents the incisor teeth are long, chisel-shaped, and keep on growing all the animal's life at the same rate as they are worn away

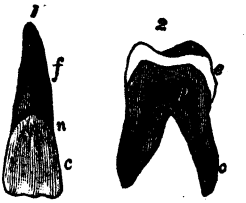


FIG. 430.—1, A human upper incisor tooth: *e*, crown; *n*, neck; *f*, fang. 2, A section through a molar tooth: *e*, cap of enamel; *c*, cement; *d*, dentine; *p*, pulp cavity. (Turner's *Anatomy*.)

by gnawing. In some animals, such as the dog and boar, the canine teeth are elongated so as to be dangerous offensive weapons. In carnivorous animals generally, the back teeth are not flat-topped grinders, but have a jagged cutting edge, so that the upper and lower teeth tear the prey like a pair of shears. In herbivorous animals, the teeth are flat-topped for crushing herbs and fruit. The elephant has peculiarly modified incisors in the upper jaw (tusks), and molars which appear one at a time; and in the

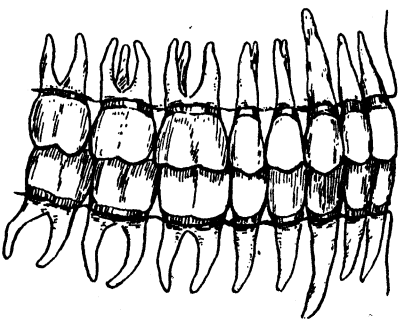


FIG. 431.—Adult teeth on right side of upper and lower jaw.

narwhal, one of the canine teeth is developed into a long spear-like organ.

In man, the shape of the various teeth indicates that they are adapted for the mixed diet that custom has found most convenient. The adult set consists of two chisel-shaped incisors in each half jaw, one pointed canine tooth, two pre-

molars, each with two cusps on the crown, and three flat-topped molars; that is, thirty-two in all. In the child, the molars have no predecessors, so that the teeth are two incisors, one canine, and two premolars in each half-jaw, or twenty teeth in all.

Development.—The first stage in the formation of the teeth consists of a groove produced in the soft connective tissue underlying the mucous membrane of the gum by the down-growth of a ridge of cells derived from the epithelium on the surface of the mucous membrane. Here and there at the bottom of this groove, papillæ of connective tissue appear, similar to those of the skin upon which hairs are developed. From each of these papillæ, ten in number in the lower jaw, and ten in the upper jaw, the pulp, dentine, and cement of a milk tooth are produced, while the caps of epithelial cells lying on the papillæ form their enamel. The neck of epithelial cells which joins the enamel of each tooth to the surface is next cut off and each tooth becomes surrounded by a sac. Finally, when the child reaches a certain age each tooth begins to develop a fang, which, as it grows, pushes the tooth out of its sac and through the mucous membrane of the gum. The permanent teeth are developed in a similar manner, and their formation commences even before the milk teeth are completely formed. When the time approaches for the milk tooth to be shed, its fang is gradually absorbed and the growing permanent tooth pushes out the crown. If this

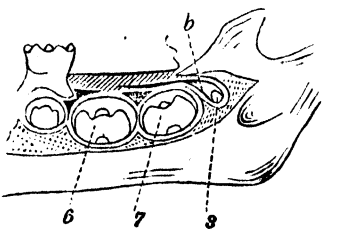


FIG. 432.—Lower jaw of a child about six years old. The hindmost milk tooth is shown with the permanent tooth ready to grow up into its place. 6, 7, 8, Permanent molars developing in their cavities. (Turner's *Anatomy*.)

process of absorption does not take place properly, the new teeth are apt to come through crooked.

Time of appearance. — The teeth appear in a definite order and at definite periods, unless delayed by disease. The order for the milk teeth is as follows:

Middle incisors	about	6th month
Lateral incisors	,,	9th ,,
First molars	,,	12th ,,
Canines (eye-teeth)	,,	18th ,,
Second molars	,,	24th ,,

As regards the permanent teeth, the first molars appear when the child is six years old, the incisors about seven and eight, the bicuspids about nine and ten, the canines about twelve, the second molars about thirteen, and the wisdom teeth frequently do not cut the gum till the age of twenty or twenty-five.

TEETH, DISEASES OF.—From the fact that the teeth are highly sensitive, that any interference with their use causes marked disturbance of digestion, and that good teeth form a highly æsthetic feature, disorders of these structures are of great importance. Only the most common disorders will be mentioned here; some conditions affecting the gums are mentioned under MOUTH, DISEASES OF; see also GUM-BOIL and NOSE, DISEASES OF.

TEETHING is a condition of irritation in the mouth that accompanies the appearance of the teeth. With infants it is apt to be specially troublesome and to give rise to such general symptoms as diarrhœa, cough, skin eruptions, and even convulsions. The source of irritation is generally quite evident, as the child continually rubs the part of his gums beneath which the growing teeth are situated. These symptoms are often aggravated when parents have delayed the vaccination of the child so long that the child is troubled by the two sources of irritation at one time. Even adults possessed of a small lower jaw sometimes suffer great pain during the cutting of the lower wisdom teeth, the reason being that there is not enough space left for the new tooth in the corner between the second molar and the vertical portion of the jaw.

Treatment.—In children, comfort is often got when the child is given some harmless object, such as an india-rubber ring, against which it can press the gums. If the gums be evidently very painful and inflamed, a few superficial scratches with a sharp knife give immediate relief, though this does not quicken the appearance of the tooth. In the young adult,

somewhat similar means may give relief, but it is occasionally necessary to extract the wisdom tooth or the tooth in front of it.

TOOTHACHE is a symptom of several affections of the teeth and neighbouring parts. The pain may vary from slight annoyance to great agony, and it often comes on at fairly regular intervals.

Causes.—Much the commonest cause of toothache is caries or decay affecting one or more teeth, particularly when the cavity in a tooth reaches near to or exposes the pulp. Gumboil, consisting of an inflammatory condition connected with the root of the tooth, which often proceeds to the formation of an abscess, is another cause of dull, throbbing pain. (*See* GUMBOIL.) The want of effective cleansing of the mouth, leading to the presence of acid secretion on the gums and between the teeth, which eats gradually into the enamel, is another cause of very annoying though less severe toothache. Certain general causes also, especially digestive disturbances, general debility, and pregnancy, render persons much more liable to suffer from toothache than when they are in ordinary health. Given some of these conditions, an attack of toothache is started by exposure to cold, a hot drink, or some sweet or acid article of food.

Treatment.—The careful avoidance of the above causes, and particularly the prevention of decay, will relieve persons who are liable to attacks of toothache (*see below*). During an attack of toothache affecting a whole row of teeth relief can often be obtained by rinsing the mouth with warm bicarbonate of soda solution. If a tooth with a large cavity be affected, the pain can generally be at once eased by filling the hole with a small piece of cotton-wool dipped in pure carbolic acid, or in an essential oil, such as oil of cloves, or in a mixture of chloral and menthol. In any case, pain can be temporarily abolished by an injection, with a hypodermic syringe, of novocain into the space between the root of the tooth and the jaw. A dose of Epsom salts is also beneficial. If the tooth be so far decayed as to be useless for chewing, it should be extracted. When the toothache is due, however, to general debility, tonic remedies give relief. (*See also* NEURALGIA.)

CARIES OF THE TEETH is an extremely common condition among civilised peoples, and is most frequent in childhood and early adult life. It has been found that between 70 and 90 per cent of all children attending school have at least one carious tooth, while from 12 to 20 per cent show advanced dental disease.

Causes.—The direct cause of caries is attributable to micro-organisms which flourish in the food particles and tartar on the teeth, and which produce acids that dissolve their lime salts. In some persons, however, the teeth decay much more readily and more quickly than in others. This is in many cases due to bad quality of the teeth, in others due to overcrowding or a bad arrangement in the jaw which allows food particles to accumulate between the teeth and prevents their cleansing, or which prevents opposing teeth from meeting one another properly in chewing. Decay rarely appears on free, smooth surfaces that are exposed to the rubbing of the lips and tongue and the scouring of the food; nor among primitive peoples who subsist on coarse food that requires a great deal of chewing. It begins usually in some groove or pit in the enamel or between the teeth, and when the process has made a small opening through the enamel it may spread widely in the dentine, so that the first sign the person gets, apart from discoloration of the tooth, may be its sudden caving in during a meal. For this reason the teeth should be carefully inspected by a dentist once or twice every year.

Treatment.—In early life the provision of suitable and sufficient food is of great importance in forming strong teeth. The prevention of caries, though not always successful, may be greatly assisted by constant care of the teeth. This consists mainly in cleansing the teeth with a soft brush morning and night, especially at night, and, if food particles tend to collect between the teeth, in removing these at the same time with a quill toothpick or with a thread of floss-silk. A chalk tooth-powder should be used as this substance both scours the teeth and neutralises the acid mentioned above. Various alkaline and antiseptic tooth-pastes are also useful in preventing decay. Substances like charcoal, which impart a brilliant polish to the teeth, should not

be often used, since they scratch the enamel and help to erode it. Persons taking medicines containing acids, like some of the iron preparations, should rinse the mouth out with water immediately after each dose. The question of food is important, especially in children. The chewing of hard foods scours the teeth and stimulates the circulation in the jaw and gum. It is important, also, for the child, and for the pregnant mother, to have foods with calcium salts in them, such as milk, cheese, and green vegetables. For the calcium to be of use to the body, vitamin D is necessary, which is present in eggs, milk, butter, liver and fish-liver oils.

IRREGULARITY OF THE TEETH, when the permanent set appears, may be due to defective development of the jaw, to a highly arched palate, or very often to slowness in casting off the temporary set. Slight irregularities disappear as the jaw grows, but if the deformity be great, much may be done to remedy it by judicious extraction of some teeth and by wearing an elastic apparatus in the mouth which maintains a steady pressure upon others.

LOOSENING OF THE TEETH may be due to accident, to wasting of the gums in consequence of the irritation set up by tartar on the teeth, or to the degenerative processes of advancing age. A tooth knocked out by injury may be washed and replaced in its socket, when it will usually again become firmly fixed, and the same is true of teeth which have been merely loosened. When the gums are receding and the teeth loosening in consequence of a deposit of tartar and inflamed gums, the tartar should be removed by a dentist and some antiseptic mouth-wash used.

INFLAMMATION OF THE GUMS (gingivitis) is a chronic condition affecting chiefly middle-aged persons and more common in women than men. The gums are congested, often bleed either when food is chewed or when the teeth are brushed, and frequently show a certain amount of ulceration and purulent discharge at their edges. There is a considerable amount of tenderness leading to solid food being swallowed without proper chewing, and hence producing dyspepsia. Tartar at the same time collects on the teeth and the inflammation in severe cases spreads to the palate and the interior of the cheek. Various bacteria and spirochætes are found on the inflamed parts. At a later stage, the gums waste and their margins shrink away from the teeth, leaving the necks of these exposed. The person whose teeth show either of these changes generally suffers from indigestion and frequently from diarrhœa and has a considerable degree of anæmia. There is, however, no discharge of pus from the sockets of the teeth, a condition which distinguishes this disease from pyorrhœa. The tartar should be carefully scraped from the teeth and a mild antiseptic mouth-wash should be used daily. The gums should be regularly brushed with a soft tooth-brush and antiseptic aromatic tooth-paste, or, if too tender for this, should be wiped with tincture of myrrh on a pledget of cotton-wool. Daily massage of the gums with the fingers improves the circulation in the gums and their nutrition.

PYORRHŒA ALVEOLARIS, or RIGG'S DISEASE, is a condition of suppuration within the sockets of the teeth, in which large quantities of pus are produced round the teeth and are constantly swallowed with the food, so that increasing ill-health results. The condition is often confused with the much milder state of inflammation of the gum-margins, known as gingivitis.

Cause.—This is not known, though in some cases it is attributed to the presence of an amœba, similar to that of dysentery, within the tooth sockets. The condition is associated with various diseases in which there is marked loss of vitality, like pernicious anæmia and chronic inflammation of joints.

Treatment consists in the use of measures which improve the general health, careful dental attention, and the regular use of antiseptic mouth-washes, particularly peroxide of hydrogen.

INFLAMMATION OF THE TOOTH FANG (periodontitis) is a condition which may be present in various degrees. There may be simple acute inflammation following a blow on the tooth; less acute inflammation due to the presence of an imperfect stopping; and in the severest form pyorrhœa.

Symptoms.—There is pain and inflammation in a tooth or teeth without any obvious cause in the form of decay.

Tenderness is present when the affected tooth is touched, and especially when the tooth is used for biting. The tooth usually appears to the individual to stand up a little higher than the other teeth and congestion is often visible in the neighbouring gum. Such a condition may come and go for a long time. If an X-ray photograph is taken of the teeth, a clear or rarified area may be seen round the fang or as a small rounded area at its tip (*root abscess*). This condition is believed to have a considerable effect of a harmful nature upon the general constitution, leading to rheumatic changes in the joints and occasionally to inflammation in serous membranes such as on the valves of the heart. In some cases, when the inflammation of the tooth sockets is caused by bacteria whose products have a destructive action on the blood corpuscles, severe anæmia is a result. This condition may at times cure itself by the formation of an acute abscess, which distends the socket and bursts through the gum (*see* GUMBOIL), or it may remain for many years and ultimately develop into the condition of pyorrhœa.

Treatment.—In early stages, painting the gum with weak tincture of iodine or other counter-irritant is sufficient to abate inflammation, but the tooth may require to be extracted. In more advanced conditions a certain amount of extraction of the teeth is necessary. All decayed teeth which cannot be satisfactorily stopped, all roots which have lost their crown, and all teeth which are unopposed in the opposite jaw or which show a considerable amount of pyorrhœa should be extracted. The other teeth should be treated by the application of antiseptic lotions night and morning. Vaccines prepared from the tooth sockets are sometimes used, and the mouth should be kept clean by the use of an aromatic mouth-wash. The general condition of the patient as regards dyspepsia and anæmia, often requires considerable attention also.

TELANGIECTASIS means an abnormal dilatation of arterioles and capillaries, forming sometimes a tumor or TELANGIOMA.

TELEGRAPHIST'S CRAMP is a form of habit spasm which occurs in persons habitually using a telegraph key and generally takes the form of inability to produce the combination of dots and dashes necessary to make certain letters (*See* CRAMP.)

TELLURITE TEST (*see* MANZULLO'S TELLURITE TEST).

TEMPERAMENT (*temperamentum*), is a term that includes those vague general peculiarities of mind and body that render some persons more liable than others to be affected by particular diseases. (*See* CONSTITUTION, IDIOSYNCRASY, IMMUNITY, *and also* ALCOHOLISM, HYSTERIA, INSANITY, NEURASTHENIA.)

TEMPERATURE (*temperatura*) of the body is a subject of great importance and will be dealt with here. For the proper temperature of rooms, baths, etc., see NURSING; BATHS; COLD, USES OF.

Animals are generally divided as regards their temperature into two classes, viz. *cold-blooded animals*, including reptiles, amphibians, fishes, and invertebrates generally, whose temperature varies to a great extent according to that of the surrounding medium; and *warm-blooded animals*, including mammals and birds, whose temperature remains almost constant, no matter how the surrounding temperature falls or rises. In warm-blooded animals, this constancy of body temperature is effected by a perpetual balancing of the various forces which produce heat and give off heat. The chief heat producer in the body is the oxidising action that takes place on muscular contraction, and the chief cooling agents are the skin and lungs, which act by the exposure of the blood circulating in them to the air, and by the evaporation of moisture from their surfaces. The temperature of different warm-blooded animals varies considerably, being high in birds, viz. about 105° to 107° Fahr., while in man it is somewhere between 98° and 99° Fahr. It varies in different persons, but is generally stated at about 98·4° Fahr. or 37° C. in man. Even in a given healthy individual the temperature is constantly changing, and may vary by 1° or 2° Fahr. in the day, being lowest in the early morning and highest in the evening. The chief reason for

this change is to be found probably in the variations as regards activity at different periods of the day. The temperature also varies in different parts of the body, that of the skin being about half a degree lower than that taken within the hollow organs of the body; and in stout people this difference between the surface and the interior is still more marked. In parts exposed to cold or provided with a feeble blood supply, such as paralysed limbs, the temperature may sink very low.

Temperature in disease.—The maintenance of a nearly equal temperature is the result of a constant process of balancing between heat-production and heat-loss, controlled probably by a special centre in the nervous system. In disease, one or other of these processes may be impaired or the controlling mechanism may be thrown completely out of gear. The general temperature may rise as high as 110° Fahr., or sink to 90° for a time; but the risk to life is great when it passes above 106° or below 95°.

Fall of temperature may be due to many causes. Thus it generally accompanies great loss of blood, starvation, and the collapsed condition which sometimes results from severe attacks of fever, peritonitis, and other devitalising acute diseases. Certain chronic diseases are generally accompanied by a subnormal temperature; of these myxœdema, diabetes, and Bright's disease are the most outstanding.

Rise of temperature is a characteristic of acute diseases, and of diseases due to micro-organisms, the poisonous products of which lead to increased waste of the tissues. Injuries to the nervous system, even unpleasant sensations in children and nervous people, may have a similar effect. In persons dying in a feverish condition, the temperature often rises very high immediately before death, owing probably to failure of the circulation and other conditions which diminish the body heat. Rapid rise of temperature in such a case is therefore a very ominous sign.

Many diseases have a characteristic course of temperature, so that in hospital a glance at the temperature chart is often sufficient to acquaint a physician with the disease from which the patient is suffering. Thus advanced consumption, pneumonia, enteric fever, measles, and malaria show, as a rule, quite recognisable temperature records. Characteristic temperature charts are given under the headings of these diseases.

High temperature in some diseases is a much less serious feature than in others. Thus in enteric fever or pneumonia 105° Fahr. is an ordinary temperature, while in rheumatic fever and diphtheria the temperature generally ranges between 101° and 103°, so that in these diseases a temperature of 104° gives cause for anxiety.

In most diseases the temperature gradually abates as the patient recovers, but others, for example pneumonia and typhus fever, end rapidly by a *crisis* in which the temperature falls, perspiration breaks out, the pulse becomes slower, and the breathing quieter. The reason for the sudden change lies probably in the fact that in favourable cases, after the disease has lasted a certain time, the resisting power of the body becomes able fully to neutralise the poisons produced by the organisms of the disease. This crisis is often preceded by an increase of all the symptoms, including an 'epicritical' rise of temperature.

Record of temperature.—Temperature is generally measured by a thermo-

FIG. 433.—Clinical thermometer.

meter, those intended for clinical use possessing a long, narrow bulb, an index registering from 95° to 110°, and being so made that the column of mercury does not fall back into the bulb till it is shaken down.

There are two scales in common use, the Fahrenheit scale, generally employed in Great Britain and in the United States, and the Centigrade or Celsius scale, used on the Continent of Europe. The difference consists in this, that in the Centigrade scale the freezing-point of water is marked 0° and the boiling-point 100°, while in the Fahrenheit scale these are 32° and 212° respectively. Accordingly 100 divisions on the Centigrade scale are equivalent to 180 divisions on the Fahrenheit scale, and 1 degree C. equals 1·8 degrees Fahr. To convert from degrees Fahr. to degrees

C. the following formula may be used:

$$n^\circ \text{ Fahr.} = [(n - 32) \times \tfrac{5}{9}] \text{ C.},$$

and to convert from degrees C. to degrees Fahr. the following:

$$n^\circ \text{C.} = [(n \times \tfrac{9}{5}) + 32] \text{ Fahr}$$

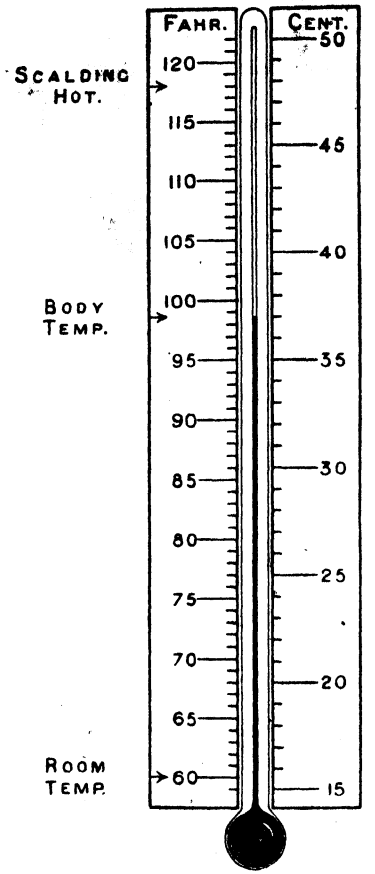


FIG. 434.—Thermometer scale ranging from room temperature to that of water used for douches, etc., and showing the corresponding points upon Fahrenheit and Centigrade scales.

For examples:

$$98{\cdot}6^\circ \text{ Fahr.} = [(98{\cdot}6 - 32) \times \tfrac{5}{9}] = 66{\cdot}6 \times \tfrac{5}{9}$$
$$= 37^\circ \text{C.}$$

$$38^\circ \text{ C.} = [(38 \times \tfrac{9}{5}) + 32] = 68{\cdot}4 + 32$$
$$= 100{\cdot}4^\circ \text{ Fahr.}$$

The Réaumur scale, in which the freezing-point is 0° and the boiling-point 80°, is also used in some countries, *e.g.* France, though not for scientific purposes.

As to the part of the body where temperature is taken, the armpit is preferable if time be no object. The skin should be wiped dry, the bulb of the thermometer placed as high as possible, and the arm tightly folded across the chest. To obtain a correct reading, it is necessary to leave the thermometer in place for at least 5 minutes, because the skin surfaces do not at once represent the internal temperature of the body. The mouth may also be used, the bulb of the thermometer being placed beneath the tongue. A more correct reading is thus obtained in a shorter time. The instrument must be carefully washed with cold water before use, so that it does not convey infection, and the patient must be directed to keep the mouth shut and breathe through the nose. Occasionally, and especially in

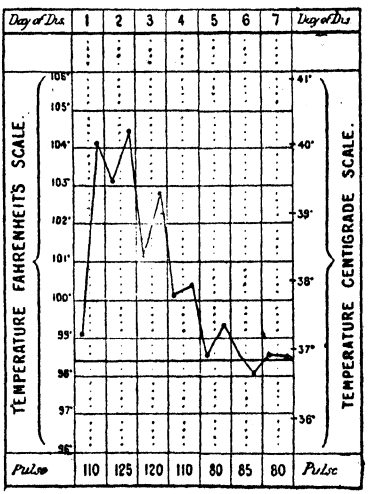


FIG. 435.—Temperature chart from a case of scarlatina, showing the method of registering the temperature.

infectious cases, the temperature is taken by inserting the thermometer bulb about 2 inches into the rectum, a method which gives the most correct result of all.

To keep a record, a piece of paper ruled with vertical lines to represent

the periods at which the temperature is taken, and with horizontal lines corresponding to degrees, is used. A large dot is marked in the proper place each time the temperature is taken and the successive dots are afterwards joined by straight lines.

Treatment of high temperature is mentioned under ANTIPYRETICS ; COLD, USES OF ; and FEVER.

TEMPLE (*tempus*) is the name given to the side of the head above the line between the eye and ear. The term temporal is applied to the muscles, nerves, artery, etc., of this region. The hair usually begins to turn grey first at the temples and the degree of tortuosity which has appeared in the temporal artery is a general measure of the degree to which degeneration has taken place in the arteries generally, and, therefore, in the vital capacity of the person concerned.

TENDERNESS is the term usually applied in medical nomenclature to pain experienced when a diseased part is handled, the term ' pain ' being reserved for unpleasant sensations felt apart from any manipulation.

TENDON (*τένων*), SINEW, or LEADER is the cord that attaches the end of a muscle to the bone or other structure upon which the muscle acts when it contracts. Tendons are composed of bundles of white fibrous tissue arranged in a very dense manner, and are of great strength. Some are rounded, some flattened bands, while others are very short, the muscle-fibres being attached almost directly to the bone. Most tendons are surrounded by sheaths lined with membrane similar to the synovial membrane lining joint-cavities. In this sheath the tendon glides smoothly over surrounding parts. The fibres of a tendon pass into the substance of the bone and blend with the fibres composing it. One of the largest tendons in the body is the ' tendo Achillis ', which attaches the muscle of the calf to the calcaneum or heel-bone.

TENDOVAGINITIS means inflammation of a tendon and of the sheath enveloping it.

TENESMUS (*τεινεσμός*) is a term applied to a symptom of disease affecting the lower part of the large intestine, such as dysentery, piles, or tumor. It consists of a constant sense of weight about the lower bowel and desire to go to stool, coupled with straining at stool and the passage of little but mucus and perhaps some blood.

TENNIS ELBOW (*see* ELBOW).

TENO- (*τένων*, tendon) is a prefix denoting some relation to a tendon.

TENOSITIS means inflammation of a tendon.

TENOTOMY (*τένων*, a tendon ; *τέμνω*, I cut) means an operation in which one or more tendons are divided, usually with the object of remedying some deformity. The operation is, in general, a slight one.

TENTORIUM (*tentorium*, tent) is the name of a wide process of dura mater forming a partition between the cerebrum and cerebellum and supporting the former.

TENTS (*tendo*, I stretch) are instruments used for dilating narrow openings. The tent consists of some substance, like sea-tangle or sponge, which shrivels up when dried, and expands powerfully as it absorbs moisture. It is introduced dry into the opening it is to dilate, and expands in the course of some hours without producing pain.

TERATOMA is the term applied to any one of a group of tumors that may form in the body and consist of partially developed embryonic tissues.

TERCININ (*see* PATULIN).

TEREBENE is a clear, colourless fluid, with an odour like fresh pine sawdust, prepared by the action of sulphuric acid upon turpentine. It is used as an expectorant in bronchitis, and also in dyspepsia with the view of checking fermentation and vomiting. The dose is 5 or 15 drops upon sugar or taken in capsule.

TEREBINTHINA is the Latin name for turpentine.

TERPIN is a product obtained by the action of strong acid on oil of turpentine and alcohol, and known also as turpentine camphor.

TERPINOL is an aromatic liquid obtained by the action of strong acid on terpin and used in various lung affections in doses of 1-5 minims.

TERTIAN FEVER (*tertianus*, belonging to the third day) is the name applied to that type of malaria in which the ague-fit reappears every other day. (*See* MALARIA.)

TERTIARY (*tertius*, third) is a term applied to the later manifestations of syphilis.

TESTICLE.—The testes or testicles are the two male sexual glands. Each is developed in the corresponding loin, but before birth they descend through openings in the lower part of the front of the abdomen into a fold or pouch of skin known as the scrotum. This fold is strengthened by a layer of muscle-fibres and fibrous tissues, and within it each testicle possesses a separate covering known as the tunica vaginalis. This tunic is a double layer of serous membrane similar in structure to the peritoneum or pleura, and it is derived from the peritoneum while the testicle is still within the abdomen. Occasionally, as the result of defective development, a more or less open channel of communication is left between the peritoneum and tunica vaginalis, and down this channel a hernia is liable in childhood or later to take place. Throughout life, the openings in the abdominal wall remain, but these 'inguinal canals' should be just large enough to allow the passage of the two spermatic cords, each of which is composed of the vas deferens or duct of the testicle, together with the blood-vessels, nerves, and lymphatics proceeding to the gland. Within the tunica vaginalis lies a dense fibrous coat known as the tunica albuginea, which affords protection to the gland. On microscopic examination, each testicle is found to consist of a series of minute tubes from eight hundred to one thousand in number, supported by fibrous tissue in which the nerves and blood-vessels run, and lined by cells from which the spermatozoa are formed. These tubes communicate with one another near the centre of the testicle, and are connected by a much-convoluted tube, the epididymis, with the vas deferens, which enters the abdomen and passes on to the base of the bladder. This duct, after joining a reservoir known as the vesicula seminalis, opens, close to the duct from the other side of the body, into that part of the urethra which is surrounded by the prostate gland. Owing to the convolutions of these ducts leading from the testicles to the urethra, and their indirect route, the passage from testicle to urethra is over twenty feet in length. In addition to producing spermatozoa, the testicle also forms an internal secretion which is responsible for the development of male characteristics. This hormone has been isolated and is known as testosterone.

TESTICLE, DISEASES OF. — The pouch of skin in which the testicles lie is liable to various general skin diseases, but particularly to eczema, which is in many cases very irritable and very difficult of cure. Cancer of the skin in this region seems to be specially common among chimney-sweeps, the result, it is supposed, of some irritating substance contained in soot. Hernia, which in some cases passes into the scrotum, is treated under a special heading. Sometimes, owing to defective development, the testicles are retained within the abdomen, and in that case these glands are likely to be atrophied and useless as well as painful.

HYDROCELE is a local dropsy affecting one tunica vaginalis, and distending that side of the scrotum with fluid. (*See* HYDROCELE.)

VARICOCELE is a condition in which the veins of the spermatic cord, especially on the left side, become unusually numerous and distended, the causes being much the same as those of varicose veins in other parts. The chief symptom is a dragging sensation in the testicle, which in some cases becomes at times very painful. This symptom is specially marked in warm weather and after exertion, the mass of veins at such a time becoming very distinct and resembling a 'bag of worms', though they empty quickly when the person lies down. Cold sponging of the part, careful regulation of the bowels, and the support of a suspensory net bandage afford all the treatment that is necessary in most cases; but an operation may sometimes be advisable.

INFLAMMATION of an acute type (orchitis) may arise in persons suffering from cystitis, stone in the bladder, and various forms of inflammation in the urinary organs, the most common cause of all being gonorrhœa. It may follow also upon some cases of mumps. The symptoms are intense pain and swelling with redness of the skin over the affected testicle; and the usual treatment consists of rest in bed, the application of opium fomentations, suppositories of morphia, and administration of a saline purgative. In some cases the condition goes on to the formation of an abscess which bursts through the skin with immediate relief of pain. The condition is then treated as an abscess elsewhere.

TUBERCULOSIS comes on in the testicle occasionally, especially when some other organ, such as the bladder, is already the seat of the disease. It causes practically no pain, and is therefore often far advanced before it attracts attention. In cases where no other organ is affected, the testicle is usually removed in order to prevent the spread of the disease to other parts of the body.

INJURIES of the testicles are rare. A severe blow may lead to shock and symptoms of severe collapse for a time, and may cause an effusion of blood into the tunica vaginalis. These symptoms are, however, relieved by rest in bed.

TEST MEAL is a term applied to a meal given for the purpose of testing the digestive powers and is of several varieties. *Ewald test meal* consists of 2 rolls or slices of bread or toast together with 10 oz. of tea with sugar but without milk. *Boas test meal* is a tablespoonful of oatmeal in a quart of water boiled down to 1 pint. *Leube-Riegel test meal* consists of 12 oz. of soup, 4 oz. of minced steak, 2 oz. of white bread, and 6 oz. of water. The two simpler meals are drawn off by a stomach tube within one hour after they have been taken and are tested for the presence of acids, ferments, etc. For the fractional test a thin tube (duodenal tube) is passed into the stomach immediately before the meal is taken and small quantities of the contents are drawn off every 15 or 30 minutes and tested similarly. The *Boas test meal* is used for this purpose.

TESTOSTERONE is the name given to the male sex hormone secreted by the testes. It has also been prepared synthetically and has a formula $C_{19}H_{28}O_2$. In true eunuchoid conditions it has the power of restoring male sexual characteristics.

TEST-TUBE is a tube of thin glass closed at one end, which is used for observing chemical reactions or for bacterial culture.

TETANUS (*τέτανος*), or LOCKJAW, is a disorder of the nervous system, consisting in a greatly increased excitability of the spinal cord and manifesting itself by painful and lengthened spasm of the voluntary muscles throughout the body. The disease was well known in former wars, and Hippocrates (400 B.C.) refers to its rapidly fatal character.

Causes.—The onset of the disease generally follows a wound, especially a deeply punctured, lacerated, or gunshot wound, usually appearing some 4 or 5 days after the wound has been inflicted, although it may be delayed for 3 or 4 weeks, by which time the wound is likely to be completely healed up. Cases in which no wound is discoverable when the tetanus appears, used to be known as *idiopathic tetanus*, but it is probable that in every case there is some breach of the surface, however small it may be. The presence in a wound of some foreign body, such as a splinter of wood or a portion of a bullet, seems to favour the onset of tetanus.

The direct cause of tetanus was discovered in 1889 by Kitasato, a Japanese observer, to be a bacillus. This bacillus has a very characteristic appearance, being long and bearing often at one end a large spore which gives to it a 'drumstick' outline. It inhabits earth and dust, living especially a little distance below the surface in places where the manure of horses and cattle is collected. Hence it is found especially in the neighbourhood of stables, and is liable to infect wounds soiled with earth. The bacillus develops a poison or toxin in the wound, and this, being absorbed, appears to find its way up the motor nerves to the spinal cord, which it renders excessively sensitive, so that its cells are excited by mild stimuli that under ordinary conditions would produce no reaction. After death, patients

who have died of tetanus show very few lesions except congestion of the brain and spinal cord and degenerative changes in the cells of the latter.

Symptoms.—There is an incubation period usually of four or five days following the wound. Cases which develop very seriously have as a rule a short incubation period, and, if the incubation period is delayed for ten days or more, the chances are that the attack of tetanus will not be fatal. The first signs of the disease usually show themselves as stiffness in the muscles near the wound, followed later, no matter where the wound is situated, by stiffness about the muscles of the jaw, causing difficulty in opening the mouth, which soon increases to *lockjaw* or trismus. This is accompanied by spasm in neighbouring muscles, and the drawn features and exposed teeth give to the countenance the peculiar expression known as *risus sardonicus*. The rigidity extends to the muscles of the neck, back, chest, abdomen, and extremities, and the body frequently assumes a bent attitude, either backward (*opisthotonos*), forward (*emprosthotonos*), or laterally (*pleurosthotonos*). This general muscular rigidity, which at first is not constant but occasionally undergoes relaxation, is accompanied by frequently recurring convulsive seizures, which are readily excited by the slightest irritation, such as from a draught of cool air, a bright light, the closing of a door, etc. In such attacks there is great suffering and the expression of the face is indicative of agony. The function of respiration may be seriously involved and asphyxia threaten or actually take place. The temperature of the body sometimes rises to a high degree, and copious perspiration is also a constant symptom. These acute symptoms may subside after a few days and the patient gradually recover. More frequently the symptoms increase in severity and death ensues either by asphyxia from prolonged spasm of the respiratory muscles, or exhaustion consequent on the violence of the symptoms, together with the absence of sleep. Throughout the whole course of the disease, the mind is clear, and the patient waits with anxiety for the next convulsive attack. In milder cases the symptoms are less severe, the course more chronic, and recoveries more common.

Tetanus sometimes occurs in new-born children showing itself within a week of birth by obvious difficulty in the acts of sucking and swallowing; by the supervention of lockjaw, together with prolonged contraction of the muscles of the limbs and body, accompanied by convulsive seizures. *Local cases* of tetanus occur in which the muscles of a limb in the neighbourhood of the wound show spasms, but these do not become general, or they pass off after appearing to a slight extent. Such cases often show stiffness for several months.

The symptoms of strychnine poisoning bear a strong resemblance to those of tetanus, but in the former case they are more acute, less prolonged than the spasms of tetanus, come on after something has been swallowed, and end either in death or in recovery within a few hours. Hydrophobia, too, resembles tetanus.

Treatment.—Tetanus tends especially to follow wounds infected by stable refuse, by street dust, or by the deeper soil thrown up by shells on the battlefield. All wounds exposed to infection in this way should be carefully purified.

An antitoxic serum has been prepared, and its use has been attended by great benefit in the case of operations upon animals, like the horse, which are liable to contract tetanus. In human beings, however, the results of its injection for the cure of tetanus have been less successful, due to the fact that the disease has usually obtained a firm hold upon the nervous centres before marked symptoms appear and call for the use of the antitoxin. To be of any use this serum must be injected at the earliest possible moment. The usual preventive practice during the Great War was to inject 500 units of the serum as soon as possible after a wound had been sustained in circumstances likely to cause tetanus, and to follow this by a similar dose each week for a month. If symptoms of tetanus appear, much larger doses are given into the muscles near the wound, the nerve trunks, and especially into the spinal canal. In the war beginning September 1939, the armed forces were in large numbers injected with a prophylactic dose of tetanus toxoid.

Various drugs, which diminish the reflex excitability of the spinal cord and relax spasm, help in relieving the

patient's sufferings and in carrying him over the period during which the toxin of the disease is being excreted. Chloroform or ether inhalation may be used for this purpose. Chloral hydrate and bromide of potassium are among the most useful agents which can be employed, and must be given in very large doses. Quietness around the patient, a darkened room, and the absence of all noise and excitement are of great importance in preventing convulsions, and the patient must receive fluid nourishment of a stimulating character.

TETANY (Fr. *tétanie*, from τέτανος) is a comparatively slight and passing malady consisting of localised muscular spasms, brought on in persons, especially children, of nervous temperament by such causes as rickets, teething, convalescence from acute disease, and dyspepsia. Occasionally, however, it forms a serious malady. The administration of extract of the parathyroid glands is believed to have a beneficial influence on the symptoms of this malady.

TETTER is a vague name for skin diseases of the eczema type.

THALAMENCEPHALON, also known as the INTERBRAIN or TWEENBRAIN, is the part of the brain lying below the cerebrum, around the third ventricle and containing the optic tracts, the grey matter of the optic thalami, the infundibulum, pineal body, and other parts.

THEINE is the alkaloidal principle which gives to tea its stimulating properties. (*See* CAFFEINE.)

THENAR EMINENCE (θέναρ) is the name given to the projecting mass at the base of the thumb.

THEOBROMINE is the alkaloidal principle upon which the stimulating action of cocoa and chocolate depends. (*See* CHOCOLATE *and* DIURETIN.)

THEOPHYLLINE is a substance combined with sodium acetate to form a white powder, also known as theocin sodium acetate, which is used in cases of dropsy due to heart disease in doses of 2 to 5 grains.

THERAPEUTICS (θεραπευτική) is the general name applied to the science and art of healing.

THERAPY (θεραπεία), means the treatment of disease.

THERIAC (θηριακή, an antidote to bites) means an antidote or substance given to neutralise poison. The name was specially given to Venice treacle, a celebrated mixture of 64 drugs prescribed in olden times as an antidote for poisons and a preventative of disease.

THERMO- (θέρμη, heat) is a prefix implying some relation to heat.

THERMOMETER SCALES (*see* TEMPERATURE).

THERMOPHORE (θέρμη, heat; φέρω, I bear) is the name applied to a box or rubber bag filled with a mixture of glue, acetate of soda, chloride of soda, and sulphate of calcium. When it is placed in hot water for some time it has the property of retaining its heat for several hours and is used as a warm application.

THIAMINE, or ANEURIN, is another name for vitamin B1 (*see under* VITAMINS).

THIAZAMIDE is a proprietary term for SULPHATHIAZOLE.

THIERSCH'S GRAFT is the term given to a method of skin grafting in which strips of skin are shaved from a normal area and placed on the abnormal area to be grafted.

THIGH is the portion of the lower limb above the knee. The thigh is supported by the femur or thigh-bone, the longest and strongest bone in the body. This fits by a rounded head at its upper end into the acetabulum, a hollow at the side of the pelvis, and at the lower end two large rounded condyles or knuckles rest upon the head of the tibia, and, along with the patella or knee-cap, form the knee-joint. A large four-headed muscle, the quadriceps, forms most of the fleshy mass on the front and sides of the thigh and serves to straighten the leg in walking and to maintain the erect posture of the body in standing. At the back of the thigh, lie the hamstring muscles; and on the inner side the adductor muscles, attached above to the pelvis and below to the femur, pull the lower limb inwards. The large femoral vessels emerge from the abdomen in the middle of the groin, the vein lying to the inner

side of the artery. These pass downwards with an inclination inwards deeply placed between the muscles, and at the knee they lie behind the joint. The large internal saphenous vein lies near the surface and can be seen towards the inner side of the thigh passing up to the groin where it joins the femoral vein. The anterior crural nerve accompanies the large vessels and controls the muscles on the front and inner side of the thigh, while the great sciatic nerve, about the thickness of a lead pencil, lies close to the back of the femur and supplies the muscles at the back of the thigh and muscles below the knee.

Deep wounds on the inner side of the thigh are dangerous by reason of the risk of damage to the large vessels. Pain in the back of the thigh is often due to inflammation of the sciatic nerve (*see* NEURALGIA). The veins on the inner side of the thigh are specially liable to become dilated (*see* VARICOSE VEINS). The femur on account of its strength is seldom broken, and for a similar reason dislocation at the hip and knee joints very seldom occurs.

THIOCOL is a substance derived from guaiacol, the chief ingredient of creosote, and used for similar purposes.

THIOSINAMINE, or ALLYL THIOUREA, is a bitter crystalline substance derived from oil of mustard and ammonia. It appears to have the property of softening fibrous tissues and is used in cases of chronic tuberculosis, chronic rheumatism, and similar conditions in which there is an excessive deposit of hard fibrous or scar tissue.

THIOSULPHATE OF SODIUM, or sodium hyposulphite, is much used in photography as a solvent of silver, and in medicine is administered by intravenous or intramuscular injection in doses of 5 to 20 grains as an antidote in cases of over-dosage with preparations of arsenic, mercury, bismuth, or gold. It is obtainable under various proprietary names such as thiostab and ametox.

THIOUREA. — CH_4N_2S. A substance having properties similar to those of urea, and the remarkable property of interfering with the synthesis of thyroxine by the thyroid gland. By virtue of this property it is notably successful in controlling Graves's disease, and already severe cases of this have been brought into a normal condition by taking thiourea by mouth. If the drug is given up, the hyperthyroidism returns. As good results are given with a drug more pleasant to take—THIOURACIL. Many other compounds having a similar action are being tried out in the treatment of hyperthyroidism. Treatment with thiourea or thiouracil is not, however, free from risk.

THIRST, like appetite, is an instinctive craving for something necessary to the continuance of bodily activity. The sensation of thirst is generally referred to the back of the throat, because, when there is a deficiency of water in the system, the throat and mouth especially become parched by evaporation of moisture from their surface. The mere swallowing of water is, however, not sufficient to abolish thirst, as appears in cases where a fistulous opening into the gullet exists, through which the water escapes. Thirst is increased by heat, and is a constant symptom of fever; it is also present in diseases which remove a considerable amount of fluid from the system, such as diarrhœa, chronic Bright's disease, diabetes, and after great loss of blood by hæmorrhage. A desire for water is also a feature of many conditions associated with great exhaustion.

THORACIC DUCT is the large lymph-vessel which collects the contents of the lymphatics proceeding from the lower limbs, the abdomen, the left arm, and left side of the chest, neck, and head. It is about the size of a goose quill, is provided with very numerous valves, and opens into the veins at the left side of the neck. (*See* GLANDS *and* LYMPHATICS.)

THORACOCENTESIS (θώραξ, the chest; κέντησις, a pricking) means tapping of the chest. (*See* ASPIRATION.)

THORACOPLASTY is the term applied to the operation of removing a varying number of ribs so that the lung lying adjacent to the spaces left collapses. This form of 'collapse therapy' is used for pulmonary tuberculosis and bronchiectasis, when other methods of treatment fail.

THORAX (θώραξ) is another name for the chest.

THORN-APPLE is a popular name for stramonium. (*See* STRAMONIUM.)

THREAD-WORM (*see* PARASITES).

THREE-DAY FEVER, also known as PHLEBOTOMUS FEVER, SAND-FLY FEVER, and PAPPATACI FEVER, is a short, sharp fever occurring in the eastern Mediterranean and other places, brought on by the bite of a small hairy midge (*Phlebotomus papatasii*).

Symptoms.—There are headache, feverishness, general sensations like those of influenza, flushed face and bloodshot eyes, but no signs of catarrh. As the name implies, the fever passes off in three days, but the patient may take some time to convalesce.

Treatment.—As the midges affect certain localities numbers of persons are apt to contract the fever at one time, and the principal necessity is preventive treatment by application to the face, wrists, and ankles of eucalyptus, cassia, or other volatile oil. Relief may be obtained from the feverish symptoms by a dose of laudanum.

THRILL is a tremor or vibration felt on applying the hand to the surface of the body. It is felt particularly over the region of the heart in conditions in which the valve openings are narrowed or an aneurysm is present.

THROAT is, in popular language, a vague term applied indifferently to the region in front of the neck, to the larynx or organ of voice, and to the cavity at the back of the mouth. The last-mentioned use of the word, to denote the pharynx or cavity into which the nose, mouth, gullet, and larynx all open, is the correct one. (*See* PHARYNX.) Information will also be found under NECK, LARYNX, TONSILS, NOSE.

THROAT DISEASES form a large and important class, and include some of the most serious and fatal of maladies. Strictly speaking, the term 'throat diseases' should include only affections of the pharynx or throat proper, the general cavity into which the nose, mouth, larynx, gullet, and Eustachian tubes open; but for convenience the chief diseases that affect also the larynx and gullet are considered here.

Information will also be found under the headings CHOKING, CLERGYMAN'S SORE THROAT, CROUP, DIPHTHERIA, LARYNGISMUS; MOUTH, DISEASES OF; NOSE, DISEASES OF; TONSILLITIS.

The diagnosis of diseases affecting the throat has been greatly aided by the introduction into medical practice of the *laryngoscope*, invented by Garcia in 1855,

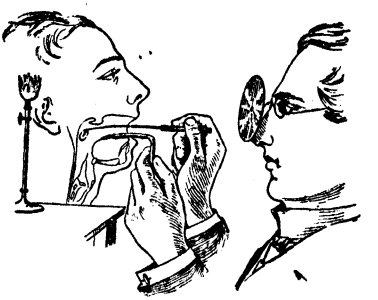


FIG. 436.—Diagram showing the method of using the laryngoscope, for the diagnosis of throat diseases. (After Bennet.)

though this again is largely superseded by small electric lamps introduced into the mouth. The requisites are a light which can be directed into the back of the throat, and a long narrow handle bearing at its end a small mirror which is set at such an angle that, when introduced into the back of the throat, it catches the beam of light and projects it straight downwards into the larynx. By the help of various delicate instruments, the expert can view the larynx with the small mirror held in one hand, while he operates upon it with an instrument held in the other hand. For the appearances seen in the normal larynx see LARYNGOSCOPE.

The *bronchoscope* is another instrument used in examining the lower air passages. It consists of a long straight tube provided with lenses and electric light bulb, which is passed down the larynx as the patient lies on his back. Through it the physician can obtain a direct view of the air passages down to the point in the chest at which the trachea ends in the bronchial tubes. Local applications and the removal of foreign bodies can be effected by its use.

The *œsophagoscope* is a similar instrument which is used for examining the gullet, the patient lying in a similar position.

LARYNGITIS, or inflammation of

THROAT DISEASES

the mucous membrane of the larynx, may be either acute or chronic.

ACUTE LARYNGITIS. — **Causes.**— This complaint is usually produced by exposure to cold, either directly or through a catarrh extending from the nose above or from the bronchial tubes beneath to the mucous membrane of the larynx. It accompanies some of the infectious diseases in which the throat is liable to suffer, such as measles, scarlatina, diphtheria, smallpox, and erysipelas. Excessive use of the voice, as in loud and prolonged speaking or singing, sometimes produces laryngitis. Further, the inhalation of irritating particles and vapours, and the swallowing of very hot fluids are well-recognised causes.

Symptoms.—The chief changes in the larynx are great redness and swelling, which affect the whole interior of the cavity, but are specially marked where the tissues are loose, such as the neighbourhood of the epiglottis and of the vocal cords. The effect is to produce narrowing of the channel for the entrance of air, and to this the chief dangers are due. The symptoms vary with the intensity of the attack, but, along with more or less feverishness and constitutional disturbance, there is usually a sense of heat, dryness, and pain in the throat, attended with some difficulty in the act of swallowing. Cough is a constant symptom, and is either loud, barking, or clanging, or else husky and toneless. It is at first dry, but afterwards is accompanied with expectoration. The voice, like the cough, is rough, husky, or may for a few days disappear almost entirely. The breathing shows evidence of laryngeal obstruction, both inspiration and expiration being prolonged and difficult. with a somewhat hissing sound, and with almost no interval between the two acts. In severe cases, the face and surface generally become livid, and suffocation threatens, particularly during the paroxysms of coughing. In favourable cases, which form the majority, the attack tends to abate in a few days, but on the other hand death may occur suddenly in a suffocative paroxysm, particularly in the case of children. Many cases of acute laryngitis are so comparatively slight as to make themselves known only by hoarseness and the character of the cough; nevertheless, in every instance the attack demands serious attention.

Treatment.—The treatment consists in keeping the patient in bed in an atmosphere of 65° to 70° F., made moist by steam (*see* BRONCHITIS). The use of warm gargles, and the frequent inhalation of the vapour of hot water, containing such soothing substances as benzoin, or menthol, and the application of hot fomentations to the front of the neck, will be found of much value. Internally, diaphoretics, such as small doses of Dover's powder, are also to be recommended. Such remedies usually suffice to relieve the attack, but in very severe cases more active interference may be necessary. When there is much swelling of the mucous membrane in the upper portion of the larynx, as shown by great obstruction of the breathing, scarification of the parts with the aid of the laryngoscope may afford relief, and even tracheotomy may have to be performed where death appears to be imminent from suffocation. Attacks of laryngitis may be largely prevented in those liable to them by a regimen calculated to invigorate the system, such as the cold bath, regular open-air exercise, etc.

CHRONIC LARYNGITIS.— **Causes.**—This may occur as a result of repeated attacks of the acute form, or may arise independently owing to such causes as habitual exposure (especially where along with this there is over-indulgence in alcohol), the habitual over-use of the vocal organs, etc. Any interference with the entrance of air through the nose, leading to the bad habit of mouth-breathing, has a great influence in setting up chronic laryngitis. The changes taking place in the parts are more permanent than in the acute form, consisting mainly in thickening of the mucous membrane, vocal cords, etc. Some cases are due to tuberculosis, syphilis, and other chronic inflammatory diseases, and these are apt to produce ulceration of the vocal cords and other parts of the larynx and ultimately destruction of its cartilages.

Symptoms. — The symptoms vary according to the extent and amount, as well as the duration, of the inflammation. Thus there may simply be a certain huskiness or hoarseness on attempts at

the use of the voice, this condition being well exemplified in the so-called clergyman's sore throat or *dysphonia clericorum* (*see* CLERGYMAN'S SORE THROAT); while, on the other hand, there may be not only complete loss of voice but severe pain in the act of swallowing, and great difficulty in breathing, accompanied sometimes with expectoration of large quantities of matter in the cases where ulceration is present. Under this variety of the disease may be included the ulceration due to syphilis and that occurring in the course of phthisis, both of which are attended with the symptoms now mentioned. The diagnosis and the treatment of all such cases are greatly aided by the use of the laryngoscope, by which a view of the affected parts can be obtained, and the proper remedies more readily applied.

Treatment.—In the treatment of the chronic forms of laryngitis, rest to the parts is essential, any attempts at continuing the use of the voice only aggravating the condition; while tonic remedies and regimen should be employed to strengthen the system generally. Applications to the affected parts in the forms of solutions of lactic acid, nitrate of silver, alum, tannin, etc., either by means of a brush or syringe introduced into the cavity or by the simpler method of spraying, are often beneficial. The insufflation of powders, such as iodoform, or starch mixed with a minute quantity of morphia, is also practised, as are likewise inhalations of vapours of iodine, carbolic acid, turpentine, eucalyptus, etc. The diet must be made as simple as possible, and all irritating condiments such as mustard, pickles, and spices should be avoided. Alcohol is also highly prejudicial, especially in the form of strong spirits, and should be avoided. The habit of smoking must be abandoned. The improper use of the voice has been dealt with under the simple but very troublesome form of laryngitis known as CLERGYMAN'S SORE THROAT, which is prone to affect those who use the voice a great deal.

TUMORS and various *inflammatory growths* are frequently met with in the larynx and may give rise to symptoms of chronic laryngitis. Such growths may be of simple character, in the form of isolated fibrous formations attached by a peduncle to some portion of the laryngeal mucous membrane, or as warty excrescences occurring upon or in the neighbourhood of the vocal cords. They are detected by means of the laryngoscope, and can often be dealt with effectually by a very slight operation, though one requiring great skill. Cancer of the larynx may often be removed successfully if the disease is detected in its early stages. *Hoarseness may then be the only symptom.* Hence arises the great importance of a careful examination of the larynx by an expert in every case of hoarseness that has lasted for some weeks or more. In the more serious malignant tumors which either take origin in the larynx, or spread into it from adjacent parts, interference by surgical measures can only afford temporary relief, though even in very bad cases the serious operation of entirely removing the larynx and tumor may prolong life over many months. In hopeless cases, tracheotomy is often performed so as to prevent the act of breathing from irritating the diseased part, by providing an entrance for air beneath the larynx. This usually gives considerable relief.

NERVOUS AFFECTIONS of the larynx occur independently of any local disease. One of the most important of these is *laryngismus stridulus*, otherwise called *child-crowing* or *spasmodic croup*. This condition occurs chiefly during the early years of childhood, and manifests itself by a suffocative attack accompanied by peculiar 'crowing' breathing, as the result of spasmodic approximation of the vocal cords which causes great interference with the entrance of air. The causes and treatment of the condition are dealt with under LARYNGISMUS.

Symptoms not unlike those of laryngismus sometimes occur in adults as the result of irritation of the recurrent laryngeal nerve, by the pressure upon it of an aneurysm or other tumor situated in the chest. Such pressure, if long continued, results in paralysis of the nerve, occasioning great loss of voice. (*See* RECURRENT LARYNGEAL NERVE.)

In the condition known as *nervous aphonia*, which occurs mostly in women of hysterical temperament or in circumstances of enfeebled health, the voice becomes reduced to a whisper, but there

is seldom any affection of the breathing, or cough, and the laryngoscope reveals a perfectly healthy state of the parts. In such cases the remedies must be directed to the improvement of the general health. The use of electricity (faradism) applied to the neck is often attended with marked benefit. This condition may, like other hysterical conditions, be present for years, causing even complete loss of voice and then may suddenly disappear as the result of a powerful mental impression.

PHARYNGITIS is a chronic inflammatory condition affecting the wall of the pharynx or throat proper. It is usually associated with derangements of the digestive organs, but may accompany chronic laryngitis, and is often caused by the irritation of highly spiced food or of constant spirit-drinking, or even by excessive tobacco-smoking. On looking into the back of the throat, while the tongue is held down, one sees the mucous membrane unduly red and glazed, with enlarged lymph-follicles like sago-grains scattered over it. Small varicose veins are often seen here and there, and when these burst, the person may spit up a good deal of blood, which he is apt to attribute wrongly to some disease in his lungs. It produces considerable irritation, cough, tickling in the throat, and discomfort which may last long if not treated. Treatment consists in removing any cause of irritation, in remedying any dyspepsia that may be present (*see* DYSPEPSIA), and in the application to the part of mild caustic solutions such as nitrate of silver, or of the galvano-cautery.

NARROWING OF THE GULLET. —The *œsophagus* or gullet may be the seat of catarrhal or inflammatory conditions causing discomfort in swallowing, but the more important ailments affecting this tract are those which arise from local injuries, such as the swallowing of scalding or corrosive substances. This may cause ulceration followed by the formation of a scar which narrows the passage and produces the symptoms of *stricture* of the œsophagus—namely, pain and difficulty in swallowing, with regurgitation of the food. The severity of the case will necessarily depend upon the amount of narrowing and consequent mechanical obstruction; but in some instances this has occurred to such an extent as practically to close the canal. Cases of œsophageal stricture of the kind now referred to may sometimes be dilated by the use of suitable instruments.

A still more serious and frequent cause of œsophageal stricture is that due to cancerous growth in the canal, which may occur at any part, but is most common at the lower end, in the vicinity of the entrance into the stomach. The chief symptoms of this condition are increasing difficulty in the passage downwards of the food, steady decline in strength, together with enlargement of the glands in the neck, while the diagnosis is rendered the more certain by the absence of any cause, such as local injury, for the formation of a stricture, and by the age (as a rule at or beyond middle life). Treatment here can only be palliative while life continues, which in general is not long. Feeding by the bowel (enemata) may be resorted to as supplementary to efforts to administer liquid nutriment in the usual way. It is to be observed in all cases of organic stricture that the food does not necessarily return at once, but seems as if it had passed into the stomach. In reality, however, it has passed into the dilated or pouched portion of the canal, which is almost always present immediately above the seat of stricture, where it remains until, from its amount, it regurgitates back into the mouth, when it can be seen, by the absence of any evidence of digestion, that it has never been in the stomach. Life may be prolonged for a considerable time and freedom from pain obtained by fluid food; and the operation of gastrostomy, by which an opening is made through the front of the abdomen, allows food to be directly introduced into the stomach.

Strictures of the œsophagus may also be produced by the pressure of tumors or aneurysms within the cavity of the chest but external to the canal. Further, a variety of œsophageal stricture is not infrequently met with, which is due entirely to nervous causes, and is quite unconnected with organic disease—namely, that form occurring in hysterical persons termed *spasmodic stricture*. Here the attack of difficulty in swallowing comes on usually when the patient is at meals, and the food cannot pass down.

The absence, however, of all history of any organic source of disease, its sudden onset, and especially the perfect facility with which the œsophageal tube or bougie is passed, together with other manifestations of hysteria commonly present, serve readily to establish the diagnosis. The remedies most suitable are tonics and the frequent passage of the stomach-tube, which, as a rule, soon entirely remove the tendency to spasm.

Finally, difficulty in swallowing sometimes occurs in certain serious nervous diseases from paralysis affecting the nerves supplying the muscular coats of the pharynx, which thus loses its propulsive power (bulbar paralysis). When such complications occur, they usually denote an advanced stage of the brain disease with which they are connected, and a speedily fatal termination.

INJURIES OF THE THROAT from without have been briefly referred to under CUT THROAT.

FOREIGN BODIES sometimes lodge in the throat, being either of the nature of food which has been swallowed in too large or too hard pieces, or of the nature of indigestible substances like coins which children are apt to place in the mouth. Bodies which lodge in the respiratory part of the throat, *i.e.* at the entrance to or in the cavity of the larynx, set up immediate symptoms of choking. (*See* CHOKING.) Bodies which lodge in the gullet, on the contrary, do not usually set up any immediately serious symptoms, though their presence causes a considerable degree of discomfort. Such bodies are divided for practical purposes into two classes. One class includes smooth bodies like coins or fruit stones, which may be pushed down into the stomach or pulled up into the mouth by means of a bougie or a special instrument known as a 'coin-catcher', or, better still, by forceps passed down under the direct guidance of the œsophagoscope. The other and more dangerous class comprises bodies which are too large to be pushed down into the stomach and safely passed by the bowels, or too rough to be pulled back into the mouth, such as large pieces of bone, or large plates of artificial teeth. In cases where it is impossible to dislodge a foreign body up or down, it becomes necessary to perform an operation in order to remove the body from the gullet directly through the side of the neck.

THROMBOSIS (θρόμβωσις, a curdling) means the formation of a blood-clot within the vessels or heart during life. The process of clotting depends upon the same factors as in clotting of blood outside the body, involving the fibrinogen and lime salts circulating in the blood, as well as a body set free from the white corpuscles when clotting is about to occur. The indirect cause of thrombosis is usually some damage to the smooth lining of the blood-vessels brought about by inflammation, or the result of atheroma, a chronic disease of the vessel walls. The blood is also specially prone to clot in certain general conditions such as anæmia, the ill-health of wasting diseases like cancer, and in consequence of the feeble circulation of old age.

Thrombosis may occur in the heart and terminate some chronic wasting disease; it frequently takes place in the vessels of the brain and thus causes apoplexy in persons whose arteries are much diseased; it is sometimes a salutary thing, as in aneurysm, where the deposition of a clot within the sac forms the natural cure of this condition.

Thrombosis of a coronary artery of the heart is a very serious condition which affects as a rule elderly persons, appearing suddenly during rest and causing great pain in front of the chest or upper part of the abdomen, with pallor, feeble pulse, breathlessness and sometimes vomiting. These symptoms may last for several hours or days, the pain being lessened by injections of morphine, but recovery takes place from about one-half of such attacks after a period of prolonged rest lasting three months or more.

THRUSH is a type of inflammation affecting the mouth of weakly children and causing a patchy white appearance on the lips, tongue, or palate. It is caused by the growth of a fungus on the surface of the mucous membrane. (*See* MOUTH, DISEASES OF.)

THYMOL is a white, crystalline, camphor-like substance derived from oil

of thyme and other volatile oils. It has an antiseptic action, and is used both externally in ointment and sometimes internally in putrefactive conditions of the alimentary canal. It is used also to expel worms from the intestinal canal, especially the hookworm and whipworm which cause anæmia. For the latter purpose it must be given in large doses of 30 grains or more in several successive doses. When it is thus given, care must be taken not to administer alcohol or oil with it, as it is readily soluble in these and might be absorbed, with poisonous results.

Compound solution of thymol (liquor thymol co.) is an antiseptic and aromatic fluid containing numerous volatile oils and much used as an antiseptic mouth wash and gargle. A teaspoonful is usually added to a cupful of warm water for this purpose.

THYMUS GLAND (*θύμος*) is a temporary structure which reaches its greatest size at about the second year of life and then gradually dwindles away. Its function is not certain, but it appears to be connected with the development of the blood and other tissues in infancy. In some persons the gland continues to increase in size, and is found well developed in adult life. These persons appear to exhibit a peculiar liability to suffer severely, and even to die suddenly, from slight injuries.

The gland consists of a right and a left lobe, and lies in the lower part of the neck and upper part of the chest, reaching down at the second year of life to the fourth rib. In structure, each lobe consists of a large number of nodules

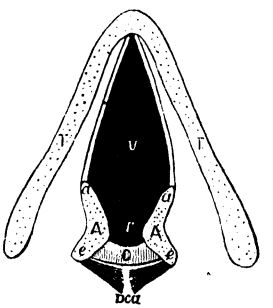


FIG. 437.—Diagram of a cross-section through the larynx to show the shield shape of the thyroid cartilage *T*. For other letters see LARYNX. (Turner's *Anatomy*.)

bound together by connective tissue, and closely resembling small lymph-glands in microscopic appearance.

THYROID CARTILAGE (*θυρεοειδής*, shield-shaped) is the largest cartilage in the larynx and forms the prominence of the Adam's apple in front of the neck. (*See* LARYNX.)

THYROID GLAND (*θυρεοειδής*, shield-shaped).—This is a highly vascular organ situated in front of the neck. It consists of a narrow 'isthmus' crossing the windpipe close to its upper end, and joining together two 'lateral lobes'

FIG. 438.—Section through a thyroid gland, showing the gland vesicles and supporting connective tissue. *e*, Secreting epithelium; *ct*, connective tissue; *c*, thick secretion of the gland; *v*, blood-vessels. (Turner's *Anatomy*.)

which run upwards one on each side of the larynx. The gland is therefore shaped somewhat like a horseshoe, each lateral lobe being about 2 inches long and the isthmus about ½ inch wide, and it is firmly bound to the larynx. The weight of the thyroid gland is about one ounce, but it is larger in females than in males, undergoes in many women a periodic increase at each time of menstruation, and often reaches an enormous size in the condition known as goitre.

Minute structure.—The gland is enveloped in a layer of fibrous tissue and possesses a very rich blood supply. It is composed of multitudes of closed vesicles, each formed by a layer of cubical cells and containing a thick yellow (colloid) fluid. Round the vesicles there is a dense network of capillary blood-vessels, while the finest lymphatic vessels communicate with the interior of these vesicles.

Function.—The colloid substance appears to be a secretion of the thyroid, which, as the gland possesses no outlet, is absorbed by the blood or lymph. This

substance exerts a profound influence upon the nutrition of the body, described under the heading of MYXŒDEMA. The active principle of this colloid substance has been isolated and is named thyroxine.

THYROID GLAND, DISEASES OF.—When the secretion of the gland is not produced in sufficient amount or the gland undergoes atrophy, the diseases known as CRETINISM and MYXŒDEMA are liable to result, according as the affected person is an infant or is already grown. Enlargement of the gland is described under GOITRE, and a peculiar type of enlargement associated with nervous symptoms and protrusion of the eyes is known as *exophthalmic goitre*. In some cases the gland undergoes rapid enlargement, it may be in one part, with symptoms of palpitation, nervousness, sweating, etc. This condition is known as *thyrotoxic goitre*.

Cases in which a minor degree of insufficient action of the thyroid gland is present with modified symptoms of myxœdema are known as *hypothyroidism*, and are sometimes associated with defective action of the kidneys and relieved when thyroid gland extract it administered. Other cases occur presenting liability to tremor, palpitation, and nervousness, which are associated with a mild degree of overaction in the thyroid gland, and these are known as *hyperthyroidism* and may be successfully treated by administration of thiourea (*q.v.*).

THYROID GLAND, USES OF.—The thyroid gland of the sheep was introduced as a remedy for myxœdema, in consequence of the researches of several persons. (*See* MYXŒDEMA.) At first the gland, or a portion of it, was transplanted from a sheep to human beings in whom the gland had atrophied, but later it was found that the gland might be eaten with equally satisfactory results. An extract, known as thyroideum, and also called dry thyroid, thyroid extract, and thyroid gland, is now administered in doses of $\frac{1}{2}$ to 5 grains. It is usually made up into tablets. These tablets are used in other diseased conditions where the chemistry of the body is at fault, although there is no apparent defect in the thyroid gland. Among the conditions in which it has proved valuable are cretinism, excessive stoutness, eclampsia, and some cases of widespread psoriasis. Also in the later stages of pregnancy, a condition which appears to make great demands upon the activity of the thyroid gland, these tablets are often administered with advantage. Overdoses of the gland are apt to produce violent headache and feebleness of the heart's action.

THYROXINE is a crystalline substance, containing iodine, isolated from the thyroid gland and possessing the properties of thyroid extract. It may be used instead of the extract of the gland in cases of defective function of the thyroid, such as goitre, cretinism, and myxœdema.

TIBIA (*tibia*) is the name of the larger of the two bones in the leg. One surface of the tibia lies immediately beneath the skin in front and towards the inner side of the leg, forming the 'shin', and fractures of this bone are accordingly very liable to wound the skin and become compound. The thigh-bone rests upon the larger upper end of the tibia at the knee-joint, while below, the tibia and fibula together enter into the ankle-point, the two bosses or malleoli at the ankle belonging, the inner to the tibia, the outer to the fibula.

TIC DOULOUREUX (Fr.) is another name for facial neuralgia due to some affection of the fifth cranial nerve, and characterised by pain situated somewhere about the temple, forehead, face, or jaw, and sometimes by spasm in the muscles of the affected region. (*See* NEURALGIA.)

The name tic is also applied to habit spasms and spasms which form a personal peculiarity in neurotic subjects. (*See* CRAMP.)

TICK is the general name given to a group of arachnid insects of which some act as transmitters of diseases.

TIN-POISONING is supposed sometimes to occur when preserved meat has been left in contact with the tin containing it, after the tin has been opened. Any evil effects are in all probability due to decomposition of the meat, and

poisoning by ptomaines (*see* PTOMAINE POISONING), or to lead or arsenic with which the tin is contaminated.

The strong soluble salts of tin used by dyers, calico-printers, etc., act as irritant poisons. (*See* POISONS.)

TINCTURE (*tinctura*, a dye) is an alcoholic solution, generally of some vegetable substance. The official tinctures include tincture of the following drugs: asafœtida, belladonna, calumba, capsicum, catechu, cinchona, coccus, colchicum, digitalis, ginger, hyoscyamus, ipecacuanha, krameria, lemon, lobelia, myrrh, nux vomica, opium, orange, quassia, quillaia, senega, squills, stramonium, strophanthus, tolu, and valerian. There are compound tinctures of benzoin, cardamoms, cinchona, gentian, rhubarb, and a camphorated tincture of opium. Most tinctures are given in doses of ½ to 1 teaspoonful, but those of the more powerful drugs, such as belladonna, capsicum, colchicum, digitalis, lobelia, nux vomica, opium, squills, and stramonium, are given in smaller doses, usually 5 to 30 minims, while the dose of tincture of strophanthus is 2 to 5 minims.

TINEA (*tinea*, a moth) is the technical name for ringworm. (*See* RINGWORM.)

TINNITUS (*tinnitus*) means a noise heard in the ear without any objective cause. It is a frequent accompaniment of deafness. (*See* DEAFNESS *and* EAR, DISEASES OF.)

TISANE (Fr.) is a name sometimes given to barley-water. (*See* BARLEY-WATER.) The term is also applied to a light variety of champagne wine.

TISSUES OF THE BODY are the simple elements from which, on microscopic examination, the various parts and organs are found to be built. All the body originates from the union of a pair of cells, but as growth proceeds the new cells produced from these form tissues of varying character and complexity. (*See* CELL.) It is customary to divide the tissues into five groups:

(1) Epithelial tissues, including the cells covering the skin, those lining the alimentary canal, those forming the secretions of internal organs, etc. (*See* EPITHELIUM.)
(2) Connective tissues, including fibrous tissue, fat, bone, cartilage. See these headings.
(3) Muscular tissues (*see* MUSCLE).
(4) Nervous tissues (*see* NERVES).
(5) Wandering corpuscles of the blood, lymph, etc. (*See* BLOOD.)

Many of the organs are formed of a single one of these tissues or of one with a very slight admixture of another, such as cartilage, or white fibrous tissue. Other parts of the body that are widely distributed are very simple in structure and consist of two or more simple tissues in varying proportion. Such are blood-vessels (*see* ARTERIES, VEINS), lymphatic vessels (*see* LYMPHATICS), lymphatic glands (*see* GLANDS), serous membranes (*see* SEROUS MEMBRANE), synovial membranes (*see* JOINTS), mucous membranes (*see* MUCOUS MEMBRANE), secreting glands (*see* GLANDS, SALIVARY GLANDS, THYROID GLAND, etc.), and skin (*see* SKIN).

The structure of the more complex organs of the body is dealt with under the heading of each organ.

TITRATION is the term applied to a form of chemical analysis by means of standard solutions of known strength.

TITUBATION (*titubatio*) means a staggering or reeling condition, especially due to disease of the spinal cord or cerebellum.

TOAST WATER.—This forms a useful diluent fluid for administration to invalids, containing a small amount of protein and carbohydrate nourishment. To prepare it one takes two or three slices of bread, toasts them thoroughly without burning, puts them into a large jug, and pours over them a quart of boiling water. This is strained when cold, sweetened with sugar, and flavoured with lemon.

TOBACCO is the leaf of several species of Nicotiana, especially of the American plant *Nicotiana tabacum*. It is not used in medicine except to prepare a soothing lotion, but demands some notice here on account of its popular use and the marked effects it produces.

The practice of smoking has probably been known for ages, but did not come into use in Europe till it was introduced

from the West Indies by the followers of Columbus. The use of tobacco was popularised in England during the sixteenth century by Sir John Hawkins and Sir Walter Raleigh, and the plant was at the time successfully grown in England and Scotland. From the first, smoking was bitterly opposed by many who did not care for the practice. Popes issued edicts against it; in Turkey and Russia it was made a punishable offence, and in England James I. was constrained to issue his *Counterblaste to Tobacco*, in which he described smoking as 'a custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, . . . resembling the horrible Stygian smoke of the pit that is bottomless.' Notwithstanding the fact that three centuries of experience have, since that time, shown the comparative harmlessness of tobacco, when used in moderation, equally violent diatribes are still directed occasionally against smoking.

Composition.—In addition to vegetable fibre, tobacco leaves contain a large quantity of ash, the nature of this depending largely upon the minerals present in the ground where the tobacco plant has been grown, but amounting to 12 or 20 per cent of the whole. Of the organic constituents the brown fluid alkaloid known as nicotine is far the most important, as the special action of tobacco depends upon it. The milder and better-flavoured tobaccos of Havana and Manilla contain only 2 to 3 per cent of nicotine, while some of the common French and German brands have as much as 9 per cent. The nicotine is to a large extent destroyed as the tobacco burns, and necessarily so, since a strong cigar contains more than sufficient nicotine to poison a person, in the pure state. Various ammonia products, an oil, and a resinous substance are also produced as the tobacco burns.

Snuffing is perhaps the method of taking tobacco in which it produces least effect upon the system, having little but a stimulating action, while chewing is, from all points of view, the most objectionable. The pipe, cigar, and cigarette in this order are methods of smoking by which increasing amounts of nicotine are taken into the system from a given weight of tobacco. As a cigar or cigarette is smoked, the nicotine and other volatile products retreat before the heat, so that the stump or butt becomes very highly charged with them and is the most active part of the cigar.

Action and uses.—The action of tobacco depends largely upon the constitution of the smoker, his habituation to the drug, and the circumstances under which he smokes.

A very small amount of nicotine, such as that derived from a single cigarette, has a decidedly stimulating effect upon the mental and bodily powers. Thus a pipe after breakfast is said to impart a feeling of vigour and to exert a laxative effect.

In larger amount, the action is a depressant and narcotic one, which in habitual smokers is modified to a sedative and quieting effect upon the nervous system, without much depression of the heart or other organs. The most suitable time for smoking is generally admitted to be after meals, and especially in the evening after the day's work is at an end, when the sedative action is most beneficial to the nervous system. Different people vary widely in their susceptibility to the influence of tobacco; for in some, and particularly in young persons, very small quantities suffice to cause depression and irritability of the nervous system, the heart's action, and the digestive and other powers; while others, especially those who lead an open-air life, are not in the least affected by very large amounts. Generally speaking, excessive smoking is a hurtful thing, particularly for young people, and a liberal allowance of tobacco for a healthy, full grown man is usually fixed at a maximum of four ounces in the week.

Among the evil effects of smoking may be mentioned the temporary nausea, depression, giddiness, and vomiting which affect the unaccustomed smoker. These effects, however, pass off quickly, and the tendency to their occurrence disappears as the person becomes habituated to tobacco. Of more importance is the group of symptoms produced by continued and excessive smoking, especially of cigarettes. These include palpitation and irregularity of the heart, giddiness, and a tendency to sudden attacks of faintness, symptoms often grouped together under the popular name of 'tobacco heart'. Other common symptoms are liability to fatigue on slight exertion, dyspepsia, and dimness of vision asso-

ciated with impairment of power for seeing colours, especially green and red. These symptoms also pass off gradually when smoking is discontinued, or when the amount of tobacco consumed is reduced within suitable bounds; but, while they last, they cause great impairment of the health, and the partial blindness is very liable to continue for long.

Another set of symptoms frequently arising in those who smoke short pipes, and often attributed to a mistaken cause, consists of irritable cough, soreness of the throat, and enlargement of the tonsils, liable to become worse in damp weather. These symptoms also pass off when smoking is discontinued, or some change is made in the method of smoking. (*See* THROAT DISEASES.)

Acute tobacco-poisoning seldom occurs, though it has sometimes been caused by a child having eaten some tobacco. The symptoms are the same as those that affect the unaccustomed smoker. The treatment to be adopted resembles that for poisoning by opium and other narcotics, including the administration of an emetic, if tobacco has been swallowed, followed by strong tea, coffee, or other stimulant.

TOES (*see* CORNS, FEET, NAILS).

TOLU (*see* BALSAM).

TOLUOL, or METHYL BENZOL, is an oily substance with properties similar to those of benzol.

-TOMY (τομή, a cutting) is a suffix indicating an operation by cutting.

TONGUE.—The tongue is made up of several muscles, is richly supplied with blood-vessels and nerves, and is covered by highly specialised mucous membrane. It consists of a free part known as the 'tip', a 'body', and a hinder fixed part or 'root'. The under surface lies upon the floor of the mouth, while the upper surface is curved from side to side, and still more from before backwards so as to adapt it to the roof of the mouth. At its root, the tongue is in contact with, and firmly united to, the upper edge of the larynx; so that in some persons who can depress the tongue readily the tip of the epiglottis may be seen projecting upwards at its hinder part.

Structure. — The *substance* of the tongue consists almost entirely of muscles running in various directions. One runs along the upper surface and another along the lower surface from root to tip. Other fibres run vertically from the upper to the lower surface, while the chief bulk of the tongue is made up of muscle-fibres running from side to side. These various fibres are chiefly concerned in making changes in the shape of the tongue and moving it within the mouth. In addition to these, the tongue has numerous outside attachments; one muscle on each sides unites it to the lower jaw-bone just behind the chin, and this muscle serves to protrude the tongue from the mouth; other muscles, which retract the tongue, attach it to the hyoid bone, the larynx, the palate, and the styloid process on the base of the skull.

The *mucous membrane* on the under surface of the tongue is very thin, so that the large ranine vessels on each side can easily be seen through it. In the middle line a fold of mucous membrane, the frenum, passes from the under surface to the floor of the mouth, and, when this frenum is attached too far forwards towards the tip of the tongue, the movements of the organ are impeded, and the condition is known as 'tongue-tie'. On the upper surface or 'dorsum' of the tongue the mucous membrane is thicker, and in its front two-thirds is studded with little projections of three kinds. The majority of these projections or *papillæ* are of *conical* shape, and when the tongue becomes 'furred' the appearance is due to an unhealthy collection of epithelium upon them. Some of them end in long filaments, and are then known as *filiform* papillæ. The roughness of the tongue in cats and other carnivorous animals is due to large backwardly directed conical papillæ, which assist in cleaning the flesh off bones. On the tip, and towards the edges of the tongue, small red rounded *fungiform* papillæ are seen, which act in all probability as end-organs for the sense of taste. On a line dividing the front two-thirds from the hinder one-third, and set in the shape of a V, is a row of seven to twelve large flat-topped *circumvallate* papillæ, each placed in a corresponding depression and just visible, in most mouths, when the tongue is pressed

firmly down with some flat instrument. These also act as end-organs for the nerves of taste. Each circumvallate papilla is surrounded by a trench, and upon both sides of the trench open numerous *taste-buds*. A taste-bud is

FIG. 439.—Taste-bud. *s*, Its surface cells; *G*, the gustatory cells, each with *p*, a peripheral, and *c*, a central process connected with a nerve-fibre. (Turner's *Anatomy*.)

shaped somewhat like a barrel, with an outer covering of flattened stave-like cells, enclosing a bundle of spindle-shaped cells which end in hairlike processes at the mouth of the bud, and are connected at their deeply placed end with some filaments from the nerves of taste. These taste-buds are also found in the fungiform papillæ, though in smaller numbers, and they are scattered over the throat, fauces, and palate; so that the popular expression 'a fine palate', as applied to the sense of taste, is quite correct.

Nerves.—No fewer than five nerves supply branches to each side of the tongue. These are the *lingual* branch of the 5th nerve, which is the nerve of ordinary sensation, to the front two-thirds of the tongue; the *chorda tympani* branch from the 7th nerve, which is supposed to be the nerve of taste, for a similar extent; the *glosso-pharyngeal* or 9th nerve, which conveys sensations both of touch and taste from the hinder third; the *superior laryngeal* branch of the 10th nerve, also sensory; and the *hypoglossal* or 12th nerve, which supplies the muscles of the tongue.

Functions.—The chief uses of the tongue are of three kinds: (*a*) To push the food between the teeth for mastication, and then mould it into a bolus preparatory to swallowing; (*b*) as the organ of the sense of taste, and as an organ provided with a delicate sense of touch; and (*c*) to play a part in the production of speech. (*See* VOICE AND SPEECH.)

As to taste, the Greeks recognised nine varieties, but it is usual to classify any taste as—

1. Sweet;
2. Salt;
3. Bitter;
4. Acid,

since finer distinctions are largely dependent upon the sense of smell. The loss of keenness in taste brought about by a cold in the head, or even by holding the nose while swallowing, is well known. Sweet tastes seem to be best appreciated by the tip of the tongue, acids on its edges, and bitters at the back. It is possible too, by chewing the leaves of an Indian plant, *Gymnæma sylvestre*, to do away with the power of tasting bitter and sweet substances, while the sensation for acids and salts remains, so that in all probability there are different nerve-fibres and end-organs for the different varieties of taste. Many tastes depend upon the ordinary sensations of the tongue, such as the 'constringing' taste of tannin and the 'metallic' taste of a weak galvanic current passed through the tongue.

Like other sensations, taste can be very highly educated for a time, as in tea-tasters and wine-tasters, but this special adaptation is lost after some years.

TONGUE, DISEASES OF (*see* MOUTH, DISEASES OF).

TONGUE, FURRING OF (*see* MOUTH, DISEASES OF).

TONICS (*τόνος*, strength) are remedies which gradually restore the muscles, nerve-cells, and various bodily organs from a lax and sluggish state to a condition in which they are ready for immediate activity. The term, like the name stimulants, is very vague, but while stimulants cause immediate increase of activity, tonics act more slowly and give a sense of increased well-being and strength.

Varieties.—There are many types of tonics acting in different ways, though all require time in order to exert their beneficial action.

Nervine tonics act through the nervous system, and, by increasing its activity, render the muscles firmer and the secretions of the internal organs more healthy. Among these may be mentioned nux vomica and strychnine, cinchona and quinine, also cold-bathing,

and increase of daily exercise in the fresh air.

Gastric tonics increase nutrition when the stomach and other digestive organs are so weak that they are unable to utilise the food presented to them. As examples of these we have malt extract, cod-liver oil, petroleum emulsion; bitters such as calumba, quassia, gentian, bitter beer; and dilute acids, such as hydrochloric acid, nitric acid, citric acid.

Another group, often known as *blood-tonics*, supply some substance which is necessary for the bodily activity and which is either wanting from or insufficiently supplied by the person's ordinary diet. Among these may be mentioned fats, common salt, iron, lime salts, and various special forms of diet.

Still other tonics act by *altering the chemical changes* that take place in the tissues, among which may be mentioned iodine, arsenic and phosphorus, and perhaps the salts of zinc, silver, and gold which are sometimes administered. Thyroid extract administered over a period of a week or two is a powerful agent of this nature. Change of air, as, for example, from a town to the seaside, produces its beneficial effect in all probability to a great extent in this fashion.

In another class, tonics act by *removing waste products* and other poisonous materials from the body, and these include massage, baths, exercise, iodides, and the various drugs which stimulate the skin, kidneys, and bowels to increased activity.

Most tonics have, however, a *combined effect*, exerting two or more of the actions just mentioned.

Uses.—In cases where the nervous system is jaded by constant work, as shown by dullness, loss of memory, languor, and liability to speedy fatigue, some of those tonics mentioned above as nervine tonics are of most benefit. Persons whose atonic condition manifests itself by dyspepsia are aided by some of the gastric tonics. (*See* DYSPEPSIA.) Some of the nutritional defects will not be remedied till the special substance that is wanting has been supplied, as, for example, some preparation of iron in bloodlessness. (*See* ANÆMIA.)

Among the generally useful tonics are the following. In children and young persons of feeble physique or after some acute illness, the compound syrup of the phosphate of iron (Parrish's Syrup) or the syrup of the iodide of iron is very suitable. In adults whose nervous system is overworked and digestion out of order, the compound syrup of the hypophosphites (Fellows's Syrup) acts extremely well. Where a more powerful tonic, acting more speedily, is desired, the syrup of the phosphate of iron with quinine and strychnine (Easton's Syrup) is also useful. Any of these tonics should be taken in a large quantity of cold water immediately after a meal.

Although tonics form a valuable class of remedies, their employment may be a source of danger through conferring an artificial sense of well-being upon a person who stands in need of more energetic treatment or of complete rest, as, for example, a person suffering from neurasthenia or early consumption. In such a case the mere use of tonics, although it enables the person to go about his usual pursuits for some time longer, leads in the end to a more complete breakdown. The particular tonic which will suit the combination of symptoms in any given case is a matter for careful consideration.

TONSILS (*tonsillæ*) are two almond-shaped glands situated one on each side

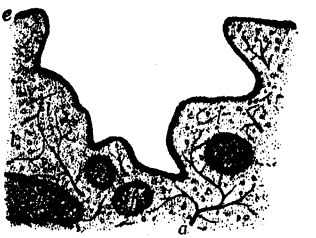


FIG. 440.—Vertical section through the surface of a tonsil, showing one of the lacunæ. *e*, Epithelial covering; *f*, *f*, lymph nodules or follicles; *l*, *l*, *l*, lymph cells diffused through the connective tissue; *a*, small artery. (Turner's *Anatomy*.)

of the narrow 'fauces' where the mouth joins the throat. Each has a structure resembling that of a lymphatic gland, and consists of an elevation of the mucous membrane presenting twelve to fifteen openings, which lead into pits or lacunæ. The mucous covering is formed by the ordinary mucous mem-

brane of the mouth, which also lines the pits; and the main substance of the gland is composed of loose connective tissue containing lymph corpuscles in its meshes, and packed here and there into denser 'nodules' or 'follicles'. The tonsils appear to be concerned in the formation of these corpuscles, which escape into the saliva and discharge some important function connected with digestion, or the protection of the body from bacteria taken in with the food.

TONSILLITIS, or TONSILITIS, means inflammation of the tonsils and may be either acute or chronic.

ACUTE TONSILLITIS may be of several types. Thus the gland tissue of the tonsil may be affected, or the inflammation may be situated in the fibrous tissue around it. Again, the condition may result in an abscess (quinsy), or, in very severe cases, ulceration may take place on the surface of the tonsil.

Causes.—As in other cases of inflammation, this condition is directly due in the majority of cases to the growth of bacteria. Quinsy is, however, an affection of youth and is very rare after middle age is reached. It is more common in persons of rheumatic constitution, and one attack predisposes to others. The inflammation generally follows a chill, but it appears to arise in connection with other disturbances also, such as digestive disorders. Insanitary conditions such as even a slight escape of sewer-gas, or of coal-gas, into the air of a room, may be sufficient to predispose persons living or working in the room to contract tonsillitis. Persons who have recently taken up work in a hospital are apt to suffer from a severe and ulcerated type of tonsillitis, which, on this account, goes by the name of 'hospital sore throat'.

Symptoms.—The symptoms come on somewhat suddenly and sharply, with chill followed by fever, the temperature frequently attaining a high point of elevation (104° or 105° Fahr.). Pain in the act of swallowing is experienced from the outset. The inflammation is usually at first confined to one tonsil, but on examining the throat there is seen to be considerable redness and swelling of the whole surrounding mucous membrane, the uvula, soft palate, etc., while a copious secretion accumulates at the parts, and causes much discomfort. The tongue, too, is covered in general by a thick, creamy fur, and the breath has an offensive smell. The act of swallowing becomes increasingly difficult, and fluids are apt to regurgitate through the nose. Pain is felt along the Eustachian tube towards the ear, and there are tenderness and swelling in the neck about the angle of the jaw on the affected side, the glands in the side of the neck being often hard and enlarged. The voice acquires a peculiar and very characteristic snuffling tone, and there may be some embarrassment to the breathing. In a few days the inflamed tonsil may show signs of suppurating, and an abscess is seen bulging forward into the mouth. When this bursts or is evacuated, speedy relief is obtained, and the patient is soon restored to his usual health. Occasionally, however, the inflammation passes from the one tonsil to the other. An attack of quinsy rarely lasts beyond a week or ten days, and is not as a rule attended with any danger to life, though valvular disease of the heart is sometimes due to acute tonsillitis.

Treatment is much the same as that for an ordinary cold, confinement to the house, the employment of diaphoretic medicines, together with light diet, being all that is necessary as regards general management. (*See* CHILLS AND COLDS.) At the very beginning of a sore throat of this nature, lozenges containing chlorate of potash and guaiacum appear often to be highly beneficial in cutting short the attack. Black-currant jelly is a household remedy which seems to be of some efficacy also. In rheumatic cases remedies appropriate for acute rheumatism give relief, and a brisk purgative is often very helpful. It is almost impossible to gargle when the tonsils are much enlarged, but hot milk or gruel may be sipped and held as long as possible in contact with the throat. A spray of menthol or cocaine will give partial relief when the person has to go about, and these drugs also seem to exert some check upon the inflammatory process. Warm applications to the outside of the neck, as well as the above warm articles of food, give much relief.

When an abscess is forming, it may be punctured, and this procedure gives immédiate relief if pus be already present, and if there be not yet a definite collection of pus, it appears at least to hasten the development and bursting of the abscess. In this little operation great caution is necessary lest any large blood-vessel be wounded.

CHRONIC TONSILLITIS is a very common condition in delicate children, the tonsils being much enlarged, slightly inflamed, and very liable to attacks of acute inflammation. In some cases the substance of the tonsils is chiefly inflamed (*follicular tonsillitis*), in others the openings (crypts) in the tonsils are filled with cheesy-looking, decomposing material which gives to the breath a very offensive smell (*lacunar tonsillitis*). In the case of some young people, enlargement of the tonsils constitutes a tuberculous tonsillitis. (*See* CONSUMPTION.) In the first-mentioned form of chronic tonsillitis the adenoid formation on the back of the throat is enlarged, as a rule, along with the tonsils. In this case the three projecting masses cause great narrowing of the air passage, shortness of breath, mouth-breathing, and other evils. This condition is described with reference to the symptoms and treatment of 'adenoids' under NOSE, DISEASES OF. In lacunar tonsillitis, when offensive masses collect in the tonsils, these may be gradually removed by swabbing the tonsils night and morning with considerable pressure. For this purpose a piece of cotton-wool is rolled round a wooden rod and dipped in peroxide of hydrogen solution. It is then pressed hard with a rubbing motion against the tonsil. If the condition persists, relief may be obtained by removing the tonsils.

When enlargement of the tonsils is not sufficiently great to call for removal, it is treated by remedies which promote the general nutrition, like cod-liver oil, iron, etc., by various gargles (*see* GARGLES), and by astringent applications such as tincture of iodine. Instead of the simple tincture of iodine one may use a paint (Mandl's solution) with the following composition: iodine, 6 grains; potassium iodide, 20 grains; oil of peppermint, 3 drops; glycerin, 1 ounce. This is painted with a brush night and morning upon the tonsils.

TOOTHACHE (*see* TEETH, DISEASES OF).

TOPHUS (*tophus*, tufa) is the name given to the concretions which form in connection with joints or tendon sheaths as the result of attacks of gout. At first the tophus is a soft mass, but later becomes quite hard. It is composed of biurate of soda. (*See* CONCRETIONS, GOUT.)

TORMENTIL is the root of a small plant with yellow flower *Potentilla tormentilla*, which possesses astringent properties, and which is used as a remedy for diarrhœa, either by chewing the root or in the form of a fluid extract.

TORMINA (*tormina*) is the technical name for griping pains felt round the navel, as the result of spasmodic action of the muscular coat in the small intestine. (*See* COLIC.)

TORPOR (*torpor*) is a condition of bodily and mental inactivity not amounting to sleep, but interfering greatly with the ordinary habits and pursuits. It is often found in persons suffering from fever, and is a common symptom in aged people whose arteries are diseased. It may annoy young persons after meals when they are the subjects of constipation or of dyspepsia, due to eating too much animal or indigestible food. Torpor in the forenoon, when the person should be most active, is also a symptom of Bright's disease.

TORSION (*torsio*) means twisting. The term is applied to the process in which organs, tumors, etc., which are attached to the rest of the body by a narrow neck or 'pedicle,' become twisted so as to narrow the blood-vessels or other structures in the pedicle.

Torsion is also the term applied to the twisting of the small arteries severed at an operation, by which bleeding from them is stopped.

TORTICOLLIS (*tortus*, twisted; *collum*, the neck) means wry-neck. (*See* CRAMP, WRY-NECK, SPASMODIC TORTICOLLIS.)

TORULA (*torulus*, a little lump) is another name for yeast. (*See* BACTERIOLOGY.)

TOTAQUINA is a mixture of alkaloids from various forms of cinchona bark, introduced in place of pure quinine, which is more expensive.

TOUCH, according to the popular idea, is the fifth sense diffused all over the body, by which we become conscious of our surroundings otherwise than by the four special senses of hearing, seeing, tasting, and smelling. But when this diffused sensitiveness is examined it is found to consist of a group of senses, several of which have special end-organs situated in the skin, muscles, etc., and special nerve-paths to convey their impressions to the brain. It is convenient, however, to adopt the popular view so far, and to consider all these under one heading. The cutaneous sense then is made up of the following:

Touch sense proper, by which we perceive a touch or stroke and estimate the size and shape of bodies with which we come in contact, but which we do not see.

Pressure sense, by which we judge the heaviness of weights laid upon the skin, or appreciate the hardness of objects by pressing against them.

Heat sense, by which we perceive that a body is warmer than the skin.

Cold sense, by which we perceive that a body touching the skin is cold.

Pain sense, by which we appreciate pricks, pinches, and other painful impressions.

To these we may for convenience add:

Muscular sensitiveness, by which the painfulness of a squeeze is perceived. It is produced probably by direct pressure upon the nerve-fibres in the muscles.

Muscular sense, by which we test the weight of an object held in the hand, or gauge the amount of energy expended on an effort.

Sense of locality, by which we can, without looking, tell the position and attitude of any part of the body.

Common sensation, which is a vague term used to mean composite sensations produced by several of the foregoing, like tickling, or creeping, and the vague sense of well-being or the reverse that the mind receives from internal organs. (See the article on PAIN.)

The structure of the end-organs situated in the skin, which receive impressions from the outer world, and of the nerve-fibres which conduct these impressions to the central nervous system, have been described under NERVES.

Touches affect the Meissner's or 'touch' corpuscles placed beneath the

FIG. 441.—Vertical section through the skin showing a Meissner's or touch corpuscle, *t*, lying in one of the papillæ of the skin and connected to a nerve-fibre, *n*. For other letters see SKIN. (Turner's *Anatomy*.)

cuticle, and, as these differ in closeness in different parts of the skin, the delicacy of the sense of touch varies greatly. Thus the points of a pair of compasses can be felt as two on the tip of the tongue when separated by only $\frac{1}{24}$ of an inch, on the tips of the fingers they must be separated to twice that distance, while on the arm or leg they cannot be felt as two points unless separated by over an inch, and on the back they must be separated by over two inches. On the parts covered by hair, the nerves ending round the roots of the hairs also take up impressions of touch. Pressure is estimated probably through the same nerve-endings and nerves that have to do with touch, but it depends upon a difference in the sensations of parts pressed on and those of surrounding parts. Heat-sense, cold-sense, and pain-sense all depend upon different nerve-endings in the skin; and thus, with care and delicate instruments like needles, bristles in holders, and metal pencils through which hot or

cold water can be made to circulate, the skin may be mapped out into a mosaic of little areas where the different kinds of impressions are registered. While the tongue and finger-tips are the parts most sensitive to touch, they are comparatively insensitive to heat, and can easily bear temperatures which the cheek or elbow could not tolerate. The muscular-sense in all probability depends on the sensory organs known as 'muscle-spindles', which are scattered through the substance of the muscles, and the sense of locality is dependent partly on these and partly upon the nerves which end in tendons, ligaments, and joints.

Disorders of the sense of touch occur in various diseases.

HYPERÆSTHESIA (more correctly called hyperalgesia) is a condition in which a mere touch or gentle handling causes acute pain. It is found in various diseases of the spinal cord immediately above the level of the disease, combined often with loss of sensation below the diseased part. It is also present in neuralgia, the skin of the neuralgic area becoming excessively tender to touch, heat, or cold. Heightened sensibility to pain is seen sometimes in drunkards, who wince at a mere touch when not under the influence of alcohol. Heightened sensibility to temperature is a frequent symptom of neuritis. (*See* PAIN.)

ANÆSTHESIA, or diminution of the sense of touch, causing often a feeling of numbness, is present in many diseases affecting the nerves of sensation or their continuations up the posterior part of the spinal cord. The condition of *dissociated analgesia*, in which a touch is quite well felt, though there is complete insensibility to pain, is present in the disease of the spinal cord known as syringomyelia, and affords a proof that the nerve-fibres for pain and those for touch are quite separate. In locomotor ataxia there is sometimes loss of the sense of touch on feet or arms; but in other cases of this disease there is no loss of the sense of touch, though there is a complete loss of the sense of locality in the lower limbs, thus proving that these two senses are quite distinct.

PARÆSTHESIÆ are peculiar forms of perverted sensation such as creeping, pricking, or hot flushes.

TOURNIQUET (Fr.) is an instrument used for the temporary stoppage of the

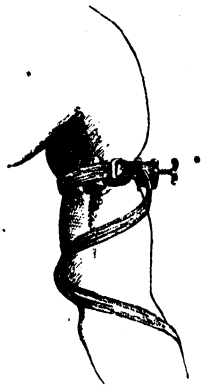


FIG. 442.—Petit's tourniquet applied to the brachial artery. (Miller's *Surgery*.)

circulation in a limb, so that bleeding may be controlled. There are various forms of tourniquet, the simplest being a *tourniquet improvised* from a band

FIG. 443.—Two simple forms of tourniquet. *a*, An improvised tourniquet, the knot being over the femoral artery, and the lower band being intended simply to keep the handle of the tourniquet from unwinding; *b*, Esmarch's elastic band tourniquet.

such as that made by a handkerchief folded cravat-wise, tied round the limb,

and then twisted up by means of a rigid object passed beneath it. *Petit's tourniquet* has a linen strap passing over two pairs of brass rollers, which can be separated from one another by a screw, thus tightening the strap after it has been buckled round the limb. *Esmarch's tourniquet* consists of an elastic band which is wrapped with moderate tightness round the limb, and then prevented from unwrapping by tapes. It is the form generally used. (*See* HÆMORRHAGE.) A rubber tube knotted, or fixed with a clip, round the limb is also frequently used for arresting the blood-flow. In applying a tourniquet for bleeding, it must be rendered sufficiently tight to stop the circulation completely. Otherwise if the veins only be compressed and the arteries still open, the bleeding is made worse. A tourniquet must not be left in position longer than is absolutely necessary; otherwise gangrene of the limb may result.

TOXÆMIA (τοξικόν, poison; αἷμα, blood) is a vague term applied to mild forms of blood-poisoning, due to the absorption of bacterial products (toxins) formed at some local site of infection. Inflammation of the gums, abscesses at the roots of teeth, and chronic inflammation in various internal organs, such as cystitis and colitis, are especially blamed in this connection. In other cases the toxæmia is due to defective action of some excretory organ, such as the kidney. To the most severe forms, caused by the entrance of micro-organisms into the blood, the name of 'septicæmia' is given. (*See* BLOOD-POISONING.)

As regards treatment, the most important consideration is to remove the source of infection by extraction of teeth, relief of constipation, the local application of antiseptic substances, etc. Vaccines made from the bacteria responsible for the inflammation are also much used in the treatment of this condition.

TOXICOLOGY (τοξικόν, poison; λόγος, discourse) is the science dealing with poisons. (*See* POISONS.)

TOXINS (τοξικόν, poison) are poisons produced by the action of bacteria upon the tissues of the body or other material in which the bacteria develop. (*See* BACTERIOLOGY, IMMUNITY, SERUM THERAPY.) Toxins are usually soluble, easily destroyed by heat, sometimes of the nature of crystalline substances, and sometimes albumins. When injected into animals in carefully graduated doses, they bring about the formation of substances called antitoxins which neutralise the action of the toxin. These antitoxins are generally produced in excessive amount and the serum of the animal when withdrawn can be used for conferring antitoxic powers upon other animals or human beings to neutralise the disease in question. The best known of these antitoxins are those of diphtheria and tetanus. Substances like toxins are found in many plants and in snake venom. Some toxins are not set free by the bacteria, but remain in the substance of the latter and then are known as endotoxins and are not capable of producing antitoxins.

TRACHEA (τραχύς, rough) is another name for the windpipe. (*See* AIR PASSAGES.)

TRACHEITIS means inflammation of the trachea. It may occur along with bronchitis, or independently, due to similar causes.

TRACHEOTOMY (*trachea*, and τέμνω, I cut) is the operation in which the windpipe is opened from the front of the neck, so that air may obtain direct entrance into the lower air passages. It is usual to classify the operation as *high tracheotomy* when the trachea is opened above the isthmus of the thyroid gland, which crosses opposite the third and fourth cartilaginous rings of the trachea, and *low tracheotomy* when the opening is made below this level; though in actual practice the thyroid gland is often cut across.

The higher the trachea is opened, the easier is the operation, because the trachea recedes from the surface as it passes downwards, and in the lower part of the neck is placed close to large blood-vessels. Nevertheless, the condition for relief of which the operation is performed frequently renders it necessary that the operation should be performed as low down as possible.

Reasons for operation.—Inflamma-

tory conditions, which lead to narrowing of the opening into the larynx and threaten to prevent the entrance of air, form the chief class of conditions that demand tracheotomy, in order to provide an opening lower down. Chief among these is diphtheria. Wounds of the larynx, followed by inflammation, as in cut-throat, require it sometimes for the same reason. Or the blockage of the larynx may be due to some foreign body which has gone down into the air passages or to some tumor growing in the larynx, or tuberculous disease of the vocal cords. In young children, the operation of *intubation* is sometimes preferred, and as the tube in this case is pushed in through the mouth no cutting operation is required. Though intubation of the larynx has several points of advantage, tracheotomy is generally more successful when an operation becomes absolutely necessary.

Tracheotomy tubes. — When the trachea has been opened by a vertical slit on its front surface, after division of the skin and separation of the fatty tissue on the neck, it is necessary to introduce a tube in order to keep the opening from closing. The tubes are made either of hard rubber or more often of metal; and there is always an *outer tube* which is fixed in position by tapes passing round the neck, and an *inner tube* which slides freely out of and into the other, so that it may be removed at any time for cleansing, and is readily coughed out should it happen to become blocked by mucus.

A dressing of boracic lint is generally applied between the edges of the outer tube and the wound; while the entrance to the inner tube is protected by a few layers of gauze wrung out of hot water and sprinkled with terebene, so as to form a filter for the air entering the trachea.

The inner tube must be removed and washed several times daily, and if at any time it gets blocked by coughed-up mucus, it must be instantly removed and wiped. The outer tube is not removed till one or two days have elapsed after the operation, and then it is replaced by a fresh tube carefully introduced.

After-treatment.—When the operation has been performed for some permanent obstruction, the tube must be worn permanently; and the double metal tube is in such cases replaced after a short time by a soft rubber single one. When the operation has relieved some passing condition like diphtheria, the tube is left out now and then for a few hours, and finally, at the end of a week or so, is removed altogether, after which the wound quickly heals up.

TRACHOMA (*see* EYE DISEASES).

TRADE DISEASES.—Many occupations are more arduous than others, or necessitate great exposure to the weather, or lead to irregularities in the matter of eating and drinking, so that those who pursue them are specially liable to suffer from minor illnesses or nerve strain. But beyond this, certain trades and professions bear a close relationship to certain definite diseases, which are therefore known as trade or occupation diseases.

Several forms of poisoning which are liable to be contracted by workmen in factories and workshops where these poisonous substances are used or manufactured are notifiable under the Factory and Workshop Acts in Great Britain. These are lead-poisoning, phosphorous poisoning, arsenical poisoning, mercurial poisoning, poisoning by carbon bisulphide, aniline, or benzene, and the development of anthrax, toxic jaundice, silicosis, and epithelioma or chronic ulceration occurring among workers in chrome factories.

Poisonous trades.—ARSENIC is a substance largely used for many purposes. Thus the smelters of ores containing arsenic, the makers of green artificial flowers, wall-papers, painters of green china, and others who come in contact with Scheele's green, are liable to be affected by eczema, neuritis, and other symptoms of chronic arsenical poisoning. (*See* ARSENIC, NEURITIS.)

LEAD is a substance very widely used and very readily absorbed into the system, so that workmen who, at first sight, appear to have little or nothing to do with this metal may suffer from lead-poisoning. Thus, in addition to the makers of white lead, plumbers, and compositors who handle lead constantly, file-cutters who use a leaden cushion at work, house-painters who burn off old paint, glass-polishers and

pottery-glazers who are apt to inhale lead-containing dust, are all liable to contract lead-poisoning if they do not adopt proper precautions. (*See* LEAD-POISONING.)

PHOSPHORUS, in the form of yellow phosphorus, is apt to injure match-makers, though the red phosphorus employed for safety matches is harmless. Match-makers affected by the phosphorus fumes suffer from general ill-health, and are liable to necrosis of the jaw, known as 'phossy jaw'. Some authorities attribute this condition of the jaw to the direct action of the phosphorus; others regard it simply as a manifestation of tuberculous disease occurring severely in weakly persons.

MERCURY affects felt-hat-makers who employ nitrate of mercury, and used formerly to affect those who employed an amalgam for the purpose of coating the baser metals with gold or silver in the process known as 'water-gilding'.

INDIA-RUBBER workers who are exposed to the fumes of carbon-disulphide sometimes suffer from headache, tremors, and mental and visual disturbances.

NITROBENZOLE workers, and those who employ this substance in the preparation of perfumes, aniline, etc., are subject to sleepiness, headache, disturbance of the gait, and sometimes atrophy of the optic nerves leading to blindness.

DINITROBENZENE is used in the manufacture of high explosives. Those who handle it are liable to suffer from anæmia, muscular weakness, and wasting, with pains in the limbs and loss of sensation. The general debility produced may have a fatal result.

WOOLSORTERS are liable to suffer from the bacterial disease known as anthrax, either by getting bacteria of this disease into abrasions in the hands, or by inhalation of its spores on dust off the fleeces. This is prevented to a large extent by handling the fleeces wet so that the production of the spores is prevented.

CHROME WORKERS are liable to suffer from a chronic form of ulceration which is particularly liable to take on cancerous growth, producing epithelioma. A similar result sometimes occurs among workers in soot, paraffin, coal-tar, and other irritating substances.

Trades affecting lungs or heart.—Glass-blowers, partly on account of the heat amid which they work, partly owing to the strain of blowing, suffer from bronchitis and emphysema, and are also liable to deafness. Iron-workers, partly in consequence of their laborious work, partly owing to the habits of intemperance which this is apt to induce, seem specially liable in later life to contract valvular heart disease, and to suffer from increase in size and force of this organ. (*See* HEART DISEASE.) Clergymen, though specially exempted by their even life from heart and lung conditions, are very liable, along with other public speakers, to suffer from a special type of sore throat. (*See* CLERGYMAN'S SORE THROAT.) Persons working among irritating particles and constantly inhaling them are more than ordinarily liable to contract consumption; among these trades may be mentioned those of stone-cutters, steel-grinders, cotton-workers, flax-workers, flour-millers. Especially are these trades liable to cause consumption when the work is carried on by underfed persons in badly ventilated workrooms. Potters display a special liability to disease of the lungs resembling consumption, but coal-miners enjoy a curious exemption notwithstanding the impregnation of their lungs with carbon particles. (*See* CONSUMPTION.)

Spasms and paralyses are liable to affect those whose occupation requires the constant use of one muscle or group of muscles to perform the same action over and over again. Sometimes the affected part becomes painlessly contracted whenever an attempt is made to perform the action; in other cases, the spasm is accompanied by a good deal of pain; and in still other cases, the muscles waste and great weakness ensues. In early cases the condition improves with rest and change of employment; but in advanced cases the weakness may be due to degeneration of the nerve-cells in the grey matter of the spinal cord, and recovery is then hopeless. Among these *occupation-neuroses*, as they are sometimes called, may be mentioned writer's cramp (*see* CRAMP), typewriter's cramp, telegraphist's cramp, miner's nystagmus (twitching of the eyes from straining

them at work in an awkward position), hammerman's palsy, and the spasmodic wry-neck of shoemakers, saddlers, and book-folders. Caisson workers, who labour in compressed air, suffer among other things from pains in the limbs, and sometimes from paralysis.

TRAGACANTH is a gummy exudation obtained from *Astragalus gummifer*, which swells out and forms a mucilage when mixed with water. It is used as a demulcent, or in mixtures to suspend heavy particles, such as bismuth.

TRAINING (*see* DIET, EXERCISE).

TRANCE is the term applied to a profound sleep from which a person cannot for a time be aroused, but which is not due to organic disease. The power of voluntary movement is lost, though sensibility and even consciousness may remain. It is usually due to hysteria, and may be induced by hypnotism. (*See* CATALEPSY, ECSTASY, *and* SLEEP.)

TRANSFUSION OF BLOOD is an old method of restoring a person believed to be dying by passing blood from another person into his veins. The practice was much in vogue during the seventeenth century, and was performed either by bleeding a healthy person into a basin, and, by means of a syringe, injecting the blood into a cannula previously tied in one of the sick person's veins; or by uniting a vein in the healthy person with one in the sick person by means of two cannulæ and a connecting tube, so that the blood passed directly from one to the other.

In spite of all speed, the blood introduced by either of these methods was apt to clot; and the practice was adopted of whipping the blood with fine twigs, or straining it through muslin so as to remove its fibrin, and thus introduce merely the serum and blood corpuscles.

Apart from the difficulty caused by the tendency to clot, a great objection to transfusion is that the corpuscles are liable to break up in the new circulation into which they are introduced; and the person, into whom the new blood is transfused, may suffer to a dangerous degree from symptoms such as nettle-rash, difficulty of breathing, purging, and signs of shock, while the immediate destruction of the red blood corpuscles leads to the passage of blood pigment in the urine and jaundice in some cases. A fatal result may quickly supervene. To avoid this it is necessary to find out that the blood of the 'donor' is compatible with the blood already in the circulation of the 'recipient'. This is readily determined by a simple test, for which a little blood is drawn from the recipient, and a drop of its serum mixed with a minute drop of blood from the donor, which has been allowed to drop into citrate of soda solution. If, in the course of a few minutes, the serum of the recipient causes clotting or breaking up of the donor's corpuscles, the two bloods are incompatible, and another donor of new blood must be chosen and similarly tested. Standard serums can also be obtained for testing the 'group' to which the blood of the donor and that of the recipient belong.

Various methods of transfusion are used by different practitioners, such as by uniting a vessel in the donor with a vessel in the recipient by means of a short tube, while the two lie side by side; by withdrawing the blood into a syringe and then injecting it through a cannula into the recipient's vein; or, most commonly, by withdrawing the blood from the donor into a large glass vessel, which has been coated with paraffin, and which contains a small amount of citrate of soda solution intended to prevent clotting. Many refinements of transfusion apparatus were made at the beginning of the war started in September 1939, and a highly efficient service was organised for transfusion of blood at casualty clearing stations. At home, various transfusion centres were established by the Medical Research Council, and much use was made of 'stored blood', *i.e.* blood kept in refrigerators ready for use. About three weeks was the length of time blood could be stored and still be safely used. In addition to this plasma and serum were also found highly beneficial when given as a transfusion to men who had lost much blood

or were in a state of shock. Plasma can be dried and kept in powder form and then made up into a solution when needed.

TRANSILLUMINATION means the inspection of the interior of a cavity, *e.g.* of one of the sinuses connected with the nose, by means of a strong light passed through its walls, in a dark room. The condition of the cavity as regards the presence of pus or a tumor can thus be readily demonstrated.

TRANSVESTITISM, or TRANSVESTISM, is the term given to a psychosexual abnormality in which a person goes about dressed in the clothes of the opposite sex.

TRAPS (*see* WATER-CLOSETS).

TRAUMA, TRAUMATIC (τραῦμα, a wound), are terms used to indicate disorders due to wounds or injuries. Psychic trauma is the term applied to an emotional shock.

TREATMENT. — Special forms of treatment are considered under such headings as DIET, ELECTRICITY IN MEDICINE, LIGHT TREATMENT, SERUM THERAPY, PROTEIN THERAPY, etc. The treatment appropriate to each disease will be found under the headings of the various diseases.

TREMOR (*tremor*) means a very fine kind of jerking spasm. Tremors may be seen in projecting parts like the hands, head, and tongue, or they may involve muscles or even the individual fibres of a muscle here and there. They are of various grades of fineness. Very coarse tremors, which prevent a person from drinking a glass of water without spilling it, are found in disseminated sclerosis and in St. Vitus's dance (see under these headings); somewhat finer tremors, which produce trembling of the hands or tongue when they are stretched out, are caused by alcoholism (*see* ALCOHOLISM, CHRONIC), by poisoning with other substances like lead, by trembling palsy (*see* PARALYSIS), and by the weakness which follows some acute disease or characterises old age; very fine tremors, visible in the muscles of face or limbs, and known as 'fibrillary tremors', are present in general paralysis of the insane, and in progressive muscular atrophy or wasting palsy. (*See* GENERAL PARALYSIS.)

TRENCH FEVER is a general name applied to a group of febrile, weakening conditions affecting soldiers on active service. The term is loosely used much in the same way as the term 'influenza'; but the trench fevers differ from influenzal attacks in so far that there is seldom any catarrh of the nose or bronchial tubes nor any great degree of digestive disturbance as is so frequent with influenza. The fever seems to be to a certain extent infectious, affecting especially men who are debilitated by prolonged strain or other cause, and the infection is generally believed to be conveyed from man to man by lice.

Symptoms.—Like influenza this fever often begins very suddenly with headache, pain in the back, shivering, and sweating. A very common symptom which usually appears later is aching pain down the front of the legs with great tenderness to touch over the shin bones. The fever is moderate, with rise of temperature to 102° or 103°, and lasts in most cases about five days, after which there is a fall of temperature to normal with relief of all the symptoms, but often at intervals of a few days there are one or two slight relapses. In another type of the fever, which is of longer duration, the patient has repeated rises of temperature lasting two or three days with periods of several days' (usually five or six) intermission between them. The convalescence is quicker in the first type than in the second.

Treatment.—For relief of the fever aspirin appears to be the most useful remedy, and the pain in the shins is greatly relieved by painting with tincture of iodine. Magnesium sulphate soaks are helpful in other cases, and when pain persists in the muscles sulphur is a useful remedy.

TRENCH RHEUMATISM is a name sometimes given to the muscular pains which follow prolonged exposure to cold and wet on active service. It does not differ from the similar condition contracted at home, and is treated by the remedies usually employed, sulphur being one of the most useful.

TREPHINING, or TREPANNING (*τρύπανον*, a trephine), is an operation in which a portion of the cranium is removed. Originally the operation was performed with an instrument resembling a carpenter's brace and

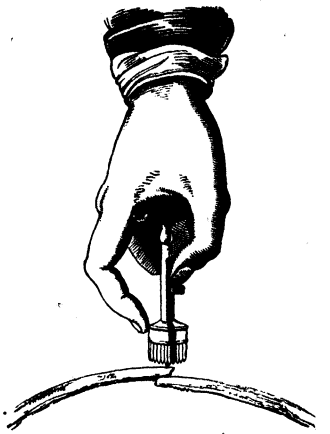


FIG. 444.—The form of trephine which has been in use since ancient times, showing its method of use. (Miller's *Surgery*.)

known as the trephine or trepan, which removes a small circle of bone; but now this instrument is used only as a rule for making small openings, while, for wider operations, gouge forceps, circular saws driven by electric motor, or wire saws are employed in order to give greater ease and speed.

The operation is one requiring nicety of manipulation, but is neither difficult nor serious, and was one of the commonest major operations of antiquity. It is said, from the appearances presented by skulls found in old French burial mounds, to have been practised by prehistoric peoples; and at all events Hippocrates describes fully the operation and the conditions that call for it, while Galen mentions two varieties of the instrument in common use. Both among the Greeks and Romans, and in the Middle Ages, resort seems to have been made to trephining, on very slight provocation, for conditions traceable to the head.

At the present time, the conditions under which it may be thought advisable to trephine the skull are chiefly as follows. In cases of fracture, with splintering of the skull, the operation is performed to remove the fragments of bone and any foreign bodies, like a bullet, which may have entered, in order that the wound may be thoroughly cleansed. In compression of the brain with unconsciousness following an injury, the skull is trephined and any blood-clots removed, or torn vessels ligatured. When an abscess is present within the skull, the operation is called for in order to evacuate the pus. In epilepsy, or in continued headache, whose symptoms point to a definite part of the brain being involved, the skull is often trephined over this area, so that any clot, scar, thickening of the bone, or cyst, which is setting up the irritation, may be discovered and removed. For a cerebral tumor, trephining is often performed either with the view of removing the tumor, if that be possible, or at all events of relieving the great pressure within the skull caused by the growing mass. In cases where the development of the skull is defective and idiocy has resulted, an extensive trephining operation has in a few cases been performed with beneficial results.

TREPONEMA (*τρέπω*, I turn; *νῆμα*, thread) is the name of a genus of spirochætal micro-organisms which consist of slender spirals and which progress by means of bending movements. *Treponema pallidum* (also called *Spirochæta pallida*) is the causative organism of syphilis.

TRICHIASIS (*τριχίασις*) means a diseased condition of the eyelids, generally the result of old-standing inflammation, in which the eyelashes grow inwards towards the eye so as to cause great pain and irritation. (*See* EYE, DISEASES OF.)

TRICHINIASIS (*see* TRICHINOSIS).

TRICHINOSIS (*τρίχινος*, hair-like) is the name of a disease set up by eating diseased pork, in which the immature *Trichina spiralis* is encysted. (*See* PARASITES.)

TRICHO- (*θρίξ*, hair) is a prefix denoting relation to hair.

TRICHOCEPHALUS (*θρίξ*, hair, *κεφαλή*, the head), or WHIP-WORM, is the

name of a parasite that infests the lower part of the bowel. It is specially common in France. (*See* PARASITES.)

TRICHOMONAS VAGINALIS.—A protozoon normally present in the vagina of about 30-40 per cent of women. It sometimes becomes pathogenic and causes inflammation of the genital passages, with vaginal discharge. A man may become infected and have a urethral discharge as a result; also a prostatitis.

TRICHOPHYTON (*θριξ*, hair; *φυτόν*, a plant) is the name of the vegetable parasite that causes ringworm. (*See* RINGWORM.)

TRICHOTILLOMANIA is the term given to the condition in which a mentally disordered person has an obsessional impulse to pull out his own hair.

TRICRESOL is the name of a clear, colourless, strongly antiseptic mixture of the three forms of cresol. It may be mixed with water in any proportions. (For uses see CRESOL.)

TRICUSPID VALVE is the valve provided with three cusps or flaps, that guards the opening from the right auricle into the right ventricle of the heart. (*See* HEART.)

TRIGEMINAL NERVE, or TRIFACIAL NERVE, is the fifth cranial nerve. It consists of three divisions: (1) the ophthalmic nerve, which is purely sensory in function, being distributed mainly over the forehead and front part of the scalp; (2) the superior maxillary nerve which is also sensory and distributed to the skin of the cheek, the mucous membrane of the mouth and throat, and the upper teeth; and (3) the inferior maxillary nerve, which is the nerve of sensation to the lower part of the face, the tongue, and the lower teeth, as well as being the motor nerve to the muscles concerned in chewing. This nerve is of special interest, owing to its liability to neuralgia.

TRIGONE (*τρίγωνον*, triangle) is the base of the bladder between the openings of the two ureters and of the urethra.

TRINITRIN (*see* NITROGLYCERIN).

TRINITROPHENOL (*see* PICRIC ACID).

TRIONAL, and TETRONAL, are white crystalline powders almost devoid of taste and closely allied to sulphonal in composition. Either is used for the relief of insomnia in doses of 10 or 20 grains, the sleep coming on, as a rule, twenty or thirty minutes after the drug has been taken and lasting five or six hours. Trional being very soluble, often succeeds in cases where sulphonal fails.

TRISMUS (*τρίζω*, I grind the teeth) is another name for lock-jaw. (*See* TETANUS.)

TROCAR (Fr. *trois quart*) is an instrument provided with a sharp three-sided point fitted inside a tube or cannula, and used for puncturing cavities of the body in which fluid has collected.

TROCHANTER (*τροχαντήρ*, the round head of the thigh-bone) is now the name given to the prominence at the upper end of the thigh-bone which can be felt on the outer side of the thigh. A small prominence on the inner side of this bone receives the name of the small trochanter.

TROCHES (*τροχός*, a disc) is another name for lozenges. (*See* LOZENGES.)

TROCHLEAR NERVE (*trochlea*, pulley) is the name of the fourth cranial nerve which acts upon the superior oblique muscle of the eye.

TROPHIC (*τρέφω*, I nourish) is a term applied to the influence that nerves exert with regard to the healthiness and nourishment of the parts to which they run. When the nerves become diseased or injured, this influence is lost and the muscles waste, while the skin loses its healthy appearance and is liable to break down into ulcers. (*See* NERVOUS DISEASES, BED SORES.)

TROPICAL DISEASES.—This term includes some diseases that occur in temperate climates, but are more common or more severe in hot latitudes; as

well as some that are found only in the tropics. (*See* BERI-BERI; BLACKWATER FEVER; CHOLERA, ASIATIC; CLIMATE; CLOTHING; DENGUE; DYSENTERY; ELEPHANTIASIS; FRAMBŒSIA; LEPROSY; LIVER, DISEASES OF; MALARIA; ORIENTAL SORE; PARASITES; PLAGUE; PRICKLY HEAT; SLEEPING SICKNESS; SUNBURN; SUNSTROKE; YELLOW FEVER.)

TRUSS is an instrument used to support a hernia, or to retain the protruding organ within the cavity from which it tends to pass.

Varieties of truss.—The nature of trusses varies according to the situation of the opening which the truss has to cover; but every truss possesses a pad of some sort to cover the opening and a belt or spring to keep it in position.

VENTRAL TRUSSES intended for a hernia protruding through the wall of the abdomen, either at the navel or at some weak spot caused by a strain or by a wound, consist of a large flat pad kept in position by a belt passing round the waist. Sometimes a small pad made to fit the opening is adopted, but this is a mistake, as its pressure tends to enlarge the aperture.

INGUINAL TRUSSES are much more commonly required than any other, and

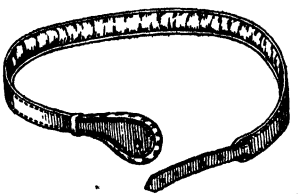


FIG. 445.—Simple truss for right inguinal hernia.

though many forms are made by different makers, all possess an oval obliquely placed pad with a spring pressing upon it. In the *ordinary truss*, there is a spring firmly fixed at one end to the pad, from which it passes right round the waist, to be bound at the other end by a short strap to the pad. Also there is a short strap passing down between the legs and fastened to the truss before and behind so as to keep the pad from slipping upwards as the person moves. This is one of the cheapest and most generally used forms. The *Mocmain truss* differs from the ordinary truss in having a soft band to go round the waist and a short lever-spring to press upon the pad. The *Salmon and Ody truss* has a large pad pressing upon the small of the back, a

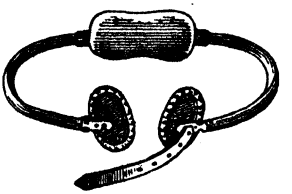


FIG. 446.—Truss for double inguinal hernia.

wide spring which runs right round the side of the body opposite to that upon which the hernia exists and crosses to the hernia, upon which it presses by a large pad with a ball-and-socket joint. *Double trusses* are often worn. They are fashioned like the ordinary truss, but have a pad for each side, and are advisable in the case of very stout people, in whom the retention of a hernia upon one side is sometimes apt to produce a hernia at the other side. *Bath trusses* are made of vulcanite, india-rubber, lacquered

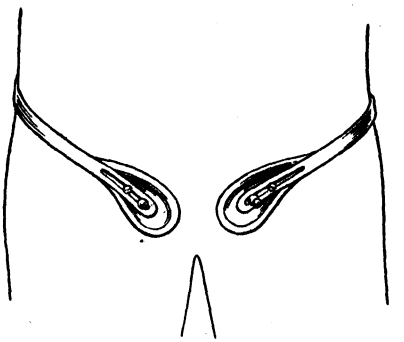


FIG. 447.—Double truss with celluloid pads in position.

metal, and other materials which will not spoil by wetting. Such trusses are also convenient for children, and many people who perspire copiously prefer them for general use. *Bag trusses*, consisting of a hollow pad kept in position by belts, etc., are sometimes necessary for the protection of a hernia which cannot be reduced.

FEMORAL TRUSSES are made in various forms similar to those of inguinal trusses. The pad, which comes down on the thigh, is small and triangular so as not to press

upon the femoral vessels. Such a truss is difficult to keep in position, and this is sometimes effected by having attached to the pad a thigh-piece which can be laced on the outer side of the thigh.

TRYPANOSOMA (*τρύπανον*, a gimlet; *σῶμα*, body) is the name of a genus of microscopic parasites of which several are responsible for causing sleeping sickness and some allied diseases. (*See* SLEEPING SICKNESS.)

TRYPARSAMIDE is a complicated organic preparation of arsenic (sodium-n - phenyl - glycineamide - p - arsonate) which was first used in the treatment of sleeping sickness, and found to be highly efficient in the destruction of the parasites although exerting little poisonous effect upon man. Recently it has been used for the treatment of affections of the nervous system caused by syphilis, and, given in large doses of ½ gram or more by intravenous injection, it has proved highly effective.

TRYPSIN is the name applied to the chief protein ferment of the pancreatic secretion. It changes proteins into peptones and forms the main constituent of pancreatic extracts used for digestion of food. (*See* PEPTONISED FOOD.)

TSETSE FLY is the name of an African fly of the genus *Glossina*. One or more of these is responsible for carrying the trypanosome which causes sleeping sickness and thus spreads the disease among cattle and from cattle to men.

TUBERCLE (*tuberculum*, a little lump) is a term used in two distinct senses. As a descriptive term in anatomy, a *tubercle* means a small elevation or roughness upon a bone, such as the tubercles of the ribs. In the pathological sense, a *tubercle* is a small mass, barely visible to the naked eye, formed in some organ as the starting-point of the disease which is now known as tuberculosis. The name of *tubercle bacillus* is given to the micro-organism that causes this disease. The term *tubercular* should strictly be applied to anything connected with or resembling tubercles or nodules, and the term *tuberculous* to anything pertaining to the disease tuberculosis.

When tubercle bacilli have gained entrance to an organ, no matter whether inhaled on dust, or whether absorbed from food and circulated through the lymphatics or blood-vessels, the following results ensue: The individual bacilli multiply, and around each group forms a minute tubercle, or granule, which is of a size almost invisible to the naked eye, and greyish in colour. These

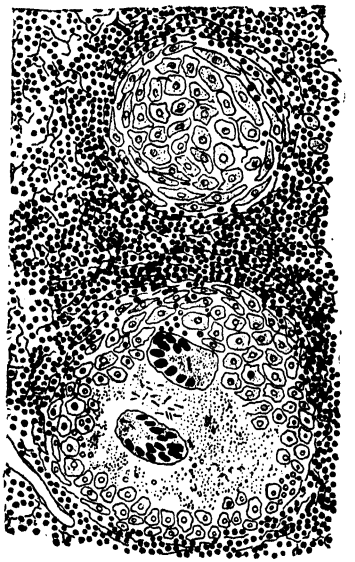


FIG. 448.—Two very small tubercles from a tuberculous gland. Both show tubercle bacilli scattered through them. The lower one has two giant cells and is degenerating into caseous material at its centre. Magnified by 160. (Thoma's *Pathology*.)

tubercles fuse together, and, at the same time, soften to a cheesy substance, so as to form yellow bodies about the size of pin heads. Each grey tubercle, under the microscope, shows the appearance of a group of cells of medium size (epithelioid cells), surrounded by many smaller cells (connective tissue cells and white blood corpuscles), attracted to the spot as a result of the inflammation set up. Scattered between these cells lie the tubercle bacilli. Near the centre of the older tubercles there are often seen one or more large cells with many nuclei (giant cells). The larger yellow tubercles form a more or less structureless mass in the centre, but show numbers of the small grey tubercles round their edge.

Thus the process spreads, the healthy tissue being broken down and giving place to the soft, cheesy mass, which, in the case of the lungs, finally bursts into a bronchial tube, is coughed up, and leaves a ragged cavity in its place. Another change, however, takes place at the same time, for, in consequence of the irritation set up by the tubercle, strands of fibrous tissue are built up round its edge, and, when the process is a very chronic one, these come to form a dense capsule for the tuberculous area, cutting it off from further advance on healthy tissue, and forming nature's cure.

TUBERCULIDE is the term given to any skin lesion which is the result of infection with the tubercle bacillus.

TUBERCULIN is the name given to preparations derived from the tubercle bacillus and intended for the diagnosis or cure of tuberculosis. The original tuberculin, introduced by Koch in 1890, did not fulfil the hopes regarding it, and in fact often produced disastrous results owing to its injudicious use.

Since that time various modifications have been introduced for curative purposes, and have been extravagantly lauded by some physicians and condemned by others. Some forms of tuberculin are used for the diagnosis of the disease both in veterinary and in human medicine.

Varieties.—Koch's Old Tuberculin (T.) was made from a culture of the human tubercle bacillus grown for 4 or 5 weeks in glycerin broth; this was boiled, concentrated, and filtered. It contained, therefore, the poisons produced by the bacilli and poisons extracted from them in boiling, but no bacilli. Koch's New Tuberculin (T.R.) contained the solid residue of fragments of the bacilli ground up in a mortar. Preparations similar to these were also made from bacilli derived from tuberculosis in cattle (German *perlsucht*) and known as Tuberculin P.T. and P.T.R. Still other preparations were made by growing and filtering off the bacilli without boiling, and these milder forms not containing the poisons produced within the bacilli were known as Tuberculin T.O.A. (human) and P.T.O. (bovine); these are also concentrated without boiling and are then known as Vacuum Tuberculins. Bacillary Emulsions, Tuberculin B.E. (human) and P.B.E. (bovine) contain the bacilli ground up in glycerin and water. Albumose Free Tuberculin (A.F.) is prepared by growing the bacilli in some substance that does not contain albumin, and is thus free from one source of harmful effect.

Other tuberculins are prepared with slight modifications by various manufacturers, *e.g.* Beraneck's, Wellcome's Tuberculins.

Uses. — (*a*) DIAGNOSIS. — The old tuberculins, either human or bovine, may be injected under the skin for this purpose. A very small dose ($\frac{1}{10000}$ cubic centimetre) must be used, and is injected at a time when the patient's temperature is steadily normal. If the patient is tuberculous the system is in a condition of special irritability to fresh tuberculous poison, and a 'reaction' takes place, of which the most noticeable feature is a rise in temperature. A non-tuberculous person remains unaffected. If the reaction does not take place markedly on the first occasion, it is likely to do so in a tuberculous person when the injection is repeated a few days later. A similar method is pursued in testing cattle; but a large dose of the bovine tuberculin is used.

Methods other than injection may also be used. Thus a drop of old tuberculin may be applied to a scratch on the surface (von Pirquet's reaction), or it may be embodied in ointment which is rubbed in (Moro's reaction), or mixed with water and dropped in the eye (Calmette's reaction), or applied to the surface rawed by a blister (Woodcock's reaction). In each case, if the person is tuberculous, localised swelling and redness appear, while a healthy person is unaffected.

All these tuberculin tests are liable to the fallacy that if very extensive disease be present the worn-out tissues may fail to react; while, on the other hand, a person who for practical purposes is quite healthy may give a violent reaction in consequence of some unsuspected focus of tuberculosis like a small gland.

(*b*) TREATMENT.—Tuberculin should be used only in carefully selected cases, especially those in which the patient is tending towards recovery, when it is

desired to help and hasten the natural healing process. The tuberculin is then supposed to hinder the tubercle bacilli and act as a gentle stimulus. It is usually administered by injection beneath the skin. Some authorities recommend a very minute dose short of that required to produce a rise in temperature; others give many thousand times this moderate dose at each injection. Various Dispensaries have been set up both in England and in America for the purpose of supplying this method of treatment to the poor.

TUBERCULOSIS (*tuberculum*, a little lump) is the general name for the whole group of diseases associated with the presence of the tubercle bacillus, of which consumption is the most important. (*See* BACTERIOLOGY, CONSUMPTION, JOINTS, DISEASES OF.)

Tuberculosis not only affects the lungs, but may invade almost any organ, being, however, seldom found in the muscles (a fact of much importance in the prevention of the disease), or in tissues with few blood-vessels, like cartilage and sinews. The disease spreads usually by way of the lymphatic vessels, and is apt to be more acute and general when it is carried in the blood. The severity of the disease varies considerably, according to the organ attacked — thus tuberculosis of the bowels produces even more speedy consumption than the lung disease, while tuberculosis affecting the membranes of the brain and causing meningitis is almost always rapidly fatal. Chronic inflammation of bones and white-swelling of joints are also manifestations of the disease, having, however, less influence upon the general health. The enlargement of glands, most common in the neck, to which the name of scrofula (Latin *scrofa*, a pig) was formerly given, because the swollen neck gives to the physiognomy a pig-like expression, is a well-known form of tuberculous disease. This form of the disease seems to have been much more widespread in former times, and was known also as 'king's-evil', from the superstition that a touch of the royal hand conveyed a cure to the affected person. Almost all chronic abscesses are tuberculous in origin, arising from this affection in a bone, a gland, or the cellular tissue. Finally, the disfiguring skin disease known as lupus is another of the manifestations of the disease. There is a tendency for the disease, beginning in one form, to affect other organs, though, in perhaps the greater number of cases, the disease is limited to the organs originally attacked.

Eradication of Tuberculosis.—A steady diminution in the number of persons who are affected by tuberculosis has been noticeable for more than fifty years past. This is borne out, for example, by the death-rate due to tuberculosis of the lungs in Scotland. In 1871 the death-rate per hundred thousand in Scotland from phthisis was nearly 270: in 1881 it had fallen to about 206; in 1891 to 189; in 1901 to 151; and in 1911 to 114. After a further decrease to 104 in 1914, there was a slight rise during the years of the war, with an increased fall afterwards, as shown by the following table. A similar diminution has taken place in the other forms of tuberculosis (in bones, joints, glands, etc.).

Year.	Pulmonary Tuberculosis.		Non-pulmonary Tuberculosis.	
	Deaths.	Death-rates per 100,000 of Population.	Deaths.	Death-rates per 100,000 of Population.
1914	4917	104	2779	58
1916	5126	107	2546	53
1918	5217	108	2483	52
1920	4194	86	1848	38
1922	4041	82	1777	36
1924	3887	80	1766	36
1926	3770	69	1477	27
1928	3318	68	1404	28
1930	3024	62	1262	25
1932	2991	61	1132	23
1934	2794	57	908	18
1936	2753	55	911	18

Apart from the treatment of individual cases the general measures adopted for its eradication are:

1. THE DISPENSARY SYSTEM introduced by Sir Robert Philip in 1887, by which cases of lung disease in large towns are classified, treated, serious ones sent to sanatoria, and their dwellings and families investigated so as to deal with other early cases and educate those exposed to infection how best to avoid it.

2. PREVENTION OF BOVINE INFECTION, especially by obtaining a pure supply of milk, cream, and butter from healthy cows; or if the milk be suspected, by sterilisation of all milk to be consumed by children. (*See* MILK.)

TUBULAR (*tubulus*, a small pipe) is a term used in two distinct senses. It is applied to disease affecting the small tubes of an organ, *e.g.* tubular bronchitis, tubular nephritis. It is also applied to the peculiar, high-pitched breath-sounds heard on auscultation over a very dense area of consolidation in the lung.

TULAREMIA is a disease of rodents such as rabbits and rats, caused by the *Bacterium tularense* and spread either by flies or by direct inoculation, for example, into the hands of a person engaged in skinning rabbits. In man the disease takes the form of a slow fever lasting several weeks with much malaise and depression, followed by considerable emaciation. It was first described in the district of Tulare in California, but is found widely spread in North America and in Europe.

TUMOR (*tumor*) means literally any swelling, but, by common consent, the term is held not to include passing swellings caused by acute inflammation, while the collections of diseased material arising in the course of chronic inflammation, like tuberculosis, syphilis, leprosy, and glanders sometimes are and sometimes are not classed as tumors, according to their size and appearance.

Varieties.—Perhaps in no department of medical science does so much confusion exist as in the classification of tumors, while the ideas as to their causation are equally vague. Some are of an infective nature, as already stated; some arise undoubtedly as the result of injury; several contributing factors are mentioned under the heading of CANCER, but for the rest, the causes of tumors are really still undiscovered.

An old idea divides tumors into two great classes. On the one hand, some are *simple* or *benignant*, growing slowly at one spot, pressing neighbouring parts aside but not invading them, not recurring after removal, and having little tendency to ulcerate; while others are *malignant*, spreading quickly from point to point, invading and destroying surrounding tissues, tending to recur after apparently complete removal, and being very liable to ulcerate. This distinction is as old as the days of Hippocrates, who gave to gnawing tumors the name of carcinoma (*καρκίνωμα*). Though in the majority of cases it is easy to decide whether a given tumor is of simple or malignant character, there is no sharp dividing line between the two kinds. Thus an expert sometimes has difficulty in stating from the microscopic characters of an *adenoma* (glandular tumor) growing in the breast or in the bowel, whether its progress will show a simple or malignant course. Again, *rodent ulcer*, a small ulcerating tumor situated generally on the face, may remain restricted to a single spot for twenty or thirty years though it has the microscopic characters of a malignant tumor and finally spreads like one. Another fact connecting the two groups is that many simple tumors, persisting as such through middle life, are liable to assume a malignant character when old age is reached.

Formerly tumors were named according to some peculiarity of shape, colour, etc. Thus a fungoid tumor was one resembling a mushroom, a polypus one which seemed to have one stalk with many feet, a mole was a dark hairy growth resembling the animal of that name, and sarcoma (*σάρκωμα*) was originally the name given by Galen to a tumor of fleshy appearance. Recently, however, the use of the microscope has brought about a more precise grouping, and tumors are now classed according to the tissues of which they are built, somewhat as follows:

(1) Simple tumors of normal tissue.
(2) Hollow tumors or cysts, generally of simple nature.
(3) Malignant tumors (*a*) of imperfect cellular structure resembling the cells of skin, mucous membrane, or secreting glands; (*b*) of imperfect connective tissue.

(1) SIMPLE TUMORS OF NORMAL TISSUE.—ADENOMA is a tumor growing from a gland and composed of gland-like tissue. These tumors are specially common in the breasts of young women; there may be several together, but they are very easily removed in general.

ANGIOMA is a tumor formed by a mass of small blood-vessels or spaces in which blood circulates. These tumors may exist in internal organs, or on the skin, when they do not project much, and are known as 'nævi' or 'mothers' marks'. Those which project some distance can often be removed, though little can be done for the widespread

'port-wine marks' which often disfigure the face.

CHONDROMA is a tumor mainly formed of cartilage. These tumors develop especially on the fingers and toes.

FIBROMA is the name given to a tumor consisting mainly of fibrous tissue. Soft fibromata are often seen as wrinkled brownish tags upon the face or body. Fibromata growing in deeper parts of the body are very closely allied to sarcomata (*see below*).

LIPOMA means a tumor mainly composed of fat. Such tumors may be found in any part of the body, but they are specially common just beneath the skin. It is sometimes hard to distinguish such a tumor, which is very soft, from a chronic abscess; but the fatty tumor generally has a firm edge and can be seen to be attached at several points to the skin, which is puckered by these attachments.

MYOMA is a tumor composed largely of muscle fibres, usually unstriped muscle. These tumors are far more commonly found in the wall of the womb than in any other position, being known as 'fibroid' tumors.

NEUROMA is a tumor growing upon a nerve and therefore in many cases producing pain. These neuromata are generally made up of fibrous tissue.

OSTEOMA is a tumor composed of bone. These are usually of small size and cause little trouble, except in so far as their position occasions discomfort. They frequently develop in children suffering from rickets.

PAPILLOMA is a tumor projecting from the surface of the skin or of a mucous membrane. It is composed of a core of fibrous tissue, which represents an over-development of the papillæ naturally found in these situations, covered by masses of cells. Warts are examples of papillomata on the skin (*see* WARTS), while soft papillomata sometimes develop in the bladder or bowel and cause much bleeding.

(2) **HOLLOW TUMORS** are described under a special heading. (*See* CYSTS.)

(3) **MALIGNANT TUMORS** of imperfect cellular structure resembling the cells of skin, mucous membranes, or secreting glands, are known generally as CANCERS. This group and the following group are treated together under the heading of CANCER AND SARCOMA. Many names are applied to cancers of different parts and according to their appearance. The name CARCINOMA is generally reserved at the present day for a cancer of some internal organ. EPITHELIOMA is a cancer springing from the skin surface, and ENDOTHELIOMA means one originating in the cellular lining of minute blood-vessels or of serous membranes. SCIRRHUS is a hard cancer in which much fibrous tissue has been developed; MEDULLARY or SOFT cancer is one in which the softer cellular element forms large masses; and COLLOID cancer is one in which a peculiar glue-like transformation takes place.

Malignant tumors of imperfect connective tissue are at the present day known as SARCOMATA; and, according to the shape of the embryonic cells, or the nature of attempts at the formation of connective tissues, these are subdivided as ROUND-CELLED, SPINDLE-CELLED, MELANOTIC, MYELOID, etc.

Symptoms.—The symptoms of simple tumors are, as a rule, nothing beyond the presence of a swelling, and such accidental symptoms as those set up by its pressure upon neighbouring important organs, by the inconvenience of its size, its position, and the like. The special symptoms of malignant tumors are referred to under CANCER AND SARCOMA.

Treatment.—The treatment of a tumor is, in general, its removal by a cutting operation. With regard to simple tumors, the advantage gained by removal is frequently not worth the inconvenience caused by an operation, and such tumors may be let alone. In particular cases, the unsightliness of the tumor, the inconvenience of its size, or the tendency that some simple tumors have to become malignant may call for removal. If a tumor be malignant, or if there be any doubt as to its character, an operation should be performed at the earliest possible opportunity. For some surface tumors and also for inoperable tumors in internal organs the application of radium and X-rays has in recent years played a great part. (*See* RADIUM *and* X-RAYS.)

TUNNEL WORM is another name for the ankylostoma. (*See* PARASITES.)

TURBINATE, or TURBINAL (*turbo*, top), is the name applied to the three processes on the outer side of each nasal fossa, formed by bony projections covered by thick mucous membrane. These serve to warm and moisten the air as it passes over them into the upper air passages on its way to the lungs. The lowest of these, the inferior turbinate process, is apt to become inflamed and enlarged, leading in some cases to blockage of the nose. In such cases it requires to be reduced in size by various astringent applications or by the electro-cautery, or to be removed by operation.

TURNING (*see* VERSION).

TURN OF LIFE is a term applied to the menopause. (*See* CLIMACTERIC.)

TURPENTINE is the oleo-resin which exudes from trees of the pine family when the bark is injured. The oil distilled from this is known as oil of turpentine, rectified turpentine, or spirit of turpentine, the residue being the resin or rosin. The natural turpentine, containing resin, is not used in medicine, since it is highly irritating; and when the word turpentine is used, the distilled product is always understood. The turpentine obtained from the ordinary yellow pine is the common form, that obtained from the silver fir is known as Canada balsam or balm of Gilead, and that got from the larch as Venice turpentine. Chian turpentine is got from the *Pistachia terebinthus*, an Eastern tree.

Action.—Turpentine has an action similar to that of other essential oils. It is highly irritating to any surface with which it is brought in contact, is antispasmodic, and, especially when it has been exposed to the air, is powerfully antiseptic.

Uses. — *Externally*, turpentine is largely used as a counter-irritant. It forms one of the most common ingredients of liniments and embrocations for application to sprains and bruises. It is used with hot fomentations when a specially strong action is desired, a fomentation sprinkled with turpentine being known as a 'stupe'. (*See* FOMENTATIONS.) In chronic bronchitis, rubbing the chest with turpentine is a favourite household remedy which is often beneficial.

Internally, turpentine is administered in small doses of 5 or 10 drops in warm milk to check bleeding from internal organs, though it is doubtful if it exerts any great action. In lumbago and other forms of chronic rheumatism, 5 drops of turpentine taken upon a lump of sugar thrice daily over a long period is an old household remedy which is often very effective after all other means of cure have failed. As an enema, an ounce of turpentine may be mixed with half a pint of soapy water in order to relieve flatulence.

TWILIGHT SLEEP is the name given in America to a method of anæsthesia sometimes used in surgical operations but particularly in childbirth. The unconsciousness of pain is brought about by the hypodermic injection of morphia in full dose, with a small dose of scopolamine which is repeated about once an hour throughout the course of the labour or until the patient is unconscious. This method has the advantage over inhalation of chloroform or of other general anæsthetic that the sleep can be maintained throughout the whole course of the labour. But it is generally admitted that there are serious drawbacks connected with its use, of which the chief are that the expulsive efforts of the womb are weakened and the labour thereby prolonged, that bleeding is apt to be more profuse in consequence, and that the child is apt to be prejudicially affected, especially in that there is sometimes difficulty in getting it to commence breathing immediately after it is born.

TYMPANITES (*τυμπανίτης*) means distension of the abdomen due to the presence of gas or air in the intestine or in the peritoneal cavity. The abdomen, when struck with the fingers, gives under these conditions a drum-like (tympanitic) note.

TYMPANUM (*tympanum*, a drum) is another name for the middle ear. (*See* EAR.)

TYPEWRITER'S CRAMP (*see* CRAMP, TRADE DISEASES).

TYPHLITIS (*τυφλόν*, the blind end of the large intestine) means inflammation

of the cæcum or first part of the large intestine, into which the small intestine and the appendix vermiformis open. As the associated condition of appendicitis is of far greater importance than typhlitis, the latter name is little used.

TYPHOID FEVER (*see* ENTERIC FEVER).

TYPHOMALARIAL is a term applied to fevers which are of malarial origin but show typhoid symptoms.

TYPHUS FEVER (from τῦφος, smoke or mist, in allusion to the stupor of the disease) is a continued fever of highly contagious nature, lasting for about fourteen days and characterised mainly by great prostration of strength, severe nervous symptoms, and a peculiar eruption on the skin. It has received numerous other names, such as spotted, pestilential, putrid, jail, hospital fever, etc. It appears to have been known for many centuries as a destructive malady, frequently appearing in epidemic form, in all countries in Europe, under the conditions to be afterwards mentioned. The best accounts of the disease are those given by English writers, who narrate its ravages in towns and describe many 'black assizes', in which it was communicated by prisoners brought into court to the judges, jurymen, court officials, etc., with fatal effect, producing oftentimes a widespread consternation. Typhus fever would seem to have been observed in almost all parts of the world, but especially in temperate or cold climates.

Causes.—This fever is most frequently found to affect the poor of large cities and towns, or to appear where large numbers of persons are living crowded together in unfavourable hygienic conditions, as has often been seen in prisons, workhouses, etc. Armies in the field are also liable to suffer from this disease; for instance, during the Crimean War it caused an enormous mortality among the French troops. At the present day the introduction of the *Rickettsia prowazeki* into the body is believed to be the essential cause. The disease has been proved to be carried generally by lice, but is now much less common than formerly, being limited in general to the most insanitary part of some of the largest cities, where limited epidemic outbursts of the disease occur from time to time, under the conditions of overcrowding and poverty. All ages are liable to typhus, but the young suffer less severely than the old. Typhus is highly contagious throughout its whole course and even in the early period of convalescence. The contagion, however, rarely spreads in well-aired wards or houses, where cases of the disease are under treatment. As a rule, one attack

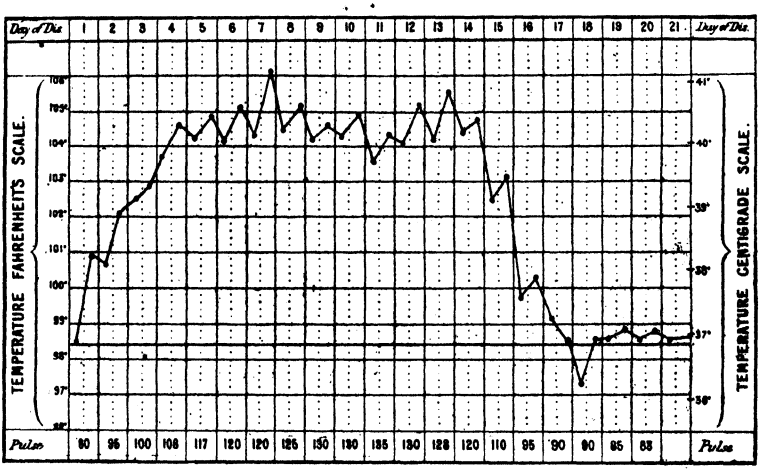


FIG. 449.—Chart showing the ordinary course of the temperature in a case of typhus fever. The fall by sudden crisis differs markedly from the gradual subsidence in typhoid fever.

of typhus confers immunity from risk of others.

Symptoms.—The course of typhus fever is characterised by certain well-marked stages. (1) The stage of *incubation* (the period elapsing between the reception of the fever poison into the system and the manifestation of symptoms) is believed to vary from a week to ten days.

(2) The *invasion* of the fever is in general well-marked and severe, in the form of a distinct shivering lasting for hours, and a sense of illness and prostration, together with headache of a distressing character, and sleeplessness. Feverish symptoms soon appear and the temperature rises to a considerable height (103°-105° Fahr.), at which it continues with little daily variation until about the period of the crisis. The pulse is rapid (100-120 or more) and at first full, but later feeble. The tongue, at first coated with a white fur, soon becomes brown and dry, while sordes (dried mucus, etc.) accumulate upon the teeth; the appetite is gone, and intense thirst prevails. The bowels are, as a rule, constipated, and the urine is diminished in amount and high-coloured. The physician, on examination, may make out distinct enlargement of the spleen.

(3) The third stage is characterised by the appearance of the *eruption*, which generally shows itself about the fourth or fifth day or later, and consists of dark-red (mulberry-coloured) spots or blotches. They appear chiefly on the abdomen, sides, back, and limbs, and occasionally on the face. Besides this, the characteristic typhus rash, there is usually observed a general faint mottling all over the surface. After the appearance of the eruption, the patient's condition seems to be easier; but this is also to be ascribed to the tendency to pass into the typhus stupor which supervenes about this time, and becomes more marked throughout the course of the second week. The patient now lies prostrate on his back, with a dull dusky countenance, an apathetic or stupid expression, and contracted pupils. All the febrile symptoms already mentioned are fully developed, and delirium, usually of a low muttering kind, but sometimes wild and maniacal (*delirium ferox*) is present both by night and day. The peculiar condition to which the term 'coma vigil' is applied, in which the patient, though quite unconscious, lies with eyes widely open, is regarded, especially if persisting for any length of time, as an unfavourable omen.

(4) A *crisis* or favourable change takes place about the end of the second or beginning of the third week (on an average the fourteenth day), and is marked by a more or less abrupt fall of the temperature (*vide* chart) and of the pulse, together with slight perspiration, a discharge of urine, the return of moisture to the tongue, and by a change in the patient's look, which shows signs of returning intelligence. Although the sense of weakness is extreme, convalescence is in general steady and comparatively rapid.

Typhus fever may, however, prove fatal during any stage of its progress and in the early convalescence, either from exhaustion, from sudden failure of the heart's action, from the supervention of some nervous symptoms, such as meningitis or deepening coma, or especially from broncho-pneumonia.

Treatment.—The patient should be strictly isolated, and treatment in a large room, or even under open-air conditions, is both good for the patient and useful in checking infection. The main element in the treatment of this fever is good nursing, and especially the regular administration of food, of which the best form is milk, although light plain soup may also be given. Stimulants may become specially necessary about the time of the crisis. Headache is with many a very distressing symptom, but may be mitigated by applying cold to the head.

U

ULCER (*ulcus*) means a breach on the surface of the skin or on the surface of the membrane lining any cavity within the body, which does not tend to heal quickly: The process by which an ulcer spreads and which involves the death of minute portions of tissue round its edge is known as ' ulceration '. The process of ulceration and that of abscess formation are the same, since both are inflammatory processes, though ulceration takes place along a surface from which its discharge escapes at once, while an abscess spreads in every direction from a centre and its products are for a time retained. The microscopic changes that take place when an ulcer forms will

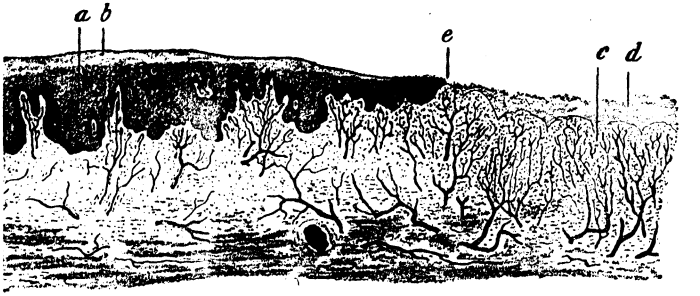


FIG. 450.—Vertical section through the edge of a simple ulcer. On the left is the healthy surface, to the right is the bare ulcerated surface. *a*, Malpighian (growing) layer of the cuticle spreading over the edge of the ulcer at *e*; *b*, its horny layer; *c*, granulation tissue forming the floor of the ulcer; *d*, discharge on its surface. Magnified by 21. (Thoma's *Pathology*.)

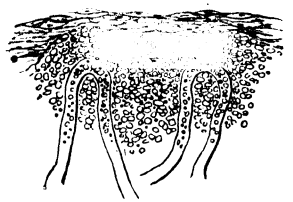


FIG. 451.—Two granulations from the floor of an ulcer more highly magnified. Two capillary loops are shown surrounded by cells, and, nearer the surface, are cells engaged in the formation of fibrous tissue. (Miller's *Surgery*.)

therefore not be described in detail, as the features of an inflammatory process have been already described under ABSCESS, ACUTE.

An ulcer consists of a 'floor' or surface, which, in consequence of the loss of tissue, is usually depressed below the surrounding healthy surface, and an ' edge ' where the healthy tissues end. The floor of a healing ulcer is composed of 'granulations ', which are small masses of cells engaged in forming connective tissue and richly supplied with capillary blood-vessels that give the ulcer a bright-red appearance ; while the edge shows a ' blue line ' of growing epithelial cells, which are constantly spreading inwards. In the process of healing, the fibrous tissue formed by the granulations contracts and thus draws the edges of the ulcer together and gives a puckered appearance to the scar. If anything interferes with these natural processes, the ulcer is prevented from healing.

Varieties.—Ulcers are sometimes classified as *local* when they are found at one spot only, such as the varicose ulcer found on the lower part of the leg ; and *constitutional* when there are usually several ulcers on different parts of the body, produced chiefly by some constitutional defect. LOCAL ULCERS are further subdivided as follows, according to their symptoms or appearance.

SIMPLE OR SLOWLY HEALING ULCER has been already described. The floor is moderately red and slightly sunk, the skin around is healthy up to the margin of the ulcer, and at the edge there is a blue line, which is of great importance as showing the progress of the healing.

Such an ulcer has a very slight white discharge and is quite free from smell.

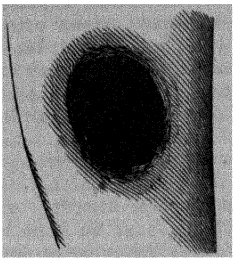


FIG. 452.—Simple healing ulcer, showing the granular surface and healing margin. (Miller's *Surgery*.)

INFLAMED ULCER is one which, as the result usually of the presence of bacteria, or in consequence of continued irritation, is still spreading. The floor of such an ulcer is very red and bleeds easily, the skin around is red and swollen,

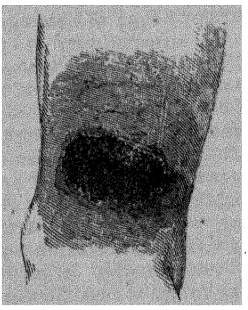


FIG. 453.—Inflamed ulcer, with breaking down edge surrounded by redness. (Miller's *Surgery*.)

there is a thick discharge of pus from the surface, and portions of the reddened skin at its edge or in its neighbourhood tend to die and thus form new ulcers. Such an ulcer, if it has become infected with very virulent bacteria, may involve the death of the patient.

WEAK ULCER is an appearance which the ulcers of weakly people, especially those suffering from dropsy, tend to assume. The granulations are soft, project above the surface, forming what is popularly known as 'proud flesh', bleed easily, and prevent the healing edge of the ulcer from growing inwards.

CALLOUS ULCER is the type of chronic ulcer most frequently met. The edge is thick and hard, the colour pale, few granulations are present, and the discharge in consequence is thin and small in amount, though often very offensive in smell.

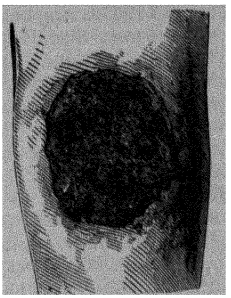


FIG. 454.—Weak ulcer, showing the protruding granulations. (Miller's *Surgery*.)

IRRITABLE ULCER is one which resembles in a mild degree the inflamed ulcer, and has the special character of being extremely painful to touch.

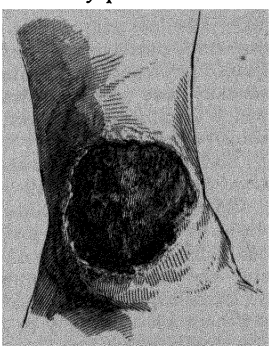


FIG. 455.—Callous or indolent ulcer, with smooth floor and thick hard margin. (Miller's *Surgery*.)

VARICOSE ULCER may belong to any of the above types. It generally comes on as the result of scratching the skin of a leg which has been rendered eczematous by the bad circulation. It will not heal so long as the patient walks about, and has a great tendency to develop into a callous ulcer.

INTERNAL ULCERS develop sometimes in the mouth (*see* MOUTH, DISEASES OF); in the stomach (*see* STOMACH, DISEASES OF); in the bowels (*see* INTESTINE, DISEASES OF); in the lining membrane of the heart (*see* HEART, DISEASES OF); and in other parts. Some of these are of a local character, though many are constitutional.

CONSTITUTIONAL ULCERS are generally the result of some widespread weakening

disease such as syphilis or tuberculosis. SYPHILITIC ULCERS have the characters of possessing a very abrupt edge, as if punched out, and of leaving behind after healing a brownish discoloured scar. TUBERCULOUS ULCERS may arise from the bursting of a tuberculous abscess under the skin; while the very chronic skin disease known as lupus, which may persist for a lifetime, healing at one part and breaking out at another, is a variety of tuberculous disease.

MALIGNANT ULCERS are developed when a cancer spreads so as to involve the skin. Such an ulcer has often a very offensive smell, requiring the use of deodorant substances.

TROPHIC ULCERS are apt to appear as the result of weakened nerve influence, *e.g.* the deep perforating ulcer on the sole of the foot in locomotor ataxia, or bed sores in people sick of some lingering disease. (*See* BED SORES.)

Causes.—An ulcer may be set up by any cause which damages the surface of the body and prevents immediate healing. Naturally, any constitutional condition which diminishes the vitality or the healing power of the body acts in this way, and among these causes may be mentioned old age, general ill-health, scurvy, diabetes, gout, syphilis, and tuberculosis, so that wounds produced in persons suffering from any of these conditions are apt to form ulcers. Defective circulation in the direction either of a poor blood supply or of the stagnation which takes place in varicose veins is another important cause. Constant movement of any part on which there is a wound is quite sufficient to delay its healing and produce an ulcer. Every one knows, for example, how difficult it is to heal a small crack at the corner of the mouth. Irritation of the ulcer by pressure, or by discharges pent up under dressings that are too seldom changed, or even by the application of strong lotions to the ulcer may prevent its healing.

Dangers.—A person afflicted with a large ulcer is to a great extent incapacitated from active work, and the presence of any such septic condition has a prejudicial effect upon the general health. Further, the person always runs the risk of an attack of acute inflammation starting from the ulcer, which may cause his death. A varicose ulcer has a peculiar danger of its own, consisting in the liability of the veins to become ulcerated and to burst, causing profuse bleeding. Even after a very chronic ulcer has healed, its scar contracts and in doing so may cause disfigurement or may even interfere with the usefulness of a limb, if situated near a joint. Finally, ulcers which have lasted many years seem prone to become the seat of cancer.

Treatment.—In treating an ulcer, three objects must be kept in view: (1) To remove the cause of ulceration; (2) to render the floor and edge of the ulcer healthy so that healing may commence; (3) to assist the healing process and ward off any source of irritation.

(1) REMOVAL OF THE CAUSE.—Any constitutional condition underlying the development of the ulcer must first of all be treated, because otherwise the tissues surrounding the ulcer are unable to exert their power of healing. Thus syphilis or tuberculosis, if present, requires the careful nourishment and special remedies suited to these diseases, while old age, scurvy, diabetes, and other conditions demand appropriate treatment. Bodily rest is also of great importance for the healing of an ulcer; and especially is this the case in ulcers of the leg, where constant movement combines with bad circulation to prevent healing. Accordingly, large varicose ulcers may refuse to heal till the person takes to bed, but when this is done, improvement is often rapid. This beneficial effect is still further aided, in the case of varicose ulcers, by raising the leg on a pillow or by elevating the foot of the bed on props so that the ulcer is brought above the level of the heart. When for any reason the person cannot lie in bed for several weeks, the evils of movement and the dependent position of the leg can be neutralised to some extent by wearing an elastic bandage over the dressing, which is applied every morning before the patient gets out of bed. Though this treatment will benefit any ulcer of the leg, it is not likely to cure a large one. (*See* VEINS, DISEASES OF.)

(2) RENDERING THE ULCER HEALTHY aims at converting any of the severer forms, *e.g.* the inflamed, weak, irritable, or callous ulcer, into the simple type,

which is the first step necessary in the healing process. When the ulcer is *inflamed*, it must be treated with active antiseptics such as eusol, acriflavine, or perchloride of mercury lotion, and the dressing covered by oil-silk or gutta-percha tissue. As soon as the ulcer has been purified, however, these strong antiseptics must be discontinued, since they retard the healing process. Sometimes the ulcer is purified quickly by the surgeon, who makes an application of undiluted carbolic acid to its surface, or scrapes away the diseased tissues thoroughly under an anæsthetic. Oxygen is sometimes used as a purifying agent, the gas being led under a closed vessel placed over the ulcer. In mild cases of inflammation, charcoal, iodoform, and various weak antiseptics are sometimes used. *Weak ulcers* are treated with blue-stone, red lotion, silver salts, or other substances which have an astringent effect upon the 'proud flesh' and stimulate the edge and floor of the ulcer. *Callous ulcer* is by far the most common variety that needs special treatment. The reparative material, which has been accumulated in the edges and floor, and which obstructs the circulation near the ulcer, and prevents healing, must be absorbed. This is effected sometimes in slight cases by massage of the skin near the ulcer, in other cases by blistering the thick edge all round the ulcer. Generally, continued pressure is the method chosen, and this is effected in one or other of two ways. The old method was by 'strapping' the ulcer; which consists in wrapping several overlapping strips of adhesive plaster round the limb so that the ends of the strips cross the ulcer and press its sides together. The more modern and more frequently used method is to wear during the day a pure rubber (Martin's) bandage, which is applied to the leg from the ball of the foot up to the knee, passing over the dressing upon the ulcer with a very slight degree of pressure. The bandage is removed and washed every night. To be successful, this treatment must be combined with complete rest and elevation of the ulcerated part. An *irritable ulcer* is treated by applying some form of caustic to the surface of the ulcer in order to destroy the sensitive nerve-endings in it. In slighter cases, when the mere contact of the dressings appears to irritate the ulcer, this may be avoided by leaving off all dressings and covering the ulcer simply with a little wire cage or a celluloid shield and washing the ulcer daily with boracic lotion.

(3) ASSISTANCE OF THE HEALING PROCESS.—When the ulcer has been purified and its floor and edges rendered healthy, a very simple dressing must be used. Care should be taken in dressing not to irritate the ulcer and make it bleed, and the very greatest care must be taken of the blue line at the ulcer's margin, as this is the healing part. The frequency of dressing the ulcer is a point of great importance; for, if the dressing be too frequently renewed, the healing tissues are unnecessarily disturbed and damaged, while, if the dressing be very seldom changed, pus is apt to collect and by its decomposition to inflame the ulcer. The usual interval allowed to elapse between the successive dressings of a healing ulcer is two or three days, or less if there be much discharge. The ulcer must be washed with some mild fluid like weak boracic lotion, and strong lotions like carbolic are quite inadmissible for a healing ulcer. The best dressing is a piece of clean lint or gauze, but this should be kept from actual contact with the ulcer by a piece of oil-silk perforated here and there and just large enough to cover the red 'granulations' of the ulcer's floor without touching the edge. At each dressing, the lint, etc., must be thoroughly soaked before removal, not pulled away roughly; otherwise the healing tissues, especially the 'blue line' at the edge, are damaged and torn. At each dressing, too, the piece of oil-silk is reduced in size. When an ulcer has become quite clean and is healing rapidly, one of the best forms of dressing consists of a weak boracic ointment spread on lint.

The healing of a large ulcer, after it has been rendered clean, may often be hastened by grafting its surface with skin from another part. (*See* SKIN-GRAFTING.)

For the treatment of internal ulcers, see under the headings of the organs in which they occur.

ULERON is the proprietary term for a drug of the sulphonamide group (*see*

SULPHANILAMIDE and SULPHAPYRIDINE) which is supposed to be especially effective in the treatment of staphylococcal infections. One of the complications of treatment with this drug is toxic neuritis.

ULITIS (*οὖλον*, gum) means inflammation of the gums.

ULNA is the name of the inner of the two bones in the forearm. It is wide at its upper end, and its olecranon process forms the point of the elbow. In its lower part it is more fragile and is liable to be broken by a fall upon the forearm, while something is grasped in the hand. Chipping off of the olecranon process is a frequent result of falls upon the elbow. (*See* FRACTURES.)

ULOGLOSSITIS means inflammation of the gums and of the tongue.

ULTRA- (*ultra*, beyond) is a prefix denoting excess.

ULTRA-VIOLET RAYS (*see* LIGHT).

UMBILICUS (*umbilicus*) is another name for the navel.

UNCINARIA (*uncus*, hook) is another name for hookworm. (*See* PARASITE.)

UNCINATE FIT is the term applied to a state in which the patient has a hallucination of smell or of taste; it may be a manifestation of epilepsy, or be the result of a tumor pressing on that part of the brain concerned with the appreciation of smell and taste.

UNCONSCIOUSNESS is a condition depending usually on some disorder of the brain, and may be of various degrees.

Varieties.—Sleep is a natural form of unconsciousness due to a resting condition of the brain (*see* SLEEP), and when the brain remains irregularly active various peculiar forms of unconsciousness or of disturbed consciousness are apt to ensue, such as delirium, somnambulism, hypnotism, catalepsy, ecstasy. (See under these headings.) In syncope or fainting, the brain ceases to act for a time in consequence of a bloodless state, brought on by feebleness of the heart's action. In the lesser forms of epilepsy (petit mal), the epileptic sometimes becomes unconscious of his surroundings, though able to perform such a simple act as to take off his clothing, or to run some distance, or even to attack another person.

STUPOR is the name given to a partial state of unconsciousness from which the person can be roused for a moment by some powerful stimulus such as a shout.

COMA means a condition of complete oblivion very near to death.

Causes.—Fainting is due to deficient supply of blood to the brain. Among injuries to the brain, apoplexy, compression, and concussion of the brain and inflammation affecting the brain or its membranes are the chief causes. Epilepsy is also a cause of passing unconsciousness either accompanied by a fit, or, in the slighter forms, without any such seizure. Narcotic poisons, chief among which stands opium, and drugs of the class to which alcohol and chloroform belong, also produce stupor. The poisons that accumulate in the blood during various diseases, such as Bright's disease and diabetes, may produce coma, that due to the latter disease being curable by insulin and glucose.

Treatment.—The cause of unconsciousness must first of all be determined. Fainting brings with it its own cure, and little is necessary beyond leaving the unconscious person recumbent. (*See* FAINTING.) The means of distinguishing the effects of narcotic poisons from those of apoplexy are given under OPIUM, and this distinction is important, since in apoplexy the main requirement is absolute quiet, while in poisoning cases energetic treatment is necessary. Unconsciousness due to compression of the brain, resulting from severe injury to the head, may have to be treated by trephining the skull. The unconsciousness of uræmia due to Bright's disease is perhaps the form most liable to be mistaken or overlooked, but doubts as to this are set at rest by examination of the urine. In this case also prompt treatment is essential if life is to be saved. For the treatment of unconsciousness due to other causes, the special symptoms present will in general indicate the cause and the treatment is given under other headings.

UNDINE is the name given to a small glass flask with drawn-out neck and an opening which can be closed by the finger. It is used for irrigating the eye with fluid. (*See* EYE DISEASES.)

UNDULANT FEVER is another name for Malta Fever, but especially for a variety of this disorder sometimes met in Britain and caused by the *Bacillus abortus* or, better, *Brucella abortus*. This organism produces contagious abortion in cattle, and is apt to be conveyed to man by contact with them or by their milk, when it gives rise to the symptoms described under MALTA FEVER.

UNGUENTUM is the Latin name for ointment.

UNIT (*unus*, one) is the term applied to a quantity assumed as a standard for measurement. The *diphtheria antitoxin unit* is the amount of antitoxin which must be mixed with the maximum fatal dose of diphtheritic toxin in order to preserve the life of a guinea-pig weighing 250 grams for at least 4 days after it has been inoculated subcutaneously with this mixture. The tetanus antitoxin unit is similarly determined. The *unit of insulin* is determined as that amount of insulin which lowers the percentage of sugar, in the blood of a rabbit weighing 2 kilos and previously starved for 24 hours, to 0·045 per cent within 3 hours; the 'clinical unit' used in marking phials of insulin for administration is one-third of this strength.

URACHUS (οὐραχός) is the name of a corded structure which extends from the bladder up to the navel, and represents the remains of the canal which in the fœtus joins bladder with allantois.

URÆMIA (οὖρον, urine; αἷμα, blood) is the condition which results from failure of renal function, as in Bright's disease (*q.v.*). It used to be thought that uræmia was caused by the retention in the blood of nitrogenous waste products. A more favoured view is that the symptoms of uræmia are due to the absorption of putrefactive products — such as phenols — from the intestine, and the failure of the liver, owing to its deranged function, to detoxicate these.

Symptoms.—Uræmia is sometimes classed as *acute*, *i.e.* those cases in which the symptoms develop in a few hours or days, and *chronic*, including cases in which the symptoms are less marked and last over weeks, months, or years. There is, however, no dividing line between the two, for in the chronic variety, which may be said to consist of the symptoms of chronic Bright's disease, an acute attack is at any time liable to come on.

Headache in the front or back of the head, accompanied often by insomnia at night and drowsiness during the day, is one of the commonest symptoms, though it is apt to be attributed to some other cause. Unconsciousness of a profound type, which may be accompanied by convulsions resembling those of epilepsy, is the most outstanding feature of an acute attack and is a very dangerous condition. If the person lives through an acute attack, he may suffer later from blindness, deafness, delirium, or some mild type of insanity characterised by delusions or by melancholia, or on the other hand he may make an apparently good recovery.

Another group of symptoms is associated with the lungs and may consist of great difficulty in breathing when the patient attempts to lie down, repeated attacks resembling asthma, or the peculiar type of breathing known as Cheyne-Stokes breathing. (*See* RESPIRATION.)

Still another symptom, which often precedes an acute attack, is severe vomiting without apparent cause.

Treatment.—The treatment of the chronic type of uræmia includes all the measures which should be taken by a person suffering from chronic Bright's disease. In the acute form, treatment must be immediate and energetic if the

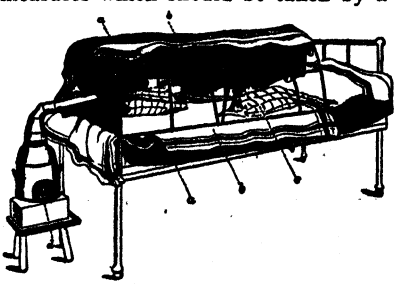


FIG. 456.—Simple arrangement for hot-air bath frequently used in the treatment of uræmia. It consists of a strong wire cage, under which the patient lies. *aa*, Waterproof sheets on bed and over cage; *bb*, blankets between patient and waterproof sheets; *c*, hot-water bottles in flannel; *d*, spirit lamp and funnel for supplying hot air under the cage. The patient lies under this cage closely wrapped in another blanket.

patient's life is to be saved. It consists mainly in getting the skin and bowels to perform the functions which the kidneys are unable for the time to overtake. Hot-air baths, hot packs, and diaphoretic drinks act upon the skin, while smart purgatives like compound jalap powder or even croton oil produce watery movements of the bowels and so relieve the kidneys. The withdrawal of blood from the loins by cupping, or from a vein in the arm, helps to diminish congestion of the kidneys and to withdraw poisons circulating in the blood. When convulsions are present, these are relieved by the inhalation of chloroform or administration of chloral.

URANORRHAPHY (*οὐρανός*, palate; *ῥαφή*, seam) is the name applied to an operation for closure of a cleft palate.

URATES (*see* URIC ACID).

UREA (*οὖρον*, urine), or CARBAMIDE, is a crystalline substance of the chemical formula $CO(NH_2)_2$, which is very soluble in water or alcohol. It is the chief waste product discharged from the body in the urine, being formed in the liver and carried to the kidneys in the blood. The amount varies considerably with the quantity and nature of the food taken, rising greatly upon an animal (protein) dietary. It also rises high during the continuance of a fever. The average amount secreted daily, during health, on a mixed diet is about 33 to 35 grams or slightly over one ounce.

Urea is administered for its diuretic action and also as a test of kidney efficiency, in doses of 15 grains to ½ oz.

Urea is rapidly changed, by a yeast-like micro-organism, into carbonate of ammonia; and to this chemical change the ammoniacal smell of badly kept latrines is due.

URETER (*οὐρητήρ*) is the tube, about the thickness of a goose-quill, which on each side leads from the corresponding kidney down to the bladder. Each ureter begins above at the pelvis of its kidney and after a course of 14 to 16 inches through the loins and pelvis it opens by a narrow slit into the base of the bladder. The lower end pierces the wall of the bladder so obliquely (lying embedded in the wall for about ¾ inch) that, though urine runs freely into the bladder, it is prevented from returning up the ureter as the bladder becomes distended.

URETHRA (*οὐρήθρα*) is the tube which leads from the bladder to the exterior, and by which the urine is voided. It is about 8 inches long in the male and 1½ inches long in the female.

URETHRA, DISEASES OF. — The urethra being merely a tube is not liable to many diseases. The chief conditions, however, which cause pain in the urethra, or interfere with the passage of urine, are urethritis or inflammation of the mucous lining, and stricture or narrowing of the tube.

URETHRITIS is often difficult to tell from inflammation of the bladder (cystitis), which, however, it may accompany and of which it is frequently the cause.

Causes.—The most frequent cause of urethritis is undoubtedly gonorrhœa, and this disease produces the most severe type of inflammation. Gout is another common cause, producing its effects either owing to the repeated passage of irritating gravel with the urine, or to a highly acid state of this excretion. The damage caused by the passage of a rough stone from the bladder or of a catheter unskilfully introduced may also occasion a severe urethritis; and various drugs or articles of diet, such as alcohol or arsenic, may bring on an attack in those who are liable to suffer from it.

Symptoms.—The symptoms consist chiefly in the constant oozing out of a small quantity of pus from the orifice of the urethra, a sense of scalding pain whenever urine is passed, increased redness of the mucous membrane as seen at the orifice, and tenderness along the course of the urethra. Subsequently, inflammation in neighbouring organs, *e.g.* the bladder, testicle, or even kidney, may be set up.

Treatment.—This varies with the cause of the inflammation, but in all cases the drinking of milk, water, and other bland fluids in large quantities is of advantage in order to flush out the urethra. The sulphonamide drugs and penicillin are highly effective in the treatment of gonorrhœa. The disease causing the inflammation requires special treatment according to its

nature, and, in addition, recourse is often had to local applications such as bougies of cocoa-butter and iodoform, astringent injections, etc.

STRICTURE is an abrupt narrowing of the tube at one or more places.

Varieties and causes. — SPASMODIC or CONGESTIVE STRICTURE is a merely temporary condition which is not of much importance. It follows upon exposure to cold, excessive exercise like bicycling, alcoholic indulgence, and frequently upon operations near the urethra, such as that for piles. It prevents the passage of urine for a few hours or days. It is treated simply by a warm sitz-bath or warm fomentations to the fork, and, if necessary, the urine is drawn off by means of a soft or flexible catheter passed along the urethra and through the stricture.

ORGANIC STRICTURE is a much more serious condition. It is a scar, due to previous injury or ulceration of the mucous membrane, which, by contracting after the manner of all scars, produces narrowing of the urethral tube. This scar is almost always due to one or other of two conditions, severe laceration of the urethra as the result of injury, or long-continued chronic inflammation

A stricture almost always occurs at one of two points: either just within the orifice of the urethra, or in the fork where the urethra turns upwards as it enters the pelvis.

Symptoms.—An organic stricture is of very slow development, and gives rise at first to few symptoms beyond those of the urethritis, etc., which cause it. As the stricture narrows, the stream of urine becomes smaller than natural, and there is straining and pain each time it is voided. Occasional attacks of spasmodic stricture are brought on by injudicious acts on the part of the person who already has an organic stricture; and this further narrowing of the tube causes complete stoppage of the urine for a time, accompanied by great pain, which results from distension of the bladder. After a stricture has lasted some years, unless it has been very carefully treated, and the person has led a well-ordered life, inflammation of the bladder almost certainly comes on, and the death of the patient may ultimately ensue from the spread of this inflammation upwards to the kidneys.

The existence, position, and calibre of a stricture are verified by the surgeon, who passes metal bougies of various sizes along the urethra.

Treatment.—The person who is the subject of a stricture must above all things live a moderate, well-regulated life, free from excesses of every kind. Highly spiced food, alcoholic beverages, and some forms of exercise, such as cycling and horseback riding, should be avoided. The diet should be simple and constipation must be prevented. By these means unnecessary irritation of the stricture is avoided, and thus spasmodic attacks with retention of the urine are warded off.

To check the gradual narrowing of the stricture some operative procedure is necessary, and, according to the situation and nature of the stricture, it is either *dilated* by means of bougies passed along the urethra, or it is divided by a special instrument passed along the urethra (*internal urethrotomy*), or by an incision made through the fork (*external urethrotomy*). After-treatment, consisting in the passage of a bougie at regular intervals of some weeks or months, is necessary after any of these operations, in order to counteract the permanent tendency of the stricture to contract.

INJURIES TO THE URETHRA may follow a severe crush which has fractured the pelvis, or a fall astride of some object. The signs of this are the presence of blood in the water, or inability to pass water at all, after such an accident. The great risks are the occurrence of an abscess round the urethra, and the formation of a stricture at a later period.

URIC ACID (*οὖρον*, urine) is a crystalline substance, very slightly soluble in water, of chemical formula $C_5N_4H_4O_3$. It is white in the pure state, but when found as a urinary deposit it is yellow, presenting a supposed resemblance to cayenne pepper. The bi-urate of sodium and urate of ammonium occur in considerable amount in the urine during a feverish state or after great exertion, and produce, as the urine cools, a dense pink or yellow sediment. The total daily quantity of uric acid passed by human beings seldom exceeds 10 grains, although in the urine of birds

and reptiles uric acid is the chief nitrogenous constituent, taking the place of the urea secreted by human beings. Uric acid, like urea, is formed in the liver and removed by the kidneys from the blood. The amount is increased in the following conditions :

(*a*) Over-much meat diet, combined with sedentary habits. (*See* ACIDITY.)
(*b*) Gout (*see* GOUT).
(*c*) Diseases in which the white corpuscles of the blood are increased, *e.g.* leukæmia.

Owing to their insolubility, uric acid and the various urates frequently produce deposits in the urinary passages, which are known as urinary sand, gravel, or stones according to their size.

URINARY ORGANS form the system by which the urine is extracted from the blood, stored up, and from time to time

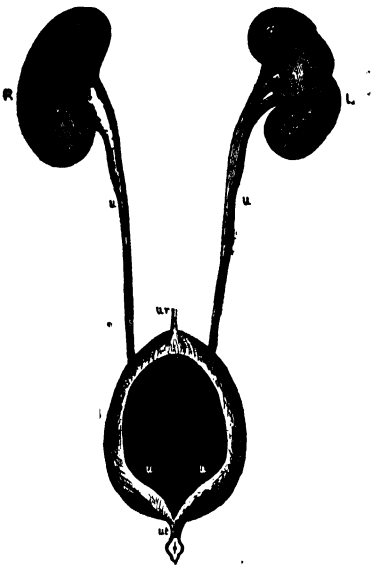


FIG. 457.—The urinary organs. *R*, The right, *L*, the left kidney; the left kidney is drawn with the fissures which sometimes divide its surface into lobules; *uu*, the ureters; *B*, the bladder, with the front removed to show the openings of the ureters into its base; *u*, commencement of the urethra; *ur*, urachus which attaches the bladder to the front of the abdomen. (Turner's *Anatomy*.)

discharged from the body. They comprise the two kidneys placed in the loins, two ureters leading from them to the bladder which is situated in the front of the pelvis, and the urethra which leads from the floor of the bladder out beneath the pubic bones to the exterior. (*See* KIDNEYS, URETERS, BLADDER, URETHRA.)

URINE (*urina*) is the excretion produced by the kidneys, and consists chiefly of waste substances resulting from the activity of the body, dissolved in water. The function of the kidneys consists almost entirely in selecting these substances from the blood; their actual formation takes place in the liver, muscles, etc. The urine and the perspiration are to a great extent interdependent; thus, if the kidneys are acting vigorously, the skin becomes very dry, while if there has been much perspiration, as in fevers, the urine is small in amount and highly concentrated. The amount of water lost from the body daily by perspiration is in health about half the amount passed as urine, and, though the sweat contains little of the waste material present in the urine, the glands of the skin can be made to take up the function of the kidneys to a great extent when the latter organs are diseased. (*See* BRIGHT'S DISEASE.) Most poisons taken into the body are excreted by way of the urine, *e.g.* morphia and strychnine, and so also are the germs of many diseases, *e.g.* those of typhoid fever.

Composition.—About 96 per cent of the urine is water, the remaining 4 per cent being solids dissolved in it. Of the solids, far the most important is urea, the daily output of which is about 35 grammes or somewhat over 1 ounce. Common salt stands next in quantity, its amount being about half that of the urea. Phosphates and sulphates are also important constituents combined with potassium, sodium, calcium, and magnesium, while there is less than 1 gramme each of creatinine, uric acid, and ammonia.

Pigments are also present in the urine, and to them its colour is due. These pigments, known as urobilin, urochrome, etc., are derived indirectly from the colouring matter of the blood, and are produced also by the liver.

Amount.—The amount of urine passed daily is about 50 ounces (1450 cubic centimetres), subject to the varia-

tions mentioned above. A child of course passes much less than an adult, and the general statement may be made that under the age of twelve years a child passes daily 2 ounces of urine for every year of its age, an infant of two years therefore passing 4 ounces of urine daily, while a child of five years passes 10 ounces daily.

The amount of urine is *increased* in some diseases, of which diabetes, chronic Bright's disease of the cirrhotic type, and hysterical conditions may be mentioned as the chief. In other conditions it is *diminished*, notably in acute Bright's disease, in fevers and feverish states generally, and in heart diseases.

COMPLETE STOPPAGE of the urine may occur for a time in the feverish conditions of children, or it may be due to acute Bright's disease, when the condition is a very serious one. When the stoppage is due to failure of the kidneys to secrete any urine, the condition is known as *suppression*. When the stoppage is due to such a cause as blockage of the ureters by stones or of the urethra by a stricture, although secretion by the kidneys still goes on, it is known as *retention*. Stoppage of the urine, to whatever cause it be due, may often be relieved by placing the patient in a hot bath and administering to him sweet spirits of nitre or other diaphoretic.

Colour.—The tint of normal urine is generally described as straw or amber coloured, but it may be considerably changed by various diseases or drugs.

PALLOR, giving the urine a watery appearance, is found in diabetes, and in chronic Bright's disease of cirrhotic type, also in persons who drink large quantities of water.

ORANGE OR RED COLOUR may appear when senna or rhubarb has been taken; when blood is present the colour may be pink or bright red; urates cause a turbid red or yellow appearance.

SMOKY TINT, depriving the urine of transparency, is caused by small quantities of blood.

GREEN OR GREENISH-YELLOW urine is usually due to bile, or may be produced by taking santonin.

BLACK URINE is most commonly due to absorption of carbolic acid from surgical dressings or from taking carbolic acid, lysol, or similar substances internally. It is often passed by those who

are taking guaiacol or creosote, *e.g.* consumptives.

Odour.—Healthy urine has a faint aromatic odour, but when it begins to decompose an unpleasant ammoniacal smell is given off. Thus the presence of cystitis or of dribbling of the urine is betrayed by the odour of the patient's personal or bed clothes. When turpentine and some other aromatic drugs have been taken, the urine acquires an odour of violets, and in diabetes it presents an aroma similar to that of new-mown hay.

Specific gravity of urine varies in health from 1015 to 1025 (distilled water being 1000). A urine of lower specific gravity suggests the presence of chronic Bright's disease, while a higher specific gravity may be due to diabetes, or to a feverish state.

Reaction.—When the urine is tested with litmus paper it is found to be distinctly acid in general, and this is of importance, because the acid has an antiseptic action. This acidity is due, not to free acids, but to acid salts such as acid phosphate of sodium. In consequence of the secretion of acid from the blood into the gastric juice that is poured into the stomach shortly after meals, the urine may at such times become distinctly alkaline. In herbivorous animals and in vegetarians, owing to the great quantities of alkaline salts eaten in the diet, the urine is permanently alkaline.

Deposits.—In healthy urine there is usually a fleecy deposit of mucus secreted by the mucous membrane of the urinary passages. A pink or yellow deposit, that settles as soon as the urine begins to cool, and that often leaves a stain upon the utensil in which the urine has stood, is due to urates. (*See* URIC ACID.) Uric acid is a rare deposit, and, when present, falls in very scanty yellow or brownish grains. A white deposit that collects upon the bottom of the utensil after the urine has stood undisturbed for some time may be due to phosphates, to pus, or to debris from diseased kidneys known as tube-casts.

Abnormal substances.—Many unusual substances taken into or formed in the body are got rid of in the urine, sometimes just as they have entered the body, in other cases considerably changed, *e.g.* drugs, and the poisons of various diseases. Further, various bacteria and parasites can be discovered in

the urine in some diseases. Elaborate chemical or microscopical examination is necessary in order to reveal these, but there are six substances whose detection is of great importance, and which are discovered with comparative ease. These substances are (1) albumin; (2) blood; (3) sugar; (4) pus and tube-casts; (5) bile; (6) acetone.

(1) ALBUMIN is present in various conditions mentioned under ALBUMINURIA, and may be recognised by the following tests:

(a) *Boiling*, after the addition of a few drops of acid, produces a copious white cloud of coagulated albumin.

(b) *Heller's test.*—Place some strong nitric acid in the bottom of a test-tube, and carefully pour in urine above it. If the urine contains albumin a dense white line forms where the two fluids meet.

(c) *Picric acid.*—Drop saturated solution of picric acid into a test-tube containing urine. If albumin is present each drop carries down a white cloud of coagulated albumin.

(2) BLOOD is present in acute Bright's disease, in congestion of the kidneys, or when a stone, ulcer, or tumor is present in any of the urinary organs. If a drop or two of tincture of guaiac resin is mixed with a little of the suspected urine to form a white fluid in a test-tube, and some ozonic ether or oxidised turpentine is poured in above this mixture, a deep-blue colour appears where the two fluids join, when blood is present. A similar result is given, however, by the urine of patients who have been taking iodide of potassium, so that for absolute certainty a drop of the urine must be examined under the microscope to find if blood-cells are actually present.

(3) SUGAR is a sign of diabetes (*see* DIABETES) when it is present constantly in the urine. It may also be found following upon a diet that contains a great deal of sugar—a harmless condition known as 'alimentary glycosuria'. In some cases the difficulty lies in the kidneys—'renal diabetes', which is also of little importance.

(a) *Moore's test.*—Place some of the suspected urine in a test-tube, render it alkaline by adding liquor sodæ or liquor potassæ, and boil for some time. If sugar is present, a brown substance with pleasant odour (caramel) is produced.

(b) *Trommer's test.*—Fill a test-tube to a depth of 2 inches with urine, add ½ inch of liquor potassæ and one or two drops of copper sulphate solution. A blue fluid is produced and must then be heated. If sugar is present, the blue cupric salt is reduced to red and yellow cuprous salts.

(c) *Fehling's test.*—A special blue-coloured solution composed of copper sulphate, Rochelle salt, and caustic potash is placed in a test-tube and boiled. While it is hot, a few drops of the suspected urine are added, and if sugar is present, red and yellow cuprous salts are formed.

(d) *Benedict's test.*—Benedict's reagent contains copper sulphate, sodium carbonate, potassium citrate, potassium thiocyanate, and potassium ferrocyanide, dissolved in distilled water. When urine containing sugar is boiled along with this pale blue solution, the colour disappears. This reagent is commonly used for estimating the amount of sugar present, the calculation being based upon the fact that 25 c.c. of the reagent are completely reduced by exactly 50 mg. of glucose, and rendered colourless.

(e) *Nylander's test.*—A clear solution containing bismuth subnitrate, Rochelle salt, and caustic potash is used as the reagent; half an inch of the urine to be tested is placed in a test-tube, a few drops of the reagent are added and the tube is heated. If sugar is present, the solution darkens and, upon standing for a few seconds, turns black.

(f) *Johnson's test.*—Pour the suspected urine, to a depth of 1 inch, into a test-tube, add ½ inch of picric acid solution, and a few drops of liquor potassæ. Boil the mixture, and if sugar is present, a deep port-wine colour is produced.

(g) *Fermentation test* is the most reliable. A little yeast is shaken up with some of the urine, placed in a special glass which is closed at the upper end, and allowed to stand in a warm place over night. If the urine contains sugar it will ferment and bubbles of carbonic acid gas collect at the upper end of the glass.

(h) *Polarimeter test.*—When the urine contains sugar, this has the property of rotating the plane of polarised light, and the angle through which the light is rotated depends upon the amount of

sugar present. This can be readily estimated by a special polarimeter.

(4) PUS AND TUBE-CASTS are the sign of inflammation or of ulceration somewhere in the urinary passages. Pus alone is generally a sign that the bladder is affected; tube-casts always point to involvement of the kidneys. If tincture of guaiac resin is added to urine containing much pus, a greenish tinge is produced, or if liquor potassæ is added the urine becomes 'ropy'. These, however, are unreliable tests, and for the detection of pus or tube-casts in small amounts a drop of urine must be placed on a glass slide and examined with the microscope.

(5) BILE in the urine is a sign that the bile-ducts are obstructed, and that bile is being absorbed into the blood. Sometimes the jaundice that accompanies this condition is so slight as to escape notice, so that the detection of bile in the urine is an important sign. Place some of the urine in a large conical glass, dilute it with water till quite transparent, and pour impure nitric acid down the side of the glass. If bile is present in the urine, a brilliant play of colours—yellow, red, violet, and green—takes place where the urine and acid meet.

(6) ACETONE may appear in the urine in cases of diabetes, general acidosis, and some other conditions. It may be tested for in several ways.

(a) *Lange's test.*—The suspected urine is poured to a depth of 1½ inches into a test-tube and a few drops of glacial acetic acid are added. Two or three crystals of sodium nitroprusside are dissolved in this, with gentle heat if necessary, giving a reddish tinge. Strong ammonia is carefully poured on the surface of this to form a layer ½ inch deep. If acetone is present, a violet colour appears at the junction of the two, the depth of violet depending upon the amount of acetone present in the urine.

(b) *Lieben's test.*—This is carried out by placing 1½ inches of urine in a test-tube, adding a few drops of liquor potassæ and a little iodine solution. The test-tube is shaken and the mixture warmed. If acetone is present, a precipitate of yellow shining crystals of iodoform is seen, and may also be identified by the characteristic smell of iodoform.

DIACETIC ACID, which is often also present with acetone, may be tested by adding to 1½ inches of urine in a test-tube, solution of 10 per cent ferric chloride, drop by drop. A precipitate of iron phosphate first forms, which is filtered off. If diacetic acid be present, a dark-red colour next develops, which disappears on boiling the urine.

URINE, EXCESS OF.—The amount of urine passed in 24 hours is often markedly increased in diabetes, a fact which sometimes, without any other symptom, attracts the patient's attention. The bladder requires to be emptied more than usual also in the chronic forms of Bright's disease, but this is due rather to greater frequency than to increased quantity of urine. The increase in this case is noticed especially during the night. Any source of irritation or inflammation in the kidneys or bladder may also produce this symptom, such as the formation of gravel or of a stone, tuberculosis of the kidney, inflammation of the bladder (cystitis), or enlargement of the prostate gland. The bladder, however, varies greatly in size in different individuals, and the necessity to pass water frequently may simply be a life-long personal peculiarity due to smallness of its capacity.

An annoying form of increase in the urine at night leads to wetting of the bed by children (enuresis).

Treatment.—Any increase in the amount or frequency of the urine calls for testing as to the presence of sugar, albumin, gravel, pus, etc. The treatment consists in that suited to any disease that may be discovered. For irritable conditions of the bladder or prostate gland, bromide of potassium, in a dose of 5 or 10 grains at night, often gives relief.

URINE, RETENTION OF.—The term 'retention' is applied to cases in which urine is duly secreted by the kidneys, but for some reason is retained in the bladder; while the more serious condition, in which the kidneys fail to produce urine, is known as 'suppression'. The latter condition is mentioned at URINE under the heading of Amount.

Causes.—The urine may be retained either because the bladder is too weak to expel it, or because of some obstruction to the passage by which it should be voided. Weakness is a rare condition

and is generally the result of some damage to the nervous system, this being one of the troublesome symptoms that follow an injury to the spinal cord; it is accompanied by dribbling away of the urine when the bladder becomes fully distended. A similar condition results from long-continued distension produced by some obstruction to the outflow.

Among the cases due to obstruction, some are acute and merely temporary, such as the difficulty of passing water that follows upon any operation near the bladder, *e.g.* one for piles, or that is apt to follow childbirth. In these cases the difficulty commonly is due to spasm, and does not persist more than a day or two. Among the more chronic cases of retention the commonest are those caused by enlargement of the prostate gland and consequent blockage of the outlet from the bladder; this condition is very common in old men. In these the retention comes on very gradually, and it is a common experience to find that the bladder never empties completely as it ought to do, but forms a sort of reservoir from which an overflow is discharged every few hours. The condition that leads to the most complete form of retention is a stricture or narrowing of the urethra due to the scar of previous injury or ulceration. (*See* URETHRA, DISEASES OF.) Similar blockage results also, in rare instances, from the pressure of some tumor upon the urethra, or the displacement of a neighbouring organ such as the womb in women.

Treatment.—Cases in which retention is due to weakness of the bladder, in a chronic invalid, are treated by the regular use of a soft rubber catheter, and this forms one of the most important duties in the nursing of such a case.

In any case of retention where the urine accumulates in and causes painful distension of the bladder the condition may often be relieved by the sufferer placing himself in a warm bath. This produces so much relaxation that the bladder often succeeds in emptying itself, a result which is still further assisted by the use of soothing draughts or of suppositories containing morphia or belladonna.

If relief is not gained by these means, the medical attendant withdraws the urine by means of a catheter passed along the urethra. (*See* CATHETERS.) The instrument chosen varies according to the cause of the retention; thus, in cases due to weakness of the bladder or to moderate spasm at the outlet, a soft rubber catheter only is necessary. In cases of severer spasm, and in cases where the prostate gland is enlarged, a flexible instrument or a hard rubber catheter with a peculiar bend upon the point (known as a coudé catheter) is generally chosen; while, in cases of very narrow stricture, the surgeon may require to pass a rigid metal instrument. As a rule, great difficulty is experienced only in the last-named class of cases; and in them it may occasionally be necessary to tap the bladder above the pubis by means of a hollow needle. After its contents have escaped the patient gains immediate relief and can generally pass urine, when it next becomes necessary, by natural means.

In the cases which require the habitual use of a soft or flexible catheter, such as those due to an enlarged prostate gland, the patient himself can readily learn to pass the instrument. It is of great importance that this small operation should be regularly performed three or four times daily in order to prevent distension of the bladder, and that the most scrupulous cleanliness should be maintained. (*See* CATHETERS.) In cases where retention has become permanent, an opening above the pubis into which a drainage tube is fitted, often gives the patient freedom from discomfort and from risk of inflammation of the bladder.

URINOMETER (*οὖρον*, urine; *μέτρον*, measure), or DENSIMETER, is an instrument designed for estimating the specific gravity of urine. It consists of a graduated stem supported upon a large glass bulb containing air which floats partly submerged, and which is kept upright by a smaller bulb containing mercury placed at its lower end. The urine is poured into a tall glass vessel, the urinometer placed in it, and, when it is floating motionless, the point on the scale which is at the surface of the urine registers the specific gravity.

UROLOGY is that branch of medicine which treats of disorders and diseases of the kidney, ureters, bladder, prostate, and urethra.

UROPAC is a proprietary term for IODOXYL, the *British Pharmacopœia* term for the original preparation, UROSELECTAN B (*q.v.*).

UROSELECTAN is a proprietary term for a complicated organic compound containing 51·5 per cent of iodine used for contrast radiography of the kidney passages. The preparation is injected into a vein, and as it is excreted through the kidney and is opaque to X-rays, it will, on radiography, reveal abnormalities of the urinary tract.

UROTROPINE, or HEXAMINE, is a substance made by the action of ammonia on formalin. It is excreted by the kidneys, and, setting free formalin gradually in the urine, has a powerful antiseptic action. It is given in cases of cystitis when the urine decomposes within the bladder, and it exerts its beneficial action very speedily. It acts only in urine with an acid reaction, and, if the urine be alkaline, acid phosphate of soda is usually taken along with the urotropine. The dose of each of these is 10 to 30 grains several times daily.

URTICARIA (*urtica*, a stinging nettle) is another name for nettle-rash.

UTERUS (*uterus*), or WOMB, is a hollow organ suspended in the cavity of the pelvis. In shape, it is triangular from side to side, and flattened from before backwards. The lower angle is prolonged into a rounded neck (*cervix*) which communicates through a narrow opening or mouth (*os uteri*) with the vagina, the passage leading to the exterior of the body. In size, the normal uterus is only about 3 inches long, 2 inches in its greatest width, and 1 inch in thickness from front to back, while the walls are so thick that the cavity consists of a mere slit. During pregnancy, however, it enlarges to an enormous extent, and the walls increase still further in thickness. (*See* MUSCLE.) The cavity is lined by a thick, soft, mucous membrane, and the wall is chiefly composed of muscle fibres arranged in three layers. The outer surface, like that of other abdominal organs, is covered by a layer of peritoneum. The uterus has a copious supply of blood derived from the uterine and ovarian arteries. It has also many lymphatic vessels, and its nerves establish wide connections with other organs. (*See* PAIN.) The position of the uterus is in the centre of the pelvis, where it is suspended by several ligaments between the bladder in front and the rectum behind. On each side of the uterus are the broad ligaments passing outwards to the side of the pelvis, the utero-sacral ligament passing back to the sacral bone, the utero-vesical ligament passing forwards to the bladder, and the round ligament uniting the uterus to the front of the abdomen.

UTERUS, DISEASES OF.—Most diseases of this organ are of a chronic type, occur in married women, and, though their symptoms in the great majority of cases are not of an extreme nature, they are apt to constitute a drain upon the general health. Among the most common symptoms may be mentioned pain or irregularity in the menstrual functions, the presence of a white discharge (*leucorrhœa*), constant pain or sense of weakness in the back, and often the inability to bear children.

MALFORMATIONS sometimes occur and give rise to trouble in childbirth; for example, the uterus may be double, may have a partition down the middle, etc. The cervix may be long and furnished with a very narrow mouth, which is sometimes a cause of pain in menstruation. Overgrowth may occur, usually as the result of chronic inflammation.

DISPLACEMENTS are of more importance. The uterus is slung in the centre of the pelvic cavity, and has great freedom of movement up and down and from before backward. It stands naturally with its long axis directed upwards and forwards between the bladder and rectum, but its position at any time varies considerably according to the state of distension of one or other of these organs. A flabby state of the muscular wall of the uterus, or a contraction of some of the ligaments that suspend it, may produce a bend upon the organ itself, or may permanently tilt it forwards or backwards. Bending forward is known as *anteflexion*, tilting forwards is called *anteversion*, and the

corresponding conditions towards the back are known as *retroflexion* and *retroversion*. In the treatment of these conditions, two objects are kept in view, the one being to diminish the inflammation that is apt to accompany them, and the other consisting in the support of the uterus in its proper position by a suitably shaped instrument known as a pessary; or by an operation, when the displacement is very marked.

Downward displacement is known as *prolapse*, and in this condition the uterus slips bodily downward in the space between the bladder and bowel, till, in bad cases, it may actually protrude from the vagina. The condition comes on in elderly women, usually those who are becoming stout, have a considerable amount of work to do, and have in childbirth suffered laceration of the parts that should support the uterus. When the condition is slight it is relieved by wearing a suitably shaped pessary, and in cases which are not relieved by this simple measure an operation (colporrhaphy), designed to repair the injury previously done, will often remedy the displacement.

INFLAMMATION is, perhaps, the commonest type of uterine disorder. It is of several forms, but the general term *endometritis* is applied to inflammation affecting the mucous membrane, *metritis* to the rarer condition in which the muscular substance is involved. This condition is frequently due to childbirth which has not passed off quite successfully; and it is still more often due to miscarriage. Exposure to cold at a menstrual period, inflammation spreading upwards from the vagina, and displacements of the uterus are other, though less common, causes. The usual treatment consists in rest, the employment of hot, antiseptic douches and other applications to the vagina, and various remedies to improve the general health, such as tonics, baths, change of air. The interior of the uterus can often be brought quickly to a healthy condition by the operation of 'curetting', which consists in scraping away the unhealthy mucous membrane with a special instrument, the 'curette', and thereafter wiping the interior with some powerful antiseptic, such as pure carbolic acid. After this operation the patient must observe the greatest caution till the next menstrual period shall have passed.

TUMORS of the uterus are by no means uncommon. *Fibroid tumors* form the commonest variety, and consist of balls of muscle fibres similar to those of which the uterine wall is composed. The cause of these tumors is unknown, though it may be said that they are most common between the ages of thirty and forty years. Their chief symptoms are menstrual irregularity, sterility, and, if the tumor be large, interference with neighbouring organs upon which it presses. Many women, however, although having such a tumor, go through life without experiencing much discomfort from it, though if the tumor be very large it may be dangerous on account of the bleeding it occasions. The treatment is, first of all, medicinal—ergot, hazeline, and bromides having some influence in decreasing the size of and checking the bleeding from the tumors. X-ray and radium treatment prove successful in some cases where operation is undesirable. Surgical treatment was first attempted in the middle of the nineteenth century, and consists generally in opening the abdomen and removing the tumor with part or the whole of the uterus, since only very small tumors can be removed by way of the natural passages.

Cancer of the uterus also occurs, especially after the menopause, and gives rise to severe pain and copious bleeding from time to time, but, fortunately, it commences usually at the neck of the womb, so that the condition lends itself to early diagnosis, at a stage when removal or treatment by radium promises some hope of success.

UVEA is a term applied to the middle coat of the eye, including the iris, ciliary body and choroid.

UVULA (*uvula*) is the small mass of muscle covered by mucous membrane that hangs down from the middle of the soft palate. It is apt to be elongated in relaxed conditions of the throat, but should not be cut, since it recovers its proper size as the condition of the throat improves. Its elongation, when sufficient to make it reach the tongue, often sets up a constant irritative cough and tendency to retch.

V

VACCINATION (*vacca*, a cow) means inoculation with the material of cow-pox, performed for the purpose of affording protection to the inoculated person against any attack of smallpox, or at all events with the view of diminishing the seriousness of and averting a fatal result from any such attack. The material now used is almost always 'glycerinated calf-lymph', obtained by inoculating healthy calves with lymph derived from cow-pox, and afterwards adding glycerin to the material got from the vesicles. The glycerin has the effect of destroying any disease-producing organisms that may be present, and thus of rendering the lymph harmless.

Effectiveness of vaccination.—Among Eastern nations there existed a very ancient practice of inoculating healthy persons with the material from mild cases of smallpox, in the expectation of producing in them a mild attack which rendered them immune from accidental infection that might produce a serious attack at a later period. This practice was introduced into England from Turkey by Lady Mary Wortley Montagu about 1717, and the necessity for some such measure may be judged when it is stated that one in every twelve of the deaths in London during the eighteenth century was due to smallpox. This practice, however, involved a considerable element of danger, and after the introduction of vaccination it was abolished by Act of Parliament in Britain in 1840.

There had long been a tradition among the country people in the West of England that an attack of cow-pox—an eruption upon the udders of cows liable to be communicated to the hands of milkers—afforded protection against a subsequent attack of smallpox. In 1796 Edward Jenner, a surgeon of Berkeley, performed his first experiment in this matter by inoculating James Phipps, a boy of eight, with cow-pox material from the hand of Sarah Nelmes, a dairymaid. Six weeks later the boy was inoculated with smallpox material, but no disease followed. Subsequently, the experiment was successfully repeated both by Jenner and by other persons, and by 1801 Jenner states that over 100,000 persons had been vaccinated in England alone. With regard to the nature of cow-pox, opinions have varied as to whether it is simply a modified smallpox or is a different disease. At the present day the general opinion agrees with that held by Jenner, that cow-pox is simply smallpox much modified by passage through the cow. It might be supposed that this fact would be one easy of demonstration, and cows have by many observers, *e.g.* by Woodville in 1799, by Ceely, by Badcock, and by Thiele of Kazan in 1838, been experimentally inoculated with smallpox, but in most cases the disease, when thus artificially produced in cows, appears to retain a considerable degree of virulence, and to produce general though slight symptoms when again communicated to human beings, instead of the purely local symptoms of ordinary vaccination. So important did vaccination appear to the Governments of foreign countries, that its practice was in a few years made compulsory by several, though in England it was not enforced till 1853. Nevertheless from its first introduction to the present day, vaccination has had its opponents, who have attacked it upon the grounds both of uselessness and of danger.

Though a satisfactory proof of the efficacy of vaccination cannot be possible so long as the very cause itself of smallpox remains unknown, yet a *prima facie* case of the strongest kind is established in its favour by the evidence of statistics.

Thus, as regards ENGLAND, while Farr, quoted by Edwards, gives the smallpox death-rate for London in the eighteenth century, just before the introduction of vaccination, as 4000 per million living in every year, and while Lyon Playfair, quoted by the same authority, gives the general rate for England as 3000 per million at this time, we find from the Registrar-General's returns that in the beginning of the twentieth century the death-rate from smallpox for England and Wales is only about 75 in every million living. That is to say, during the century in which vaccination was

practised, smallpox decreased to one-fortieth of its previous importance as a cause of death.

SWEDEN, which early adopted compulsory vaccination, gives important confirmation according to statistics quoted from Edwards. In that country, where vaccination was introduced in 1801, and became compulsory after 1816, the deaths in each year from smallpox per million of inhabitants show a striking decrease:

Period.	Deaths from Smallpox.
1774–1800 . .	2049 per million yearly.
1802–1811 . .	623 ,, ,,
1812–1821 . .	133 ,, ,,
1890–1899 . .	1 ,, ,,

The GERMAN EMPIRE, however, gave perhaps the most notable example of the change in the mortality from smallpox which was associated with the introduction of compulsory vaccination for infants in 1835, and showed an even more notable decrease in smallpox mortality following upon the enforcement of re-vaccination for school children, which became law in 1874. The following table represents the death-rate per million in Prussia:

Period.	Deaths from Smallpox.
1803 . . .	4000 per million yearly.
1854–1863 . .	224 ,, ,,
1889–1898 . .	2 ,, ,,

If the whole German Empire be taken, the death-rate from smallpox was even less in the last-mentioned decade, being only 1·4 per million; and this notwithstanding the fact that in the neighbouring countries of Russia and Austria, where vaccination was not so rigorous, the death-rates were respectively 463 and 99 per million.

A ROYAL COMMISSION on vaccination was appointed by the British Government in 1889, and after exhaustive and careful examination of all the objections to vaccination, this Commission issued its report in 1896. The conclusions as to the value of vaccination in relation to smallpox arrived at by the Commission were as follows: 'We think—

'1. That it diminishes the liability to be attacked by the disease.

'2. That it modifies the character of the disease, and renders it (*a*) less fatal, and (*b*) of a milder or less severe type.

'3. That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. It is impossible to fix with precision the length of this period of highest protection. Though not in all cases the same, if a period is to be fixed, it might, we think, fairly be said to cover in general a period of nine or ten years.

'4. That after the lapse of the period of highest protective potency the efficacy of vaccination to protect against attack rapidly diminishes, but that it is still considerable in the next quinquennium, and possibly never altogether ceases.

'5. That its power to modify the character of the disease is also greatest in the period in which its power to protect from attack is greatest, but that its power thus to modify the disease does not diminish as rapidly as its protective influence against attacks, and its efficacy during the later periods of life to modify the disease is still very considerable.

'6. That revaccination restores the protection which lapse of time has diminished, but the evidence shows that this protection again diminishes, and that to ensure the highest protection which vaccination can give the operation should be at intervals repeated.

'7. That the beneficial effects of vaccination are most experienced by those in whose case it has been most thorough. We think it may fairly be concluded that where the vaccine matter is inserted in three or four places it is more effectual than when introduced into one or two places only; and that if the vaccination marks are of an area of half a square inch, they indicate a better state of protection than if their area be at all considerably below this.'

Dangers of vaccination.—There can be no doubt that the dangers attendant upon vaccination have been enormously exaggerated by those opposed to the practice. On its first introduction the opponents of vaccination declared that it would be the means of engrafting cow-like characters upon the human race, but the absurdity of this has been proved by over a century's experience. The production of skin diseases has also been alleged against vaccination. Sometimes a general rash accompanies the formation of the vesicles, and occasionally an eczematous condition of the scalp is observed to follow vaccination, but these

are trifling disorders which speedily subside. The transmission of syphilis from one child to another was an occasional, though extremely rare, misfortune in the days when the lymph obtained from the arm of one child was inoculated upon the next; but now that calf-lymph is used, this accident is impossible, since the calf is immune from this disease. Erysipelas and the production of severe ulcers at the site of inoculation form the only real dangers attending upon this little operation, and they may be entirely avoided by scrupulous cleansing of the child's arm before vaccination, and of the instruments used.

Method of vaccination.— In the United Kingdom every parent is required by law to have his child vaccinated before it has reached the age of six months, with the exception that any parent who has conscientious objections to the practice is not punished for failure to have it performed.

If the child suffers from any skin disorder, or from diarrhœa, or if there is any severe epidemic in the neighbourhood by which the child is likely to be infected, vaccination should be delayed till the child is better. If, however, there be smallpox in the child's vicinity, nothing should interfere with its vaccination.

The arm or other part is carefully washed and dried, vaccine matter from a tube is placed upon it, and the vaccinator, using a blunt lancet or needle which has been carefully sterilised, scarifies the surface, usually in four places. The lymph is then allowed to dry, and the part is either covered by a simple dry dressing or is left exposed, care being taken not to wet it. No change is noticed till about the third day, when a slight elevation appears at the vaccinated spots. By the fifth or sixth day this has developed into a distinct vesicle, with a central depression, and the vesicle has attained its full development and become of a pearl colour one week from the day on which the lymph was inserted. There is often a red ring of inflammation round each vesicle, and both this and the vesicle increase in extent for the next day or two, the arm at the same time becoming slightly swollen and the glands in the armpit enlarged. After this the inflammation subsides, the vesicle at the end of a fortnight dries up and forms a hard brown scab, which falls off about the end of the third week, leaving a permanent, depressed scar.

The performance of vaccination, then, is extremely simple and quite free from danger. It appears also, from more than a hundred years' experience, that its practice has been accompanied by a great diminution in the frequency and severity of smallpox, which formed one of the most terrible scourges of humanity in the eighteenth century. It is therefore a matter for great regret that any parents should neglect the adoption of this simple and harmless procedure for their children; and it is eminently advisable that persons of maturer years who are either proceeding to some country where smallpox is rife, or who are liable to be exposed to smallpox infection, should have themselves revaccinated as a precautionary measure.

VACCINE is the name applied generally to a substance of the nature of dead or attenuated living infectious material introduced into the body with the object of increasing its power to resist or to get rid of a disease.

In cases where healthy people are inoculated with vaccine as a protection against a particular disease, this is done with the object of producing 'antibodies' which will confer immunity against a subsequent attack of the disease. In cases where a vaccine is used to cure acute inflammation already fully developed, it is supposed to stir up the general resisting power of the whole body to overcome what has previously been a limited condition. It is doubtful whether this principle really comes into action, and the value of the latter type of vaccine treatment has probably been greatly exaggerated.

Vaccines may be divided into two classes: 'stock' vaccines prepared from bacteria known to cause a particular disease and kept in readiness for use against that disease; and 'autogenous' vaccines prepared from bacteria which are already in the patient's body and to which the disease is due. Vaccines intended to protect against the onset of disease are necessarily of the 'stock' variety. 'Phylacogen' is the name given to an extract of a vaccine from

which the bacteria have been filtered out so that only their products remain.

A 'sensitised vaccine' is one to which in the course of its preparation has been added the serum of an animal rendered immune from the bacteria in question by previous injection; after the serum has remained in contact with the bacteria for some time it is removed by washing and the centrifuge. The advantage claimed for such a vaccine is that, while the immunity produced by it is unaffected, the inflammatory effects immediately following its injection are lessened. A 'detoxicated vaccine' is one in which an alkali has been added to the vaccine for the purpose of dissolving the bacteria and their contained toxin. An acid or acid salt is subsequently added to precipitate the material of the bacteria free from the toxin, which is rejected. Very large doses of detoxicated vaccine can be tolerated without excessive reaction. 'Oral' vaccines for administration by mouth in large doses have also been recently introduced.

Preparation of vaccine. — Most of the vaccines are prepared by cultivating the bacteria, killing by heat, counting and diluting them suitably. For example, pus-forming bacteria are grown on agar for two or three days, and the growth is scraped off and shaken up with a quantity of normal salt solution. To count the number of bacteria, a drop of this fluid is taken with an equal drop of the observer's blood and drawn up into a fine glass tube; the two drops are mixed, blown out on to a slide to make a film, stained, and the numbers of blood corpuscles and of bacteria in one field of the microscope are counted; the number of blood corpuscles being known, it is then a simple matter of proportion to determine the number of bacteria in each cubic millimetre of the fluid. The bacteria are then killed by heating the fluid to 60° C. for half an hour or one hour; the fluid is diluted so that one cubic centimetre shall contain the desired number of million bacteria for a dose, and the vaccine, thus prepared, is stored in small glass ampoules and sealed by heat.

Autogenous vaccines are prepared from the cultivation of bacteria found in the expectoration, the urine, the fæces, and in areas of inflammation such as boils. This type of vaccine was introduced by Wright about 1903. (*See* OPSONINS.)

Anthrax vaccine was introduced by Pasteur about 1882 for the protection of sheep and cattle against this disease; it seems to have a distinct protective effect for about one year.

Catarrhal vaccine is used as a preventive of colds, bronchitis and influenza for persons who are liable to take these and similar catarrhal attacks every winter. The vaccine treatment is administered in the autumn before the season of catarrhs begins. Various organisms are used to make the vaccine, but the commonest combination consists of *Bacillus influenzæ*, *Pneumococcus*, *Streptococcus*, *Bacillus septus* and *Micrococcus catarrhalis*. Such a vaccine is usually administered once a week for several weeks, beginning with about 50 million bacteria and working up to 1000 million.

Cerebro-spinal fever vaccine. — A vaccine is sometimes used as a preventive against this disease when an epidemic breaks out. The vaccine can be used in schools, barracks, etc., where many people are congregated.

Cholera vaccine was introduced by Haffkine in India about 1894. A weak vaccine is first injected and later one of exalted virulence. The method appears to be free from risk, and reduces the susceptibility to cholera.

Colon bacillus vaccine is used frequently in cases of infection of the kidney and other abdominal organs by the *Bacillus coli*. It is also used in the treatment of cases in which operations have been performed upon the appendix, gall-bladder, kidney, etc., and from which sinuses, that are slow in healing, have resulted.

Dysentery vaccine. — A vaccine which is supposed to confer a certain amount of protection against bacillary dysentery upon people proceeding to a locality where this disease is rife, is occasionally used.

Gonorrhœal vaccine.—In the treatment of this disease a detoxicated vaccine is specially used and administered in very large doses.

Hay fever vaccine. — A vaccine prepared from the pollen of various grasses is used in gradually increasing

doses for prevention of hay fever in persons susceptible to this disease.

Hydrophobia vaccine was introduced by Pasteur in 1885 for administration, during the long incubation period, to persons bitten by a mad dog, in order to prevent the disease from developing. The organism not being yet isolated the vaccine is made from spinal cords containing the poison. (*See* HYDROPHOBIA.)

Influenza vaccine. — The vaccine mentioned above for use against catarrhs is used in protecting people against influenza.

Plague vaccine was introduced by Haffkine; and in India persons inoculated with it appear to contract and to die from plague to the extent of only about one-third or one-fourth the rate among the uninoculated.

Pneumonia vaccine has been used for the protection of natives in South Africa who are very liable to contract this disease. The *Pneumococcus* has four different types, and vaccines are usually polyvalent, that is they are made from organisms of all four types.

Rheumatic fever vaccine is made from the *Micrococcus rheumaticus* for use in complicated or prolonged cases of this disease.

Smallpox vaccine was the first introduced. (*See* VACCINATION.)

Staphylococcic vaccine is used in treatment of pustular skin eruptions like boils and acne and in infections of bone.

Streptococcic vaccine is used in various localised diseases such as erysipelas, ulcers, tonsillitis, abscesses.

Tuberculin is the general name for many forms of vaccine used against tuberculosis. (*See* TUBERCULIN.)

Typhoid vaccine was introduced by Wright and Semple for the protection of troops in the South African War and in India. Two doses usually are given, one of 500,000,000 bacilli followed ten days later by 1,000,000,000, and with this are usually combined two other vaccines of paratyphoid A and paratyphoid B bacilli respectively, each in half the amount of the typhoid bacilli. This is known as T.A.B. vaccine. The skin of arm or back is painted with tincture of iodine or other antiseptic, and the hypodermic syringe with which the vaccine is inoculated is also carefully sterilised by boiling or by drawing into it alcohol or hot oil prior to use. After an inoculation no heavy work is done for two days, any appreciable reaction having usually passed off by that time.

Results of antityphoid inoculation.— If a drop of blood from the person who has been inoculated be examined about ten days after the first inoculation it is found to have developed a striking power. A drop of ordinary blood-serum mixed with a drop of emulsion of living typhoid bacilli and examined under the microscope has the power of stopping their activity and causing them to adhere together when diluted about 10 times with salt solution. A similar observation made upon the blood of the person who has been inoculated discovers that his blood possesses this power even if diluted about 100 times with fluid. After a second inoculation this agglutinating power of the blood for typhoid bacilli is increased to about 300 times that of normal blood. The effect is at its highest point about three weeks after the first inoculation, and thereafter it gradually diminishes, the protective influence passing off completely in three or four years.

The protective influence has been very marked among troops. Thus in an investigation carried out on 24 units involving about 20,000 men, of whom roughly one-half had been inoculated, the occurrence of typhoid fever was 5·6 times greater among uninoculated than among inoculated men, while the deaths among the former were 10·7 times more numerous. The following table gives the numbers of typhoid fever cases among all the British troops in India during the year 1903 before inoculation was introduced, and during the year 1913 when it had been in extensive use for eight years:

	Number of Cases.	Deaths.
1903 . . .	1384	296
1913 . . .	85	16

The difference is partly due to improved general sanitary conditions, but partly, in all probability, to the protective influence of inoculation. During the Great War, protective inoculation with typhoid and paratyphoid vaccine was rigorously carried out, and no widespread epidemic of these diseases occurred.

Whooping-cough vaccine is prepared from the Bacillus of Bordet and Gengou, or *Hæmophilus pertussis*, and is now (1941) proving to be of use in prophylaxis against whooping-cough.

VACCINIA is another term for cow-pox, a disease in which vesicles form on the udders and teats, due to a filter-passer infection.

VAGINA is the name given to the front passage leading from the exterior to the womb. Its chief disorder is inflammation. (*See* WHITES.)

VAGITUS UTERINUS is the term applied to the crying of a child just before birth and while it is still in the uterus.

VAGUS (*see* PNEUMOGASTRIC NERVE).

VALERIAN is the root of *Valeriana officinalis*, a European plant. Its action, which is a sedative one upon the nervous system, depends mainly upon a volatile oil that it contains, and also to some extent upon valerianic acid.

Uses.—Valerian is used, chiefly in the form of the tincture of valerian, to quiet nervousness, insomnia, and hysterical attacks, being taken in doses of a teaspoonful. The oil of valerian is useful, in doses of two or three drops on sugar, for the relief of dyspepsia associated with spasm of the stomach.

VALETUDINARIAN (*valetudinarius*) is a term applied to an invalid; also to a person who is constantly thinking about his own state of health.

VALGUS (*valgus*) means literally knock-kneed, and is a bending inward at the knees (*genu valgum*), or at the ankle, as occurs in flat-foot (*pes valgus*). VARUS, meaning bow-legged, is the term applied to a bulging condition at the hip (*coxa vara*), at the knee (*genu varum*), or at the ankle (*talipes varus*).

VALVES are found in the heart, veins, and lymphatic vessels, for the purpose of maintaining the circulation of the blood and lymph always in one direction. (*See* HEART, VEINS.)

VALVULAR DISEASE (*see* HEART DISEASES).

VAN DEN BERGH TEST is one performed on a specimen of serum of the blood in cases of jaundice, to decide whether this is due to ordinary bile (immediate reaction) or incompletely formed bile pigment (delayed reaction).

VAPOUR BATHS (*see* BATHS).

VARICELLA means chicken-pox.

VARICOCELE (*varix*, a dilated vein; κήλη, tumor) means a condition in which the veins of the testicle are distended. (*See* TESTICLE, DISEASES OF.)

VARICOSE VEINS (*varix*, a dilated vein) are veins that have become stretched and dilated. (*See* VEINS, DISEASES OF.)

VARIOLA (*varus*, a blotch on the face) is another name for smallpox.

VARIOLOID is the name applied to a mild type of smallpox.

VARIX means an enlarged and tortuous vein.

VARUS (*see* VALGUS).

VAS is the Latin term for a vessel, especially a blood-vessel.

VASELINE is a proprietary name given to petroleum jelly, which is extensively used as a protective coating to superficial wounds, as a lubricant for instruments, and as a basis for ointments. It possesses the valuable property of being unchanged by the action of bacteria, so that it neither allows of the growth of organisms that happen to fall upon it, nor does it become rancid. (*See* PARAFFIN.)

VASOMOTOR NERVES are the small nerve-fibres that lie upon the walls of blood-vessels and connect the muscle fibres of their middle coat with the nervous system. Through these nerves the blood-vessels are retained in a state of moderate contraction. There are also vaso-dilator nerves, through which are transmitted impulses that dilate the vessels, and, in the case of the skin-vessels, produce the condition of blushing. Various drugs produce dilatation or contraction of the blood-vessels and, particularly, several of the substances

produced by ductless glands in the body have these effects.

VEGETARIANISM means the principle of subsisting on a diet of vegetables. (*See* 'Quality of Food' *under* DIET.)

VEGETATIONS is the term applied to roughenings that appear upon the valves of the heart, usually as the result of acute rheumatism, and that lead in time to narrowing of the openings from the cavities of the heart, or to incompetence of the valves that close these openings. (*See* HEART DISEASES.)

VEGETATIVE SYSTEM is a term applied to that part of the nervous system which acts in an involuntary manner, to a large extent independently of the brain and spinal cord, and which regulates and connects movements and secretions of internal organs. The term includes the 'sympathetic' and 'autonomic' nervous systems.

VEINS are the vessels which carry blood to the heart after it has circulated through the tissues of the body. In general the veins lie alongside corresponding arteries that carry outwards to the tissues the blood which afterwards returns by the veins. The veins are, however, both more numerous and more capacious than the arteries, and, as a rule, there are two accompanying veins for each artery of moderate size. In addition to these deeply placed veins, there are superficial veins in the limbs, which can be readily seen in their distended state lying immediately beneath the skin.

Structure. — A vein is of similar structure to an artery, consisting of three coats, viz. outer fibrous, middle of muscular and elastic fibres, and inner composed of elastic membrane and flattened cells. Any vein has, however, a much thinner wall than its corresponding artery, especially as regards the middle coat. Most veins are provided with valves similar in structure to the aortic and pulmonary valves of the heart, and consisting each of two segments or pouches, which lie flat against the wall of the vein as the blood passes in the proper direction, or which meet and close the passage whenever the blood tends to run backwards. The position of these valves can easily be seen upon the arm or leg by running the finger backwards along a large vein, when the

FIG. 458.—A vein slit open to show the two pockets of a valve on its inner surface. (Turner's *Anatomy*.)

distended vein shows a little swelling at each valve. The valves are most numerous in the veins of the lower limb, those in the arm stand next in point of numbers, while there are few valves in the veins of internal organs.

Chief veins.—Four *pulmonary veins* open into the left auricle of the heart, two coming from each lung. Into the right auricle there open some small veins that run upon the walls of the heart and two great vessels, superior vena cava and inferior vena cava, that bring back blood from the body generally. The *superior vena cava* brings the blood from the head, neck, and upper limbs. It is formed by the union of two *innominate veins*, each of which results from the junction, at the root of the neck, of the internal jugular vein, from the neck, and the subclavian vein, from the upper limb. The *internal jugular vein* receives the blood from within the skull and collects branches from the face and neck as it runs downwards alongside the carotid artery under cover of the thick sterno-mastoid muscle. One of its most important branches is the *external jugular vein*, which runs beneath the skin from the angle of the jaw straight downwards to the middle of the collar-bone. This vessel can be readily seen when the veins of the neck are distended, and is very liable to be opened in wounds of this region. The *subclavian vein* is the last section of the system of veins that accompany the arteries in the arm, each vein being named after its corresponding artery. The superficial veins of the arm are of special interest, because the large *basilic vein* that runs up the inner side

of the upper arm is the vein usually opened in blood-letting, and the vein used for punctures to get blood for various tests or in order to give intravenous injections. (*See* BLOOD-LETTING.)

The *inferior vena cava*, which lies to the right side and in front of the spinal column, commencing at the junction of the two common iliac veins about the level of the navel, collects the blood from the lower limbs and abdomen. In the lower limbs and in the pelvis, the deeply placed veins correspond in name and in position to the arteries, while the surface veins of the lower limb empty their contents into an *external saphenous vein* on the back of the leg, and an *internal saphenous vein* that runs from the instep up the inner side of the leg, knee, and thigh. These veins, and especially the internal saphenous vein, are of special interest because of their liability to become distended or 'varicose', as the result of some impediment in the return of blood to the heart. Within the abdomen, the inferior vena cava receives branches corresponding to several branches of the aorta, its largest branches being the *hepatic veins*, which return not only the blood that has reached the liver in the hepatic arteries, but also blood which comes from the digestive organs in the *portal vein* to undergo a second capillary circulation in the liver. (*See* PORTAL VEIN.)

It appears from what has been said that the blood circulating in the uppermost parts of the body is returned to the heart by the superior vena cava, that from below the diaphragm by the inferior vena cava. There are, however, several connections between these two great vessels, the most important being three *azygos veins* that lie upon the sides of the spinal column, the veins on the front of the abdomen, and some veins that emerge from the abdomen at the navel and connect the portal system with those of the inferior and superior vena cava. By these means the circulation is maintained even when one of these large vessels has been blocked by some disease within the chest or the abdomen.

VEINS, DISEASES OF. — These vessels, like the arteries, are subject to few diseases, the chief being of a degenerative nature.

INFLAMMATION of a vein is a condition which is serious mainly on account of the clotting of blood that usually takes place within the inflamed part (thrombosis), and the risk that such a clot may break up and portions be swept away by the circulation to lodge in other vessels (embolism). *Phlebitis* is the name commonly applied to general inflammation of a vein, while the term *peri-phlebitis* is used when the inflammation is limited to the loose connective tissue immediately surrounding the vessel. Occasionally the inflammation is of a very acute character, the vein becoming filled with a clot containing bacteria, which are carried to distant parts of the body and there produce abscesses. This condition, known as pyæmia, is an extremely grave one. (*See* BLOOD-POISONING.) As a rule, however, phlebitis is of a more chronic type, running a course of three or four weeks and then improving under careful treatment.

Causes.—Inflammation rarely attacks veins that have been previously in a healthy state, but arises generally in veins that are varicose. It may develop in consequence of a bruise or wound of the vein; may come on in those who are the subjects of gout, rheumatism, or lead-poisoning; may follow infective diseases like typhoid fever and pneumonia, or may affect the veins of those addicted to excessive use of alcohol. It will be noticed, therefore, that some injury of the vessel wall or the presence of some poison in the blood appears to be the exciting cause. (*See* WHITE LEG.)

Symptoms.—In a typical case, the skin near the inflamed vein becomes red; the affected part becomes hot, and indeed the general temperature of the body

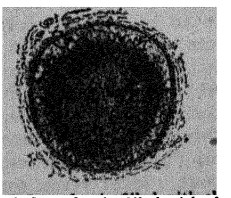


FIG. 459.—Inflamed vein filled with clot, which is commencing to 'organise'.

may sometimes be raised; there is swelling both around the vein and of the part beyond it, so that, if a vein in the leg be inflamed, the foot is swollen; finally, considerable pain and tenderness to touch

VEINS, DISEASES OF

are experienced along the vein. When a clot forms in the vein, as it commonly does, the vessel can be felt as a hard line,

FIG. 460.—Organisation proceeding and vein reopening at the edge.

and this blocked condition may persist for the rest of life, the vein being converted into a firm, fibrous cord; or a

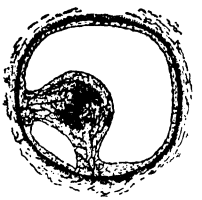


FIG. 461.—Organisation of clot nearly complete and passage through vein restored.

passage may be tunnelled through the clot after the inflammation has subsided in the course of three or four weeks.

Treatment.—Mention has been made of the great danger attaching to an inflamed vein, viz. that a portion of the clot may become detached and may block up some of the arteries in a distant organ, causing great damage or even sudden death. For this reason it is essential that the patient should rest absolutely quiet in bed for several weeks. When the vein is in one of the limbs, a suitable splint is usually applied. For the relief of pain, and with the view of diminishing inflammation, an ice-bag is sometimes used, or, more commonly, warm fomentations of lead and opium lotion. (*See* GOULARD'S WATER.) At a later stage, when the inflammation is subsiding, glycerin of belladonna is a favourite application. In cases where the patient is the subject of gout, rheumatism, or other constitutional condition, appropriate general treatment is also necessary. A moderately severe attack of phlebitis generally passes off under these remedies in three or four weeks.

VARICOSE VEINS are veins that have become stretched and dilated out of proportion to the amount of blood they have to carry. There are three positions in which the veins have a special tendency to become varicose. These are the veins about the lower end of the bowel, producing the condition known as hæmorrhoids or piles (*see* PILES); the veins of the testicle, producing varicocele (*see* TESTICLE, DISEASES OF); and the internal saphenous vein, with its branches on the inner side of the leg, knee, and thigh. Further, small veins are apt to become varicose here and there on a mucous membrane that is the seat of chronic catarrh and congestion; these minute varicose veins are found especially on the mucous membranes of the throat and stomach, and may give rise, now and then, to hæmorrhage, particularly in the case of persons addicted to alcoholism. Only the varicose veins of the limbs are considered here, the others having been dealt with elsewhere.

Causes.—Undoubtedly some persons are more liable to the formation of varicose veins than others. The veins vary greatly in thickness in different persons and at different portions of the same vein, so that the formation of the vessel wall and the condition of surrounding parts have much to do with its dilatation. Thus the tendency to varicose veins is often hereditary. Employments that necessitate long-continued standing, with little vigorous muscular exertion, not only throw a great strain upon the veins of the leg, but fail to provide the pumping action that muscular contractions exert in emptying the veins. Thus barmaids, shopmen, and washerwomen frequently suffer from varicose veins. The evil effects of prolonged standing are increased by tight garters, and, as regards the left leg especially, by constipation. Pregnancy is another constant cause of varicose veins, though the condition tends to disappear after the child is born.

An important consideration is that, after a vein has begun to dilate, its walls become weaker and its valves useless. Thus the weight of the column of blood in the limb presses down with increasing force, the condition tends to

grow worse and worse, and to spread into neighbouring veins.

Symptoms.—At first the only symptoms are a feeling of weight and aching in the limbs, accompanied sometimes by cramps. This is experienced either at night, after a long day's standing, or in the morning when the feet are first put to the ground. After the condition becomes marked, there is often swelling of the feet, especially above the ankles, that quickly disappears when the patient lies down. Varicose veins that have lasted many years are liable to become inflamed, and to produce eczema and ulceration of the skin. (*See* ULCERS.)

Treatment.—Varicose veins, as stated above, tend, when untreated, to become worse and worse. Treatment which is directed merely towards checking their increase and towards preventing ulceration is known as palliative treatment, while the entire removal of the distended veins is known as radical treatment.

PALLIATIVE TREATMENT.—In slight cases, it is often sufficient to avoid the use of garters, to remedy constipation, to avoid standing as much as possible, and, after the day's work is done, to sit with the feet elevated on a couch or chair. In more marked cases, some mechanical support for the superficial veins is necessary, in order to counteract the downward pressure of the blood in the long saphenous vein, whose valves have become useless. For this purpose one may use Martin's rubber bandage, an elastic or crape bandage, or elastic stockings. The rubber bandage is cheapest, because the others not only stretch, but must be discarded when they become soiled by perspiration. Crêpe bandages also cost little, and may be replaced, therefore, so soon as they begin to stretch; they are also very efficient, and not so heavy as the rubber bandage. The rubber bandage should be applied over thin cotton stockings, should simply be unrolled, not stretched, on the leg, and—a very important point—should be taken off the last thing at night and reapplied before the patient puts his feet to the ground in the morning. Crape bandages are used in a similar manner but may be applied directly to the skin. Some persons find elastic stockings more comfortable than bandages. There must be no tight band at the top of the stocking, but slipping down may be prevented by suspenders; while, of the various kinds, the spiral silk elastic stocking is generally regarded as the best. For the treatment of varicose ulcers see ULCERS.

Great success is now obtained from the injection, here and there into the veins, of some irritating substance, such as quinine-urethane or sodium morrhuate. A clot forms at once in the vein, which later becomes solid. This treatment is practically painless and devoid of later discomfort.

RADICAL TREATMENT is adopted when the veins are excessively dilated, when they cause much annoyance, or when the person suffering from them wishes to enter one of the public services. The most successful method consists in turning up a flap of skin on the inner side of the thigh or knee, ligaturing the vein in two places and removing the intervening dilated portions *en masse*. The wound heals quickly, and, in most cases, the cure is complete.

WOUNDS IN VEINS are not in general serious; for, though a considerable amount of dark blood flows steadily from that end of the vein more distant from the heart, it can be stopped by gentle pressure, and soon ceases of itself. When a varicose vein ruptures, as it may do if an ulcer be present, the condition is more serious. Blood, in this case, flows copiously from the end next the heart in consequence of the defects in the vein's valves, as well as from the other end; and the loss of blood may be great unless pressure be speedily applied. This also can be checked easily by pressure above and below the wound, and by raising the limb. Another danger, attaching to wounds of the veins in the neck, is that air may be drawn into them by the act of breathing, and great interference with the circulation may ensue.

VENA CAVA (*vena*, vein; *cava*, hollow) is the name applied to either of the two large vessels that open into the right auricle of the heart. (*See* VEINS.)

VENEREAL DISEASES are certain contagious maladies which are, as a rule,

communicated from one person to another by venereal intercourse. These diseases are three in number, viz. syphilis, soft sore, and gonorrhœa. (See articles under these headings.)

Much public interest has of late centred in the treatment of these diseases, and numerous societies exist for the study of means to prevent them. It has been estimated that in Great Britain about 100,000 cases occur every year, and in the United States the number appears to be considerably larger. The number of deaths returned as directly due to these diseases, in Great Britain during 1936 amounted to 1338, but if one were to add to this the deaths from general paralysis, aneurysm, softening of the brain, and other conditions known to be chiefly due to syphilis, the total number would amount to several thousands. This figure, however, does not by any means represent the amount of serious invalidity caused to the persons who have suffered from one of these diseases and to their children. The direct results of the diseases are mentioned under the headings GONORRHŒA and SYPHILIS, while the results of inherited syphilis include deafness, various forms of skin and bone diseases, and a large number of all the cases of mental defectiveness; also a large proportion of cases of blindness in young persons are due to gonorrhœal ophthalmia contracted at birth.

Among the means which have been proposed for reducing the amount of these diseases are: general instruction of the public in regard to their disastrous effects; provision of means for immediate self-disinfection; early treatment; and compulsory treatment of all persons found to be affected, the last measure almost necessarily implying notification of these diseases to the Sanitary Authority in the same manner as one of the ordinary infectious diseases. For purposes of efficient treatment, clinics, where treatment may be obtained gratuitously, have now been established in almost all the large towns in Great Britain under the superintendence of the Sanitary Authorities.

VENESECTION (*vena*, a vein; *seco*, I cut) means the withdrawal of blood by opening a vein. (*See* BLOOD-LETTING.)

VENOMOUS BITES (*see* BITES).

VENTER is the Latin term for the belly.

VENTILATION.—Ventilation consists in the continuous dilution or removal, by pure fresh air, of the vitiated products from respiration, combustion, putrefaction of animal and vegetable material, and from industrial processes and trades. It includes the ventilation of houses, factories, buildings of every description, as well as of streets, alleys, courts, and sewers. Different methods must be adopted for each variety of case. In streets and courts, reliance must be placed on the influence of winds, the height of the buildings, and the width of the street or space. In the confined areas of houses, means must be adopted for the ingress and exit of the air. Similar provision must be made in the case of sewers, the exit for which, however, must be placed where there is least chance of danger.

In the ventilation of houses, the chief factors of pollution to be dealt with are respiration and combustion. It is convenient to calculate the impurity in terms of carbonic acid gas. In the normal atmosphere ·4 per 1000 of carbonic acid is present. The average amount of carbonic acid exhaled by an adult is about 0·6 of a cubic foot per hour. Professor de Chaumont showed that until ·6 of carbonic acid per 1000 is reached no perceptible change in smell is recognisable in the air of a room. This, then, is accepted as the permissible standard of impurity, and ventilation is therefore concerned in preventing the carbonic acid rising above ·6 parts per 1000. Air, therefore, to which 0·2 of carbonic acid per 1000 has been added by respiration, has reached the limit. It can be ascertained from these data that in order to supply an individual with a requisite amount of air having a total impurity of ·6 per 1000, 3000 cubic feet of fresh air must be provided for him per hour.

$$D = \frac{E}{F}, \qquad D = \frac{0{\cdot}6}{{\cdot}0002} = 3000,$$

where D is the amount of fresh air

required in cubic feet, E the amount of carbonic acid exhaled, and F the respiratory impurity per cubic foot of air.

In the provision of ventilation, the amount of cubic space and superficial area allotted to each individual are important. With a greater cubic space the air can more readily be supplied without the production of a draught, and since the impurities of respiration tend to settle in the lower regions of the air, it is found advisable to increase the floor space for each person rather than to increase the height of the room in order to give the requisite cubic space. Thus, other things being equal, a wide, low room is better ventilated than a high, narrow one.

In ventilation, we are either dependent on processes of Nature or on artificial interference, and ventilation may therefore be described as natural or artificial (mechanical).

Natural ventilation depends on the use of certain physical processes. The prevalence of winds by which volumes of air are driven ahead into spaces, or masses of air are aspirated as the wind passes horizontally over chimneys; the law of the diffusion of gases; and the fact that air, when heated, expands, and so becoming lighter bulk for bulk, rises, allowing colder air to rush in to take its place, all play their part in natural ventilation.

In the ordinary dwelling-house, no special provision is usually made for the inlet of fresh air. The windows, doors, and spaces between the skirting boards and sashes act as inlets. The chimney provides the exit or exhaust. The chief objections, where there are no special inlets, are that one cannot control the source of the supply or ensure thorough mixture of the fresh and vitiated air.

Inlets, if the air can be warmed, should be placed preferably at the floor level. In cold climates like that of Britain, however, if the air is not specially warmed, the inlet should be placed above the occupants, with the stream directed upwards so that it may at once be well mixed with the general air of the room. A convenient special form of inlet is provided by double windows, the lower sash of the outer window being raised, and the upper sash of the inner window lowered. The air then enters between the windows.

Hinckes Bird's method of raising the lower sash about four inches by an accurately fitting wooden board, gives an inlet between the two sashes of

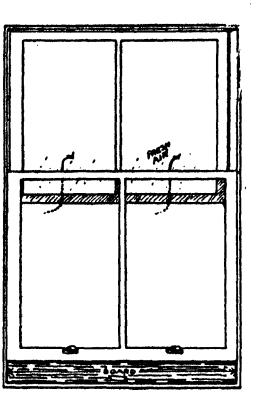
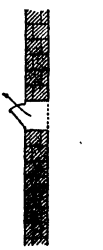


FIG. 462.—Hinckes Bird's ventilator from inside room.

FIG. 463.—Vertical section of a window, showing the board introduced beneath the lower sash.

a window. Louvres, preferably on the lowest pane of the upper sash, and Cooper's revolving glass discs covering or exposing holes in the window when required, are largely used. Windows with the upper portion hinged to fall inwards and thus directing the current upwards, are commonly employed. Sheringham's valves, in which the air passes through a perforated plate and impinges on a hinged valve, serve the same end. Tobin's tubes, frequently



SHERINGHAM'S VALVE

FIG. 464.—Vertical section of a house wall with a grating on the outer side and this valve on the inside.

TOBIN'S TUBE.

FIG. 465.—Vertical section showing the wall, grating, and flanges to direct the air over a tray of water on the floor and Tobin's tube running upwards about 6 feet.

used, have the air entering through a perforated plate at the floor level, from which it is conducted by a tube of about 6 feet in height through the wall and up its inner side. Ellison's bricks are bricks pierced with conical holes which have a small opening to the outside and a wide opening to the inside of the building. The air in this way is diffused as it enters. These bricks are much used for halls, stables, cowsheds, etc.

The air may be warmed if required by passing a coil of hot pipes through the inlet or by conducting it to a chamber behind the fire grate. In towns it may have to be filtered by passing through muslin, or moistened if the air be too dry.

Outlets should be placed at the highest parts of the room, or, if they can be heated, at any part. They should be protected by cowls to aid aspiration by wind, and to prevent their being closed or acting as channels for rain. They should be straight and smooth to lessen the retardation of the air by friction. The chimney with an open fire is the usual outlet in rooms, or the heat of the fire may be utilised by shafts round the smoke flue opening from the upper parts of the room, or again a valve may open directly into the chimney, but so arranged as to prevent the reflux of smoke.

In the 'sunlight gas burners' in public buildings the products of combustion are led off in an inner tube. This heated inner tube is encased in an outer one, which conducts off the foul air of the room. In M'Kinnell's circular tubes,

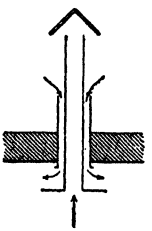


Fig. 466.—A roof provided with this ventilator, showing inlet and outlet shafts.

we have both an inlet and an outlet. The inner tube is the longer, projecting both upwards and downwards, the lower end being flanged. The air enters by the outer tube, and is directed along the upper parts of the room by the flanges of the inner tube. The inner tube acts as the outlet.

Artificial ventilation consists in the propulsion into a building of the required fresh air, or the extraction of foul air, by mechanical means. Heat may be utilised, as in the case of an ordinary chimney, or as in the heating of the upcast shaft still in use at some collieries. In large buildings, tubes may be conducted from several rooms into the chimney shaft near the fire. A steam jet has been used as the extracting force, especially in collieries, a jet of steam being able to set in motion a volume of air equivalent to 217 times its own bulk. Various forms of air-conditioning plants are now in use which purify, heat, and moisten the air, and automatically change the air in a room so many times an hour.

The advantages of artificial ventilation are, the greater certainty that the source of fresh air is pure, the ease with which the supply can be regulated, filtered, warmed, or cooled, the more effective distribution of the air, and its independence of the weather conditions.

VENTRAL (*venter*, the belly) means belonging to the belly.

VENTRICLE (*ventriculus*, the stomach) is the term applied to the two lower cavities of the heart (*see* HEART), and also to the cavities within the brain.

VENTRICULOGRAPHY is the term applied to the process of taking an X-ray photograph of the brain after the fluid in the lateral ventricles of the brain has been replaced by air; in this way any alteration in the outline of the ventricles (*e.g.* from pressure by a tumor) can be detected.

VERATRINE is an alkaloid, derived from the seeds of *Asagræa officinalis*, which has a paralysing effect upon nerves. The ointment of veratrine is accordingly used for the relief of pain in cases of rheumatism or of neuralgia.

VERATRUM, also known as green hellebore, Indian poke, and poke root, is the root of *Veratrum viride*, a plant of the United States. It acts as a sedative and depressant of the heart and

nervous system by virtue of veratrine, and other alkaloids that it contains. The drug is but seldom used, being given sometimes in the form of tincture, chiefly for the quieting of convulsive conditions.

VERBIGERATION (*verbigero*, I chatter) means the insane repetition of meaningless words and sentences.

VERDIGRIS is a basic acetate of copper. It may be formed by the action of fruit juice on copper saucepans or dishes which are not kept clean, and is said to have given rise to poisoning. (*See* COPPER POISONING.)

VERMES (*see* PARASITES).

VERMICIDES, or VERMIFUGES (*vermis*, a worm; *cædo*, I kill; *fugo*, I drive away), are substances that kill, or expel, parasitic worms from the intestines. (*See* PARASITES.)

VERMIN (*vermis*, worm) is a term applied in medicine to parasites on the surface of the body. (*See* INSECTS.)

VERONAL, or DIETHYL-MALONYL-UREA, is a hypnotic drug which acts with more certainty and less after-depression than sulphonal, trional, etc. Veronal-sodium is said to prolong sleep more than veronal, though the latter is more useful for inducing sleep. This drug and some closely allied derivatives are known by a variety of names among which are 'barbitone', 'malonal', 'hypnogen', 'proponal', 'dormigene', 'dial', 'luminal', 'medinal', etc.

Uses.—Veronal is given in doses of 5 to 8 grains, and veronal-sodium in slightly larger doses, in a hot drink at bedtime, especially to cases in which sleeplessness is combined with nervousness or depression. Caution must be exercised in taking veronal or any of its derivatives, because of the danger of over-dosage, and of habit-formation.

VERRUCA is the Latin term for a wart.

VERRUCOSE (*verrucosus*) means covered with warts.

VERSION, or TURNING, is the name given to an operation in obstetrics which consists in turning the child so that some part, usually the foot, is brought to the outlet of the womb and delivered first, in order to obviate some threatened danger.

VERTEBRA (*vertebra*) is one of the irregularly shaped bones that together form the vertebral column. (*See* SPINAL COLUMN.)

VERTIGO (*vertigo*, a whirling round) or giddiness is a condition in which the affected person loses the power of balancing himself, and has a false sensation as to his own movements or as to those of surrounding objects. The power of balancing depends upon sensations derived partly through the sense of touch, partly from the eyes, but mainly from the semicircular canals of the internal ears, and vertigo is in general due to some interference with this mechanism or with the centres in the cerebellum and cerebrum with which it is connected. Giddiness is very apt to be associated with headache, nausea, and vomiting.

Causes.—The simplest cause of vertigo is some mechanical disturbance of the body affecting the fluid in the internal ear; such as that produced by moving in a swing with the eyes shut, the motion of a boat causing sea-sickness, or a sudden fall. (*See* SEA-SICKNESS.) The cause which produces the most severe and most sudden giddiness is Ménière's disease, a name under which are grouped the various forms of direct injury to the internal ear. The most serious form is that in which sudden hæmorrhage takes place into the semicircular canals, producing an apoplectic-like fall, often of great violence. A condition of similar nature, though less violent and less permanent in its effects, is sometimes produced by the removal of wax from the ear, or even by syringing out the ear. (*See* EAR, DISEASES OF.) A third group of causes for vertigo is found in disorders of the stomach. Refractive errors in the eyes which have not received appropriate treatment by glasses, an overstrained nervous system, an attack of migraine, a mild attack of epilepsy, and gross diseases of the brain, such as tumors, form another set of causes acting more directly upon the central nervous system. Finally, giddiness may be due to some disorder of

the circulation, *e.g.* bloodlessness of the brain produced by fainting, or by disease of the heart, or the congestive state of the brain often found at the climacteric.

Treatment, while the attack lasts, consists in maintaining a recumbent posture, in a darkened, quiet room. Bromides are the drugs which have most influence in diminishing giddiness when it is distressing. After the attack is over, careful examination is necessary in order to determine the cause, for upon this depends the appropriateness of treatment.

VESICAL (*vesica*, a bladder or blister) is the term applied to structures connected with, or diseases of, the bladder. (*See* BLADDER.)

VESICANTS (*vesica*, a blister) are blistering agents. (*See* BLISTERS.)

VESICLE (*vesicula*, a little blister) means a small collection of fluid in the cuticle. The fluid in some cases consists of a drop of sweat collected at the mouth of a sweat-gland, but in general it is serum from the blood. The skin disease specially associated with the formation of vesicles is herpes ; in this disease the vesicles usually burst and then scab over. Some infectious diseases show an eruption composed of vesicles, *e.g.* smallpox and chicken-pox. When a large number of white corpuscles from the blood find their way into a vesicle, it becomes a ' pustule '.

The term vesicle is also applied to minute sacs of normal structure, such as the air-vesicles in which the finest bronchial tubes end in the lungs.

VESSEL is the name applied to any canal for carrying fluid, especially blood and lymph. (*See under* ARTERIES, CAPILLARIES, VEINS, *and* GLANDS.)

VIABLE is a term applied to a newly born child to signify that it is capable of living separately from the mother. (*See* BIRTH.)

VIACUTAN is the proprietary term for silver dinaphthylmethane disulphonate, used in a 1 per cent solution in the treatment of burns.

VIBRATOR is the name of an instrument used for vibratory massage in the mechanical treatment of disease. For its use see MASSAGE.

VIBRIO (*vibro*, I quiver) is the name applied to a bacterium of curved shape, such as the vibrio of cholera.

VIBURNUM, or BLACK HAW, is the bark of *Viburnum prunifolium* or of *Viburnum lentago*, of which the liquid extract is much used in doses of 1 to 2 drams for treating painful menstruation and threatened abortion.

VICARIOUS is a term applied to the temporary discharge by one organ of the functions of another. The word is chiefly used in connection with vicarious menstruation, when the blood that should be got rid of from the uterus runs from the nose, bowels, stomach, etc.

VICHY WATER is an alkaline mineral water from springs at Vichy in France, and is used in various constitutional disorders.

VILLUS (*villus*, hair) is the name given to one of the minute processes which are thickly planted upon the inner surface of the small intestine, giving it, to the naked eye, a velvety appearance, and greatly assisting absorption. (*See* DIGESTION, INTESTINE.)

VINCENT'S ANGINA is an ulcerative inflammation of the throat, often foul smelling, and caused by large, spindle-shaped bacilli and spirilla, thought to be associated with deficiency of vitamin B_2.

VINEGAR (*see* ACETIC ACID).

VINESTHENE is an inhalational anæsthetic. It is a mixture of 75 per cent di-ethyl ether and di-vinyl ether.

VINUM is the Latin name for wine. The wines used as medicinal remedies are wines of colchicum, antimony, ipecacuanha, citrate of iron, quinine, and orange.

VIRGINIAN PRUNE BARK, or WILD CHERRY BARK, is the bark of *Prunus serotina* which yields an oil containing hydrocyanic acid. It possesses tonic and sedative properties and in the form of tincture and syrup is used as a remedy for cough.

VIRILISM is the term applied to the condition in which masculine characteristics develop in the female, and

is commonly the result of an overactive suprarenal gland, or of a tumor of its cortex.

VIRUS (*virus*, poison) is a term applied vaguely to the poison of a disease, when it is uncertain whether this is a bacterium or chemical substance, etc. It is now most commonly used as a synonym for a filter-passing virus or filter-passer.

VISCERA (*viscus*, the bowels) is the general name given to the larger organs lying within the cavities of the chest and abdomen. The term viscus is also applied individually to these organs.

VISCEROPTOSIS, also known as splanchnoptosis, means a falling down of the viscera, especially those of the abdomen. The condition may commence in early life owing to weakness of the peritoneal ligaments which suspend the abdominal organs, but is also due to or aggravated by weakness of the abdominal muscles. It is often associated with faulty posture in standing, and may lead to considerable interference with the functions of the abdominal organs, producing especially constipation and dilatation of the stomach (*see* STOMACH, DISEASES OF, *also* BELTS AND BINDERS). In elderly women it may be associated with prolapse of the womb (*see* PROLAPSE).

VISION.—The functions of the eye as an optical instrument, which brings rays of light to the endings of the optic nerve, have been already considered (*see* EYE); in this article, vision will be dealt with as a sensation.

Rays of light pass, in the first place, through the cornea, then through the aqueous humour that fills the anterior chamber of the eye. The light then enters the hinder part of the eye through the pupil, a round hole in the iris which is automatically narrowed according to the strength of the entering light. Next it passes through the lens, which, by a similar automatic action, brings the rays to a correct focus upon the retina, where they finally arrive after passing through the vitreous humour, a jelly-like substance that fills out the eyeball. (*See* ACCOMMODATION.)

In the retina, the sensory endings appear to be the rods and cones, minute structures placed closely side by side. The number of cones in a single eye has

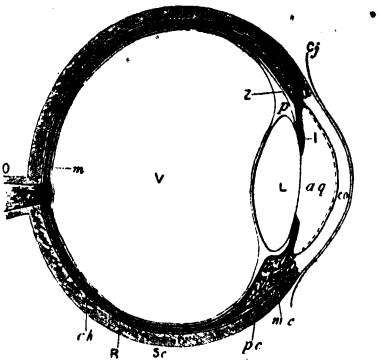


FIG. 467.—Horizontal section through the left eye. *co*, Cornea; *aq*, aqueous humour; *L*, lens; *V*, vitreous humour; *m*, macula or spot of clearest vision; *O*, optic nerve. For other letters see EYE. (Turner's *Anatomy*.)

been estimated at 3,000,000, while the rods are considerably in excess of the cones. At the *fovea centralis* or point of clearest vision, situated near the centre of the back of the eye, there are no rods, but only cones.

Light perception.—The retina is extremely delicate in its power of perceiving a faint amount of light and very

FIG. 469.—Diagram of a section through the retina, showing two rods and a cone. The layers of the retina are numbered from before backwards. (Turner's *Anatomy*.)

short flashes of light. Thus a flash from a rapidly revolving mirror lasting only one eight-millionth of a second is perceived. According to Weber's law, however, if the eye be subjected to a constant light, the light must be increased in strength by $\frac{1}{100}$ before any difference can be observed; for example, if a room be lighted by 1000 candles and the light be increased, no difference in brightness will be noticed if fewer than ten more candles be brought in at one time. The intensity of a sensation of light bears no relation to the time during which the light falls upon the eye, but a very important fact is that any image formed in the eye takes an appreciable

time to fade away, lasting about $\frac{1}{8}$ of a second. Thus, if an appearance be repeated more frequently than eight times in a second it produces an impression of permanence, and, for this reason, the spokes of a quickly revolving wheel produce an appearance as if the wheel were solid.

Acuteness of vision.—As in the case of the sense of touch, a sharp contrast between any object and its surroundings renders it more perceptible, while movement renders anything more easily seen, just as it makes a touch more easily felt. In order that an object may be distinguished, it must be of a certain size. Two points will not be seen as two unless they are at least so far apart that the lines joining them to the centre of the eye enclose between them an angle of about one-sixtieth of a degree. This distance enables the images of the two points to fall upon two cones, the centres of the cones, which are closely placed at the *fovea centralis*, being about $\frac{1}{7000}$ of an inch apart. In order that a complex object, such as a letter or figure, may be recognised, it must subtend an angle of about five times this size, that is, one-twelfth of a degree. Upon this principle Snellen's types for testing the acuteness

FIG. 470.—Three test types of Snellen's scale (D=6). These letters should be clearly visible to normal eyes at a distance of 6 metres (22 feet).

of vision are constructed. The largest letters are of such a size that at 60 metres' distance they occupy an angle of one-twelfth degree, and should therefore be clearly seen; while the smallest are of such a size that they occupy this angle at 6 metres' (22 feet) distance, and should there be correctly read. The vision of a normal-sighted person, who can read these last types at 6 metres' distance, is represented by the fraction $\frac{6}{6}$, while that of a person who can only read the largest type at the same distance is $\frac{6}{60}$, and intermediate degrees of faulty vision are $\frac{6}{12}$, $\frac{6}{18}$, $\frac{6}{24}$, etc. Still smaller types are used for testing the acuteness of near vision. It must be noted that efficiency of vision is not proportional to acuity of vision. Thus a man with '$\frac{6}{12}$ vision' has half the visual acuity of a man with '$\frac{6}{6}$ vision', but he has very little less efficiency. Indeed for ordinary manual work vision of $\frac{6}{12}$ gives practically full efficiency. This point is important in connection with accidents to the eye.

Colour sense is one of the most difficult to understand of the visual powers. It corresponds, broadly speaking, to the perception of the pitch of notes by the ear, depending upon the difference in rapidity of vibration of various rays of light. White light is supposed to be compounded of a mixture in certain proportions of the other colours, into which it may be split by refraction through the prism. This band of colours, or spectrum, may be again compounded into white light by passage through a second prism; or the same effect may be got by rotating rapidly before the eyes a disc with segments variously coloured. White light may also be formed by a disc of two colours, which are therefore known as complementary colours. These are red with bluish-green, orange with blue, or violet with yellow. Again, any colour may be produced by mixtures in varying proportions of red, green, and violet, these three being therefore known as cardinal or fundamental colours. Three theories have been suggested as to the manner in which various colours are produced.

(1) YOUNG-HELMHOLTZ THEORY is the one that finds most acceptance. It teaches that there are in the retina separate elements, probably cones, capable of being stimulated by the rays in different parts of the spectrum. Some of these react to red but not to green or violet, others to green but not to red or violet, and a third set to violet though not to red or green; while an appearance of white results when all are fairly equally stimulated.

(2) HERING'S THEORY demands the existence of chemical substances in the retina, three in number, which are constantly being either formed or broken down under the action of light. Each substance is supposed to correspond with a pair of colours, one with black or white sensations, one with red or green, and the third with yellow or blue. Destruction of each substance by light produces one colour of a pair, construction produces the other. Intermediate colours of the spectrum, such as orange,

result from light affecting two of these substances.

(3) TELEPHONE THEORY is one that has been suggested, but has not found much favour. By it the rays of all wave-lengths are supposed to be received on the retina, where they set up differing nerve vibrations that are conveyed to the brain, where, for the first time, they are analysed into different sensations of colour, just as a telephone ear-piece reproduces the voice with all its original pitch and modulations.

Field of vision.—When one looks straight forwards with one eye at a time,

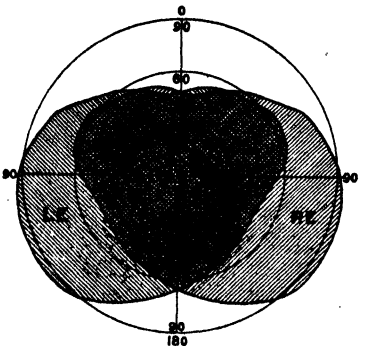


FIG. 471.—Diagram of the fields of vision. The outer circle represents the half of space lying in front of the observer. As he looks directly forwards, the figure 0 is straight above his head, 180 straight beneath his feet, and 90 straight out on either side. The two smaller circles rise 30° and 60° above the horizon. The two shaded areas represent the field visible to either eye, *LE* to the left eye, and *RE* to the right eye. The darker area, where the two overlap, is the part seen by both eyes.

one sees with special clearness the object towards which the eye is directed, and more vaguely objects for some distance around. The extent that can be seen without moving the eye is known as the 'field of vision'. It is oval in shape and extends much farther outwards than in other directions. Towards the temple, indeed, the eye of a sharp-sighted person looking straight forwards can see white objects about ten degrees behind the person. The fields of vision of the two eyes overlap to a great extent, so that objects around the centre and to the inner side of each field are viewed by both eyes. Accordingly there are 'corresponding points' in the two retinæ, an object to the right of the observer producing an image on the inner side of his right eye, but on the outer side of his left eye.

The optic nerves are arranged in correspondence with this, the nerve fibres from the left half of each retina passing to the left hemisphere of the brain, and those fibres from the two right halves going to the right hemisphere. Thus half of each optic nerve crosses from one eye to the other side of the brain at the optic chiasma.

It is interesting to note that the field of vision forms an inverted image on the retina, objects to the right falling upon the left side of each retina, those above upon its lower part, and *vice versa*. The mind, however, as the result of experience, analyses these images and so this inversion is not perceived.

The field of vision varies for different colours, that for white being largest, yellow next, then blue, red, while green is only seen for a short distance round the centre of the field when the coloured areas are of equal size.

The existence of a blind spot is mentioned and the proof of its presence detailed under EYE.

Visual judgements.—The sensations of sight imply a great amount of judgement, for while the other senses are influenced by direct physical impressions, in sight we have to examine an inverted image of microscopic size produced by ether waves upon each retina. We are, however, conscious neither of the minuteness of the visual image, nor of its inversion; nor are we aware of the blind spot in each field of vision, unless we search for it in the manner described under EYE.

The manner in which we estimate size and distance was inquired into by Bishop Berkeley in his *Essay towards a New Theory of Vision*, published in 1709, and his conclusions still in the main hold the field. He concluded that our idea of near distances was derived from three arbitrary signs: (*a*) the sense of muscular effort in converging the eyes when they are directed to something very close at hand, and of relaxation when they diverge to view some object farther off; (*b*) the blurred appearance presented by nearer objects, when we are looking at an object situated farther off, or *vice versa*; (*c*) the muscular effort of accommodating the eye for near or for distant vision. (*See*

ACCOMMODATION.) In distant vision too he held that we are mainly dependent on the three signs: (*a*) evidence derived from experience mainly of the sense of touch; a certain combination of colours and form, for example, being associated with the idea of a man felt at close quarters, the same colours and form of smaller size suggest a man some distance off; (*b*) the sense of blurring of distant objects, already mentioned, when we look at objects close at hand; (*c*) faintness in appearance of an object suggests distance, clearness suggests that the object is near at hand. When objects are seen under unusual conditions of faintness or clearness it becomes very difficult to estimate their size and distance. Thus the moon low down near the horizon and partly obscured by mists rising from the earth, or figures of men on a foggy day, loom much larger than natural, because we over-estimate their distance, owing to their faintness.

Berkeley, however, took little note of the value of binocular vision and of the partial overlapping of the two fields already mentioned. He based his theory largely upon the axiom that 'distance being a line directed endwise to the eye, it projects only one point in the fund of the eye—which point remains invariably the same, whether the distance be longer or shorter'. This, however, applies only to a one-eyed man, and, in binocular vision, each eye corrects this deficiency of the other, seeing as it were across the other eye's line of vision. Thus we can see in some degree behind or round the corners of nearer objects, and so we obtain to a great extent our idea of depth, or solidity.

VISION, DISORDERS OF.—Many disorders which indirectly affect the power of vision owing to inflammation or to a painful condition of the eye have been mentioned under EYE, DISEASES OF. Here we shall consider more permanent and direct disturbances of sight under the heads of (*a*) Dimness of vision; (*b*) Colour-blindness; (*c*) Decreased visual field; (*d*) Night-blindness.

Dimness of vision.—The most frequent cause of dim vision, or even of total blindness, is some obstruction to the entrance of light through the parts that ought to be transparent.

CORNEAL OPACITIES may produce a ground-glass-like condition of the naturally transparent cornea, so that light may be prevented from gaining access to the eye at all. Thus a dark shadow is caused upon the vision, or complete blindness is produced, according to the breadth and density of the opacity. Practically nothing can be done to remove dimness of vision due to this cause. The most common diseases leading to this condition are keratitis and corneal ulcers. (*See under* EYE, DISEASES OF.)

REFRACTIVE ERRORS produced by malformations of the cornea, the lens, or the globe of the eye, are by far the commonest causes of defective vision. They are also the most important, both because they cause great interference with the ordinary pursuits of life and may lead to a great degree of general ill-health, and still more because the recognition and appropriate treatment of these errors are easily effected by the expert. The symptoms due to refractive errors are sometimes grouped as the result of *eye-strain*, and include in the first place headache, inflammation of the eyes (*conjunctivitis* and *iritis*), and inability to use the eyes for long at one time. Children, especially, who have uncorrected errors of refraction have difficulty in keeping up with their fellows at school because of blurring of the page in reading (long-sight) or inability to see clearly maps, blackboards, and other objects at a distance (short-sight). The strain produced may even lead in delicate children to headaches or more serious nervous disorders, or to impairment of the general health. Further, children with such defects are apt to adopt a crouching position at lessons, and to evince a distaste for outdoor sports. This leads to curvature of the spine, defective chest development, and liability to lung diseases. The varieties and treatment of refractive errors are dealt with under SPECTACLES.

CATARACT is an opaque condition of the lens coming on slowly, as a rule, in elderly people. Its symptoms, etc., are treated under CATARACT.

VITREOUS HUMOUR OPACITIES are apt to be seen by any one who looks steadily at a bright surface, particularly when the general health is not

perfect. These may be due to the remains of former inflammation in the choroid coat, but as a rule they are simply the shadows of unimportant cells and fibres floating in the vitreous humour, and need not cause any worry.

DISEASE IN THE FUNDUS of the eye, consisting of chronic inflammation in the retina or choroid coat, or in both, is often a reason of diminishing vision, characterised especially by inability to see in a dim light. (*See* EYE, DISEASES OF; CHOROIDITIS.)

DISEASES OF THE BRAIN OR OF THE OPTIC NERVE may lead to temporary dimness of vision, and sometimes blindness.

Colour-blindness is a much more common disorder than is generally supposed, being present to an appreciable extent in about one person out of every fifty, and much more common in men than in women. It is usually congenital, and persists through life, though it may be acquired as the result of poisoning by various substances, notably by excessive tobacco-smoking.

Red-green blindness is the most common form, and is present in all grades of completeness, from that of a person for whom red simply loses its brilliance at a distance, to that of a person for whom vivid green and brilliant scarlet appear as one and the same colour. In one variety of red-green blindness the red, orange, yellow, and green of the spectrum appear all of one colour, 'green'; while the blue and violet both appear as 'blue', with a gap in the spectrum where the normal eye sees a bluish-green colour.

The usual test for colour-blindness consists in giving the person a skein of green or red wool, and asking him to select from many other skeins the colours which appear to him to match the one he holds. The colour-blind person confuses red with brown, greenish-brown, and yellowish-brown; and he confuses green with bluish-green, rose, and grey.

The importance in testing for colour-blindness any one who is to be a signalman or engine-driver is evident.

Decreased visual field is another form of visual defect. Complete blindness in one eye which has lasted since birth is frequently discovered only by accident in middle life, because the healthy eye has always had an unrestricted field. Another and rarer condition, which is more noticeable to the patient, consists in loss of one-half of the visual field, so that the person can see objects only at one side and must turn his head in order to appreciate his surroundings. This is due to some defect in one-half of the brain or in the optic tract. In this defect a corresponding part of each retina is thrown out of action. Local causes of decrease in the visual field of each eye are found in atrophy of the optic nerve and certain forms of inflammation of the retina. Some general conditions also produce a temporary narrowing of the field, notably great bloodlessness, and over-dosage with quinine.

These defects can be mapped out accurately by the help of an instrument called the perimeter.

Night-blindness, an abnormal inability to see things in the night, is thought to be due in many cases to vitamin A deficiency; sometimes the condition is hereditary.

Yellow vision may appear from taking santonin or in a case of jaundice.

VIS MEDICATRIX NATURÆ is a Latin term meaning the healing power of Nature, and is often used to indicate the tendency of wounds to heal and of the bodily powers to subdue disease, when left to the operation of time and rest.

VITAMIN (*vita*, life) is a term applied to a group of substances which exist in minute quantities in natural foods, and which are necessary to normal nutrition, especially in connection with growth and development. When they are absent from the food defective growth takes place in young animals and children, and in adults various diseases arise; while short of the production of actual disease, persistent deprivation of one or other vitamin is apt to lead to a state of lowered general health. Certain deficiencies in diet have long been known to be the cause of scurvy, beri-beri and rickets, but the so-called 'vitamine hypothesis' was not introduced until the 20th century.

Vitamin A, which occurs in connection with fats, is essential for growth, and deficiency of this vitamin in the

diet produces defects in the cellular coverings of the eye, skin and mucous membranes so that blindness, skin eruptions and a liability to infection may be produced when it is lacking in the food. Vitamin B, which is soluble in water and can be soaked out of the foods containing it, was originally found to be defective in the diet of persons suffering from beri-beri, a common and fatal disease in the Far East; it was later found that similar food deficiencies were responsible for pellagra, a serious disease in the southern United States, Italy, Egypt, etc., as well as for other minor conditions; accordingly it became necessary to divide this group of vitamins into B1, B2, B3, etc., although in America these are sometimes called vitamins F, G, H, etc. Vitamin C, which is also soluble in water, is widely present in fresh vegetables, and its deficiency in the diet is responsible for scurvy, and in a lesser degree for bad states of general health. Vitamin D, which is generally present in foods containing vitamin A, is defective in rickets, a disease affecting young children, and in some parts of the world occurring also in adults. Vitamin E, which is found in the germ of wheat, is necessary for successful reproduction, and its deficiency is apt to lead to sterility or abortion.

Vitamin A is usually taken in more than ample quantity in the food, and is stored in the liver. It is developed originally by plants as a yellow colouring matter, carotene, for example in carrots, and it is also found in egg yolk, butter, and most green vegetables. When stored in the liver, it is colourless and has a slight chemical difference from carotene. A concentrate of this vitamin from cod-liver oil represents about $\frac{1}{3000}$ part of the oil, while in halibut-liver oil it is present in greater amount. Deficiency of vitamin A is responsible for serious inflammation of the eyes known as xerophthalmia, which in India is one of the chief causes of blindness; also for night blindness, various skin eruptions, defective development of the teeth, and particularly for want of vitality in the tissues, which leads to localised inflammations.

Vitamin B1, also known as ANEURIN and THIAMINE, is found in the husks of cereal grains. Its deficiency may be produced by too careful milling of rice in the East, or by a diet of white bread to the exclusion of brown bread and other cereal sources of this vitamin. The resulting disease is a form of neuritis with muscular weakness, heart failure, etc., which in Japan and other parts of the East is known as beri-beri. Vitamin B1 has now been isolated in crystalline form, and a minute dose of this rapidly cures the symptoms of beriberi. The germinal part of seeds, bran, whole meal, yolk of egg and particularly yeast are good sources of vitamin B1.

Vitamin B2 is now divided into different fractions, and the term is being restricted to the vitamin known as RIBOFLAVIN, which has been isolated in crystal form. It seems to be essential for growth and the health of the skin. In human beings sore lips and inflamed mouth are thought to be due to deficiency of riboflavin. That part of the vitamin B2 complex responsible for the prevention of pellagra has now been identified as NICOTINIC ACID. Other substances separated from the 'vitamin B2 complex' are PYRIDOXINE or vitamin B6, and PANTOTHENIC ACID. Vitamin B2 is found in meat, liver, yeast, fish, and milk, and is allied chemically to lactoflavin, the yellow colouring matter of whey.

Vitamin C is especially found in fresh fruits such as the orange, and also in fresh green vegetables, and to a smaller extent in milk, meat and other fresh foods. Canned vegetables such as tomatoes also retain it if their reaction is acid. It is quickly destroyed by high temperature, by baking soda and other alkalies, and gradually by oxidation in process of keeping. Its deficiency in a few months leads to symptoms of scurvy, including muscular weakness, hæmorrhages under the skin, swelling and inflammation of the gums with loss of teeth, and serious damage to joints by hæmorrhage; it occurs in sailors and other persons long deprived of fresh foods, and also in babies fed persistently on artificial foods. This vitamin has not only been obtained in a pure state, but has been manufactured in a crystalline form as ascorbic acid.

Vitamin D is of special importance for the growth of children, and its deficiency produces rickets with softening

and irregular growth of bones, so that swollen joints, distorted limbs, deformities of the chest and similar malformations arise. It was formerly common in the dark and narrow streets of large manufacturing towns, and is still common where children are kept too much indoors. Osteomalacia, a similar disease affecting the bones of adult women, results from the same causes when lime salts are absorbed from the bones during pregnancy. Rickets is also common among young dogs and other animals. It has long been known that cod-liver oil was the chief remedy for rickets, and for a time it was supposed that its anti-rachitic action depended upon vitamin A, but it was found more than ten years ago that although the latter was destroyed by heat, vitamin D was not, while the two vitamins are not always contained in the same substances. Recently the important discovery was made that vitamin D can be produced by the action of ultra-violet rays upon a waxy constituent of animal and vegetable tissues known as ergosterol, from which vitamin D can afterwards be separated. To this synthetic vitamin D the name of calciferol has been given, and it is 400,000 times more potent than cod-liver oil in preventing or curing rickets. This substance is also formed naturally in the fatty tissues of the body when the skin is exposed to the action of sunlight, or, when this is not available, to ultra-violet rays from an arc lamp. It can also be formed in food such as milk when this is similarly exposed to light. Only a few foods contain vitamin D naturally, including cod-liver oil and other fish liver oils (especially that from halibut liver), while egg yolk contains a smaller quantity; other fats and milk contain very small quantities. The mode of action of vitamin D is to aid the absorption of phosphorus and calcium from the food, increase their amount in the blood, and thus in the bones. In the case of this vitamin bad effects may follow over-dosage, or hypervitaminosis, because if too much calcium and phosphorus are maintained in the blood the bones and teeth become over-calcified, the arteries may become unduly hardened and calculi may be formed in the kidneys and other organs.

Vitamin E has been known for some fifteen years, when it was found that its defect in the case of rats caused failure to produce young. It is derived especially from the oil contained in seeds and in green leaves, and also is present in smaller amounts in other fresh fats. It is readily stored, like vitamin A, in the body, and thus is unlikely to be found wanting in human beings except in cases of very severe under-nutrition. It is possible, however, that miscarriages may occasionally be due to its deficiency.

Vitamin H (*see* BIOTIN).

Vitamin K, or the anti-hæmorrhagic vitamin, has recently been discovered and is essential for the proper clotting of blood. It has been given successfully in cases of bleeding in infants and to patients with jaundice, who have a special tendency to bleeding. Bleeding in these conditions is thought to be due to deficiency of vitamin K. Synthetic chemical products with an identical physiological action have now been made.

Vitamin P, ERIODICTYOL, or HESPERIDIN, present in citrus fruits, appears to be responsible for the resistance of the capillaries to pressure. If there is a deficiency of vitamin P in the diet the capillaries rupture easily, resulting, for example, in purpura.

It should be said in conclusion with regard to the supply of vitamins that any person using a diet containing the 'protective foods', such as milk, eggs, butter, cheese, fat fish, wholemeal bread, fresh vegetables and fruit, should obtain an ample supply of vitamins. Infants should have a teaspoonful daily of cod-liver oil and two teaspoonfuls of orange juice or of tomato juice.

VITELLUS, or VITELLUM, is the Latin name for yolk of egg.

VITILIGO is the term given to a skin disease in which smooth light-coloured patches appear either on the skin or in the hair.

VITREOUS BODY (*vitreus*, glassy) is a semi-fluid transparent substance which fills most of the globe of the eye behind the lens.

VITRIOL, OIL OF, is an old name for sulphuric acid.

VOCAL RESONANCE is the term applied to the buzzing sound that is heard when the ear is applied to the chest as the patient speaks.

VOICE and SPEECH are two terms applied to the system of sounds which are produced in the upper air passages and in the mouth, and which form one of the means of communication between human beings.

Voice means the set of fundamental notes and tones produced by the larynx, which are modified in various ways during their passage through the mouth so as to form speech or song. Speech differs from song in being less sustained and of smaller compass with regard to pitch, and in presenting sounds which have not a musical character.

Voice is produced in the larynx of most animals, though birds have a special organ known as the 'syrinx' in which their song takes origin. The question was formerly much debated as to what musical instrument most closely resembles the larynx. Ferrein held that the violin formed the nearest artificial approach, and hence the name of vocal 'cords'. Other observers have, in a somewhat fanciful way, compared the air which the chest drives upwards to the bow, the larynx to the violin, and the tongue, lips, etc., which modify the laryngeal notes, to the string-hand of the violinist. It is generally admitted, however, that the larynx more nearly resembles a wind instrument with a pair of vibrating reeds. Many persons have made a careful study of voice production by the aid of the laryngoscope (*see* LARYNX), an instrument which enables the changes that take place in the larynx when different notes are sounded to be clearly seen.

Musical notes vary in three characters, viz. loudness, pitch, and quality or timbre. The *loudness* of the voice depends upon the volume of air which is available for agitating the vocal cords, and therefore upon the size of the chest and vigour with which its muscles can be made to act.

The *pitch* of the voice is determined by several things, the chief points being the size of the larynx; the degree of tenseness at which the vocal cords are, for the time being, maintained by the laryngeal muscles; the fact as to whether the cords vibrate as a whole or merely at their edges; and the shape which is given to the cavity of the larynx by movements of the arytenoid and epiglottic cartilages. In any given voice, the range of pitch seldom exceeds two and a half octaves, though the particular part of the musical scale that can be produced varies according as the voice is bass, tenor, contralto, soprano, etc. Generally speaking, a large larynx with long vocal cords produces low notes, and hence men have a deeper voice than women. For the same reason the small larynx of childhood produces a shrill voice, while the rapid growth of the larynx at the time of puberty and consequent uncertainty of muscular control over the vocal cords produces the 'breaking' of the voice that occurs in boys at this time. The manner in which the muscles of the larynx act upon the cords allows the pitch to change at will. Thus if the thick part of each cord be held rigid and only the sharp free edge be allowed to vibrate, a high note is the result, and a still higher note is reached in men when only the front part of this free edge is allowed to move, as in the 'falsetto' voice. On the other hand, by allowing a greater thickness of the cord to vibrate, the person loads the vibrating edge, and thus produces a much deeper note.

The *timbre* of the voice is partly due to these differences in the larynx, but chiefly to peculiarities and to voluntary changes in shape of the mouth and other cavities associated with the air passages. These changes in shape of the mouth, etc., are chiefly concerned with the alterations of the fundamental notes which produce speech, and they are considered in detail below.

It should be remembered, however, that while the muscular arrangements of the larynx are chiefly concerned with the pitch of the voice, and the shape of the mouth with its modulation, the *loudness* is varied by the movements of the chest. The neglect of this fact is often responsible for the bad voice-production which leads to great straining of the throat, and is largely responsible for the throat affections of many of those who use the voice much. (*See* CLERGYMAN'S SORE THROAT.)

There are certain peculiar forms of

voice production. The *falsetto voice* has been already mentioned. *Whispering* is a form of speech in which voice is completely absent, the larynx being wide open, and the sound produced entirely in the mouth. *Ventriloquism* is a form of speech in which the voice is produced by the indrawing of air, instead of in the usual way of expiration. Since it is always difficult to localise the source of sound, the ventriloquist can easily suggest to his audience a false place of origin for the unusual voice.

Speech consists of a series of rapid modifications of the voice, produced by changes in position of the palate, tongue, and lips. EACH VOWEL has an appropriate pitch as ordinarily spoken, though it is possible to pronounce any of the vowels in any note within the compass of the voice. The appropriate pitch of *u* (pronounced *o͞o*) is lowest, and the vowels rise through *o*, *a* (pronounced *ah*), *e* (pronounced *eh*), to *i* (pronounced *e͞e*). Apart from this slight difference in pitch, the distinguishing character of each vowel is gained by alterations in the shape of the mouth cavity through which the stream of air passes. Any one can at once prove this fact by opening his mouth widely and sounding musical notes of various pitch. All of these will have the character of *a*, nor can the vowel be changed till the mouth is shut somewhat and certain changes made in the position of the tongue and lips. These changes in the shape of the mouth have the effect of intensifying certain of the overtones in the fundamental laryngeal note, and thus the vowels are produced. The shape of the mouth in speaking the different vowels is somewhat as follows. In pronouncing *a* (ah) the mouth is something like a funnel open to the front, the lips and teeth being held wide apart. For sounding *e* (eh) the shape is slightly modified, the mouth being more closed. When *u* (o͞o) is pronounced the cavity of the mouth is shaped like a wide flask with a very narrow neck at the lips, which are protruded as far as possible. For *o* the flask shape is modified slightly, the neck being made shorter and wider by bringing the lips nearer the teeth and opening them a little. In pronouncing *i* (e͞e) the tongue is brought up to the teeth, so that the air passes through a long narrow cavity, and obtains free exit, the lips being drawn well back. Though the English language is usually said to include only five vowels, many others can be formed by slight variations in the shape of the mouth, as, for example, in the case of the modified *ö* and *ü*, and other vowels of Continental languages. Diphthongs, like *ai*, *oi*, *ae*, are produced simply by a rapid change from one mouth-shape to another while air is issuing through the larynx.

CONSONANTS are sudden sounds produced by cutting off the stream of air either wholly or partially, or by suddenly beginning it. Of necessity, a consonant forms either the beginning or end of a vowel sound, and the particular consonant produced depends upon the point at which the stream of air is checked. According to Brücke, there are four of these 'stop-positions'—

(1) Between the lips.
(2) Between tip of tongue and roof of mouth.
(3) Between root of tongue and palate.
(4) In the larynx.

The character of the consonant varies also according as the stoppage of air is complete or its commencement sudden (*explosive consonants*); as the stoppage is only partial or the commencement gradual (*aspirate consonants*); or as the margins of the opening are thrown into vibration (*vibrative consonants*). Again, in the case of some consonants, the mouth is closed at different stop positions, and the air stream is allowed to pass out by the nose (*resonant consonants*). On this principle, consonants are classified as follows:

	Explosives.	Aspirates.	Vibratives.	Resonants.
1st Stop Position	P, B	F, V, W		M
2nd Stop Position	T, D	S, Z, L Sch, Th	R	N
3rd Stop Position	K, G	Ch, J	Palatal R	-Ng
4th Stop Position		H	Saxon R	

Another distinction, which is of great importance in the treatment of stammering, consists in the amount of force which is necessary to open the stop and sound

the consonant, and the amount of voice which therefore accompanies it at the beginning of a syllable. Thus the explosives and aspirates may be grouped as—

	Explosives.	Aspirates.
Voiceless	P, T, K	F, S, Sch, Th (as in *throw*), Ch
Voiced	B, D, G	V, Z, L, Th (as in *then*), J, H

The vibratives and resonants are all voiced.

One can test this by comparing, for example, the words 'Peter' and 'Beater'. In 'Peter' the *P* has little sound, the voice becoming full only on the *E*, while in 'Beater' the full volume of sound comes out at once on the *B* and dies away on the *E*. One cause of stammering is the attempt to pronounce, with full voice, the consonants at the commencement of words which should be voiceless, instead of touching off the consonant lightly and passing on at once to emphasise the vowel.

Defects of speech.—The apparatus for speech being so complicated, and the changes which must take place constantly in its different parts so varied, it follows that the act of speech has a very elaborate controlling mechanism in the nervous system. Further, the power of speech is gained in early life by children hearing the sounds made by others and mimicking them, so that the centres for speech in the brain are intimately connected with those concerned in the sense of hearing.

MUTISM, or the entire absence of the power to speak, may be due to various causes, the most effectual being some mental deficiency which denies to the child sufficient intelligence to mimic the actions of those around him. In other cases the child seems to be quite intelligent, but, owing apparently to some defect in the nervous control of the voice and speech organs, or in these organs themselves, he is unable to make any sounds. A very common cause of mutism is complete deafness present at birth, or caused by some ear diseases in early childhood. The child in this case cannot learn to speak, simply because he cannot hear, but, if properly educated, he can be taught to speak fluently and to understand what is said by watching the lips and throat of others. (*See* DUMBNESS.)

STAMMERING is a bad habit of speech due to want of co-ordination between the different parts of the speech mechanism. (*See* STAMMERING.)

TWANGS of various kinds are assumed very easily, and, indeed, often unconsciously from those around. The ease with which the exact pronunciation of a foreign tongue is picked up by a person living in the country in question is well known. Many differences between different languages are to be explained by slight differences in shape between the speech organs of different races. Other differences are to be explained by different habits of opening the lips and mouth in various tribes of the same stock, due, perhaps, to external conditions, such as climate. Such minor peculiarities in speech as 'burrs' and 'lisps' are due to peculiarities in the action of the tongue or palate, while the deformities of tongue-tie and cleft-palate are accompanied by still greater defects of speech. When the nose is blocked by any condition, such as cold in the head or polypus, the pronunciation of the resonants *m*, *n*, and *ng* is interfered with, these being heard as *b*, *d*, and *g* respectively, for a reason which can be seen on consulting the first table given above.

APHASIA is a condition in which various forms of inability to speak, or to understand speech, come on late in life as the result of brain disease. (*See* APHASIA.)

APHONIA, or loss of voice, causes speaking to be carried on in a whisper. It is usually either due to some disorder of the vocal cords, as in the laryngitis which may form part of a cold (*see* THROAT DISEASES), or is a symptom of hysteria. It is generally of short duration.

VOLAR (*vola*, palm or sole) means something pertaining to the palm or sole.

VOLKMANN'S CONTRACTURE is the term applied to the condition in which, as a result of too great a pressure from splint or bandage in the treatment of a broken arm, the flexor muscles of the forearm contract and thus obstruct free flow of blood in the

veins; the muscles then swell and ultimately become fibrosed.

VOLSELLA is a Latin term for a forceps with hooked blades.

VOLVULUS (*volvo*, I twist) means an obstruction of the bowels produced by the twisting of a loop of bowel round itself. (*See* INTESTINE, DISEASES OF.)

VOMICA (*vomica*, an abscess) means a cavity in the lung produced by ulceration, which is usually a sign of consumption.

VOMITING (*vomo*, I vomit) means the expulsion of the stomach contents through the mouth. When the effort of vomiting is made, but nothing is brought up, the process is known as 'retching'. When vomiting occurs, the chief effort is made by the muscles of the abdominal wall and by the diaphragm contracting together and squeezing the stomach. The contraction of the stomach wall is no doubt also a factor, and an important step in the act consists in the opening at the right moment of the cardiac or upper orifice of the stomach. This concerted action of various muscles is brought about by a 'vomiting centre' situated on the floor of the fourth ventricle in the brain.

Causes.—Vomiting is brought about by some irritation of this nervous centre, but in the great majority of cases, this is effected through sensations derived from the stomach itself. Thus, of the drugs which cause vomiting some act only after being absorbed into the blood and carried to the brain, though most are irritants to the mucous membrane of the stomach (*see* EMETICS); dyspepsia also acts thus, and lies at the root of most sick-headaches; and various diseases of the stomach, such as chronic catarrh, cancer, ulcer, and dilatation act in a similar way. Irritation, not only of the nerves of the stomach, but also of those proceeding from other abdominal organs, produces vomiting; thus in obstruction of the bowels, peritonitis, gall-stone colic, renal colic, and even during pregnancy, vomiting is a prominent symptom.

Strong impressions of an unpleasant nature made upon the nerves of sense are very apt to produce vomiting. Thus an offensive smell, a disagreeable sight, any interference with the balancing sense as in sea-sickness, irritation or even tickling of the throat, and the pain of an injury or operation are all likely to be attended by vomiting.

Direct disturbance of the brain itself is naturally a cause, and often a very obscure cause, of vomiting; for example, a blow on the head, a cerebral tumor or cerebral abscess, meningitis, locomotor ataxia, and nerve-storms like migraine. Many cases of hysteria also show attacks of vomiting as one of their prominent symptoms.

Finally, the vomiting-centre may be brought into action by various poisons introduced into the blood, like tartar emetic and apomorphine; or by the poisons of various acute and chronic diseases, *e.g.* Bright's disease, small-pox, scarlet fever, typhus, and cholera. Vomiting, indeed, forms an important early symptom of these diseases.

Characters of the vomit.—FOOD, more or less softened and made sour and bitter by digestion, constitutes the vomit in the simpler cases, such as those due to emetics, sea-sickness, bad smells, etc. It should be remembered that when milk is vomited up curdled, this indicates simply that the first step in its digestion has taken place, and it is a mistake to conclude, as is often done, that the curdling indicates some intolerance of the stomach for milk.

WATERY FLUID, brought up irrespective of meals, forms the vomit in nervous conditions; in weak states, for example, in the vomiting of bloodless persons, and at an early stage of pregnancy. When the vomiting continues long, it tends to bring up mucus and bile also.

MUCUS, when vomited in considerable amount in strings, and especially when sour in taste and brought up in the morning, is a sign of catarrh of the stomach, particularly that form associated with constant indulgence in alcohol.

BILE may be brought up by any long-continued attack of vomiting, after the contents of the stomach have been expelled and retching still continues, for example, in sea-sickness, or in migraine and other forms of nervous vomiting. Usually the bile is golden-yellow in colour; but sometimes it is grass-green. The seriousness of the condition pro-

ducing the vomiting is assured when the ill-smelling, brownish contents of the bowels follow after the bilious vomit.

FROTHY MATERIAL, with a yeasty smell, which divides into three distinct layers, viz. froth on the surface, and a sediment of undigested food, with a layer of clearer fluid between, is highly characteristic of the vomit from a dilated stomach in which fermentative dyspepsia is taking place.

BLOOD may be red in colour, and brought up mixed with the food or in clots; but, much more frequently, it is vomited as a brown granular material, very much resembling 'coffee-grounds'. As a general rule, the vomiting of blood indicates some ulceration in the interior of the stomach, but the amount of blood is no guide to the size of the ulcer, because serious bleeding sometimes occurs from hardly perceptible 'erosions' of the mucous membrane. Large quantities of blood are also occasionally brought up in chronic catarrh of the stomach (especially the alcoholic variety) which is accompanied by congestion.

Treatment must have two objects in view: (1) to relieve the source of the irritation, and (2) to soothe the nervous centre.

In the first place, the cause of the vomiting must be sought for, and in general this will be found to be some disorder of the stomach. If an indigestible meal have been taken some time previously, and its remnants be still loading the stomach, an emetic or a copious draught of warm water has the effect of getting rid of the indigestible material and allowing the irritation to subside. Various substances which have a soothing action upon the stomach may also be taken when the sickness continues, such as carbonate of bismuth, or a powder composed of rhubarb (2 parts), soda (2 parts), and bismuth (4 parts), in teaspoonful doses, or a tablespoonful of chloroform water. Opium and dilute hydrocyanic acid are still more powerful sedatives, not to be used except under medical guidance. The application of some counter-irritant, such as a mustard leaf, over the pit of the stomach, has often a very marked sedative effect. (*See* BLISTERS.) In irritable stomach-conditions, posture is an important matter; the sufferer should lie with the head on a low pillow, and on his left side, so that the stomach is supported by the ribs.

The vomiting due to such serious conditions as peritonitis subsides under the treatment appropriate to these conditions, and when nothing can be retained in the stomach, the sucking of small lumps of ice often gives great relief.

The special measures applicable to sea-sickness are given under SEA-SICKNESS.

Vomiting due to inflammation or some other source of irritation in the throat is greatly relieved by soothing gargles, or by sucking lozenges containing ammonium chloride or chlorate of potash.

With the view of soothing the nervous centre that excites the vomiting, drugs such as morphia, atropine, bromides, and chloral are often administered. Fresh air is of great importance, and the drawing of deep breaths has a distinct effect in checking the tendency to vomit. Mental quiet and a darkened room also assist in soothing the nervous system.

VULVA is the general term applied to the external female genitals.

W

WAFER PAPERS are thin circular discs made of flour and water, which become pliable when wetted, and form a convenient wrapper for swallowing nauseous drugs without tasting them. For the method of use, see POWDERS.

WALK (*see* GAIT).

WALLS (*see under* SANITATION).

WARBURG'S TINCTURE is a complex liquid containing no fewer than fourteen ingredients, of which the chief is quinine. It used to enjoy a great reputation in the treatment of malaria, etc., given in doses of one tablespoonful.

WARMING (*see* LIGHTING).

WARTS are small, solid growths, arising from the surface of the skin. They are of interest from the fact that they stand somewhere between mere thickenings of the skin due to irritation, and tumors. They are, as a rule, harmless, and are objectionable only as blemishes, and not on account of any ill effects they occasion. Sometimes, however, pigmented warts, and warts that have been exposed to much irritation develop in old people into malignant growths.

Varieties and causes. — COMMON WARTS develop on the skin of children and young persons in positions where the growth of the skin is exuberant and the surface is exposed to much irritation, for example on the knuckles, on the backs of the hands, and on the face. Occasionally such warts come out in a crop when the person is reduced in health. In structure, these warts consist of a bundle of fibres produced by overgrowth of the papillæ in the true skin, each bundle enveloped by a cap of the horny cells that cover the surface of the cuticle, and the whole mass being surrounded by a ring of thickened cuticle. These fibres can easily be seen when the surface of the wart becomes worn away, and especially if the top of the wart be accidentally cut or knocked off, so that it bleeds. The dirty-brown colour of warts is due to dirt becoming lodged between these fibres. SENILE WARTS are usually hard, wrinkled, and slightly raised areas of skin found in old people. SOFT WARTS, consisting of little tags of skin, are found especially upon the neck, chest, ears, or eyelids of persons whose skin has been subjected for long to some irritation, such as that of working among paraffin. HORNS are formed sometimes upon the face or hands, as the result of the drying up of the sebaceous material exuding from the skin that covers a wart, and, as the secretion goes on, these horns occasionally reach a length of some inches. TUBERCULOUS WARTS are developed sometimes as the result of a wound in the skin of the hands, especially of those who have come in contact with persons suffering from some form of tuberculosis.

Treatment. — As a rule, warts are removed painlessly by the application of some substance which dissolves the horny surface and cauterises the parts beneath. Caustic potash, nitric acid, or lunar caustic is used for this purpose, but care must be taken that the drop of nitric acid or caustic potash applied to a wart does not run over the neighbouring skin. Several applications, as a rule, are necessary to each wart. The same result may be attained, especially as regards warts on the feet, by the use of the salicylic acid application mentioned under CORNS. Warts that hang by a pedicle are best removed by snipping off with scissors, the bleeding being easily checked by some astringent. Tuberculous warts should be completely excised. When warts come in a crop, as they sometimes do, tonic remedies will generally effect their disappearance.

WASHING (*see* BATHS, DISINFECTION).

WASHING OUT BLADDER (*see* BLADDER, DISEASES OF, *and* DOUCHES).

WASHING OUT STOMACH is performed for various reasons, particularly in order to remove a narcotic poison that has been recently swallowed, before it shall have had time to act. Washing is also employed to cleanse the stomach in cases where the food tends to collect in the organ and to ferment. For the method see Fermentative Dyspepsia under DYSPEPSIA.

WASSERMANN REACTION is a test introduced in recent years for the diagnosis of syphilis by examination of the blood. With the exception of leprosy, yaws, and some of the acute infectious diseases, the only condition in which the blood appears to give this reaction is syphilis ; and, as the diseases mentioned are not likely to cause confusion, the test forms a valuable diagnostic for the latter condition in at least 90 per cent of cases.

The reaction depends upon the principle known as ' fixation of complement ', and is only capable of being satisfactorily performed in a laboratory. In every blood there exists a substance known as ' complement '. If a poison capable of destroying blood corpuscles be introduced into the blood, some of this complement must be absorbed or fixed by the poison before the corpuscles can be broken up. In the Wassermann reaction some of the suspectedly syphilitic blood serum is mixed in a tube with an animal extract and with a definite quantity of complement, and then a test is done to find whether the complement has been fixed to the extract or not. If it has been fixed, then the suspected serum must have contained a substance capable of joining it to the extract, and the person from whom the serum was taken has syphilis. If the complement is unfixed and still free to act, then the person's blood may be pronounced healthy.

Method of use.—Blood is drawn from the suspected person by puncturing a vein in the arm or elsewhere with the needle of a large hypodermic syringe, filling the syringe, and squeezing the blood into a sterile test-tube which is sent to the laboratory. The reaction is done in two stages :

STAGE 1.—To give the syphilitic material, if present, a chance to ' fix complement '. In a small test-tube there are mixed (*a*) a small quantity of the serum separated from the clot of the suspected blood, which has already been heated for half an hour at 55° C., in order to destroy the natural complement which it contains, and diluted with normal salt solution ; (*b*) a little alcoholic extract of some animal tissue, *e.g.* liver ; (*c*) the same quantity of a healthy serum, *e.g.* that of a guinea-pig, which supplies the necessary ' complement '. This tube is placed in an incubator for 1½ hours to allow ' fixation of complement ' to occur, if it can take place.

STAGE 2.—To find whether ' fixation of complement ' has taken place or not. To the tube are now added (*d*) 1 c.c. of fluid containing 1 part of sheep (or ox) blood corpuscles, carefully washed free from serum, in 20 parts of normal salt solution ; and (*e*) a sufficient amount of a special serum derived from an animal, *e.g.* a rabbit, which has previously had sheep (or ox) corpuscles injected into its blood and has in consequence developed an ' anti-body ' capable of breaking up these foreign corpuscles. The tube is returned to the incubator for another hour.

If then the blood corpuscles have settled uninjured to the bottom of the tube, the complement must all have been fixed in the first stage, so that the anti-body could not act in the second stage ; and syphilis is therefore present. The reaction is said to be positive.

If the corpuscles are broken up, as shown by a diffuse red colour through the tube, then the complement was left free to act in the second stage and no syphilitic substance was present to fix it in the first stage. The reaction is said to be negative.

WASTING (*see* ATROPHY).

WASTING PALSY is a popular name for the disease more commonly known as progressive muscular atrophy. (*See* PARALYSIS.)

WATER-BEDS are flat, closed sacks of heavy india-rubber material, with a funnel-shaped orifice at one corner through which water can be poured, and which can be closed by a screw-stopper. They are made in various sizes, some being sufficiently large to cover a whole bedstead, though more frequently, for convenience in handling, they are of smaller size, and occasionally are made as small cushions, as rings with a hollow in the centre, or in horseshoe shape. Those of the largest size possess a special outlet at one corner through which air escapes as water enters at the opposite corner.

Water-beds have been to a great extent replaced by air-beds of strong construction. These consist of stout

rubber perforated in numerous places by rubber tubes which open on the upper and lower surfaces and add strength to the bed. The bed is blown up from one end by means of an automobile or bicycle pump to the desired hardness. Such a bed is both easier for the nurse to manage and is more comfortable to the patient than a water-bed.

Uses.—In general a water-bed is placed under a bedridden person or one suffering from some devitalising disease of the nervous system, in order to prevent the formation of bed sores, by distributing pressure all over the patient's back. Apart from the tendency to bed sores, a patient who is long confined to bed, who is fevered, or who is much emaciated, derives a sense of great coolness and comfort from a water-bed.

Method of use.—A water-bed is placed empty upon the bed before the patient is laid on it. If this be inconvenient, a strong sheet is laid on the floor, the water-bed is placed empty upon it, and water is poured in till the bed is sufficiently full. The water-bed, which is then very heavy, is lifted by several persons who catch hold of the edges of the sheet. To fill the bed, water at a temperature of about 100° Fahr. is used, except in the heat of summer, when cold water may be preferable. This is poured into the special orifice, the corner provided with this opening being raised, so that the water will not run out again. The water-bed must not be filled tight, but should contain just so much water that its upper and lower surfaces are not pressed together when the patient lies upon it, and thus the maximum of comfort is secured. Finally, before the plug of the outlet is screwed in, any air that may have gained entrance should be pressed out. For this purpose the hand is pressed firmly over the surface of the bed towards the outlet, which is raised; the corner where the outlet is attached is twisted up as far as the water will allow and the plug is then screwed in. If air be left inside, every movement of the patient will be accompanied by splashing noises. The patient is separated from the water-bed by a blanket and the usual bed-linen.

WATER-BRASH, or PYROSIS, is a condition in which, during the course of digestion, the mouth fills with tasteless or sour fluid, which is generally saliva, but sometimes seems to be brought up from the stomach. At the same time, a burning pain is often felt at the pit of the stomach or in the chest. The condition is a symptom of excessive acidity of the stomach contents, due sometimes to an irritating diet, and often characteristic of fermentative dyspepsia occurring in a dilated stomach.

WATER CANKER is another name for cancrum oris. (*See* CANCRUM ORIS.)

WATER-CLOSETS, DRAINS, and SEWERS.—This principle of removing excreta and soiled water is known as the 'water-carriage system'. In this method, special channels and receptacles are provided for the waste waters of houses, and into these drains and sewers the human excreta are swept and removed by the flow of the water. The other great method of disposal in which the excreta are removed along with the animal and vegetable refuse of households is known as the 'dry method of disposal', or the 'conservancy system', and is treated in a special article. (*See* REFUSE AND SEWAGE DISPOSAL.)

Forms of water-closet basin.—Various water-closets are utilised, depending on the special circumstances of the place, especially with reference to the adequacy of the water supply.

SLOP CLOSETS, in which the household waste waters form the flush, were in use in some places but are now rarely seen. The waste waters may be directly conducted to the basin of the closet, or may be collected in an automatic tipper, an iron or earthenware vessel balanced on pivots, which, when full, tips over and sends the contents, usually two or three gallons, as a sudden flush into the basin of the closet. The 'tipper' may be the basin of the closet itself, receiving the excreta, and, when full, projecting its contents down the drain (Fig. 472). In another arrangement, a large siphon trap is placed on the drain, beyond the 'tipper', and the closet, a vertical shaft, is placed over this trap (Fig. 473). This form of closet has the advantage of being

economical, no special water being needed, and also of preventing the liability to freezing of pipes. But the

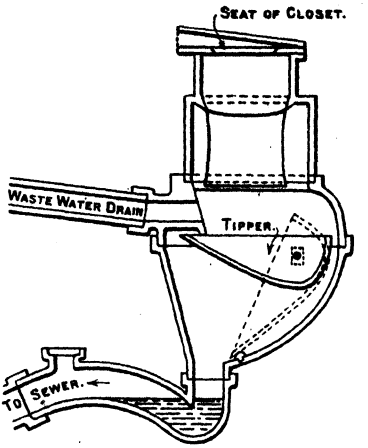


FIG. 472.—Diagram of Day's waste-water closet, in which a tipper receives the excreta and the water for flushing. (Modified from Parkes's *Hygiene*.)

closets are difficult to keep clean, since the sides of the closet get fouled, and the waste waters do not cleanse them; while the sewage, being more concentrated, is more liable to putrefaction

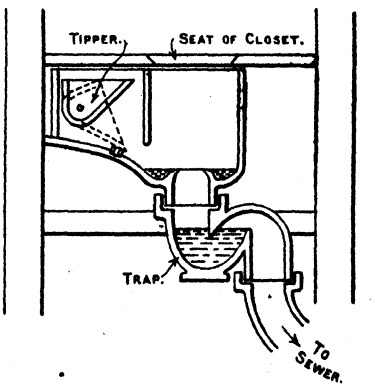


FIG. 473.—Diagram of a waste-water closet with a tipper at the side of the closet basin. (Modified from Notter and Firth's *Hygiene*.)

than if a closet with a special fresh-water flush were employed.

TROUGH CLOSETS, used frequently in connection with schools and factories,

WATER-CLOSETS AND DRAINS

consist of a long trough of iron or earthenware, partially filled with water passing beneath the seats of a number of closets. These troughs are automatically flushed with water from time to time from a tilting receiver, the waste waters of houses being utilised occasionally for this purpose (Fig. 474).

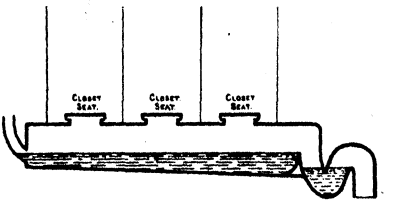


FIG. 474.—Diagram of a trough water-closet.

In houses at the present time, the chief varieties of water-closets in use are the pan or container closet, the valve or plug closet, the long-hopper closet, the wash-out and the wash-down closets.

A good water-closet must have a basin composed of some non-absorbent material shaped so as to receive the water used in flushing, and so formed as to prevent the excreta adhering to the sides, and to allow them to fall directly into the water.

PAN CLOSETS, still found in old houses but now prohibited in new buildings by the by-laws of the Ministry of Health of England, consist of a basin

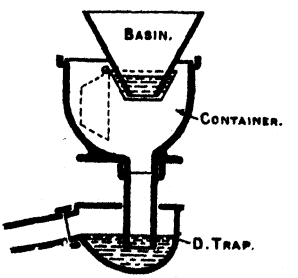


FIG. 475.—Diagram of a pan closet with D-trap. Both this form of closet and this form of trap are objectionable, owing to the readiness with which they become fouled.

surrounded by a container (Fig. 475). At the bottom of the basin is a movable pan, which contains a small quantity of water and receives the excreta.

The pan swings back when the handle is raised and the excreta pass with the flush of water through the container, frequently fouling the sides with the splashing. This form of water-closet is usually also provided with a D-trap, a highly objectionable form of trap. (*See* Traps *below*.)

LONG-HOPPER CLOSETS consist of a deep basin ending in a syphon trap. Their length and general construction make them liable to fouling, and a better form of closet should be employed when it can be obtained (Fig. 476).

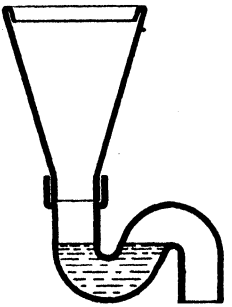


FIG. 476.—Diagram of a long-hopper closet. Also an unsuitable form.

VALVE CLOSETS have a movable valve, which supports a quantity of water into which the excreta are received before being projected into the water of the trap beneath, by the swinging aside of the valve as the handle is raised.

WASH-OUT CLOSETS, made of a single piece of earthenware, hold water in a basin formed by a ridge, and into this basin the excreta are received, to be later on swept over into the trap by the flush. The flush in this closet, if the ridge is too high, may not be sufficient to wash the excreta away. The ridge, again, may be too small to dam up sufficient water to cover the excreta, and fouling of the sides may result (Fig. 477).

WASH-DOWN CLOSETS or SHORT HOPPERS, in which a flushing rim is provided giving an adequate flush all round the basin, form an excellent type of closet (Fig. 478).

The *flush* of water given to a closet should be about three gallons but not less than two gallons, delivered by a pipe at least 1½ inches in diameter, and every closet should be provided with its own special flushing cistern, usually formed of iron, with siphonic action, and having an overflow pipe discharging directly into the outer air and not into any pipe connected with the closet.

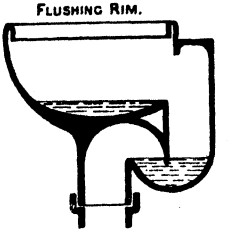


FIG. 477.—Diagram of a wash-out closet.

Water-closets should be placed at some outer part of the building (not in some convenient recess in the centre of the house), against an external wall, so that the soil-pipe may be led straight to the exterior. The room should be provided with a window opening right up to the ceiling, and should be well ventilated, if possible by two windows placed opposite each other, or when this is impossible, by at least one window and a perforated iron plate. Formerly it was customary

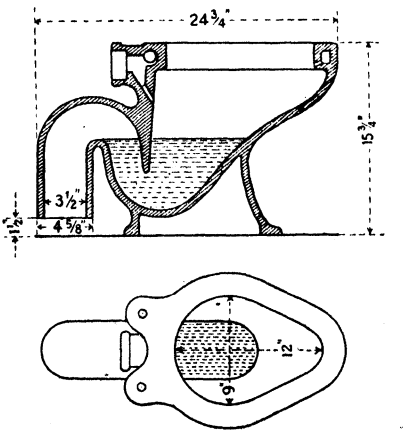


FIG. 478.—Diagram of a wash-down or short-hopper closet. This is the best form, being very simple and not liable to become fouled.

to box in the water-closet with wood, but at the present time the whole closet is usually left quite uncovered, so that all parts are more easily seen and can be cleaned or repaired if required.

Waste-pipes carrying off water from

baths, sculleries, sinks, etc., must not be directly connected with the drain or soil-pipe, but should discharge into the open air upon a channel leading to a trapped gulley-grating at least 18 inches distant from the end of the waste-pipe, as suggested by the Ministry of Health in their model by-laws. Frequently, however, the waste-pipe discharges directly over a grating above a trapped gulley or even under the grating, as shown in sketch (Fig. 479).

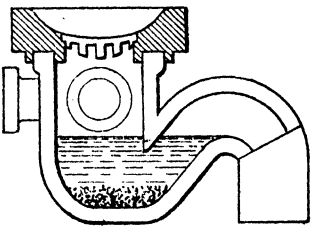


FIG. 479.—Diagram of a yard gulley with waste-pipe entering from behind and a grating for rain-water, cleansing, etc. This is a common form of gulley but not so satisfactory as the arrangement shown in Fig. 486. (Modified from Whitelegge's *Hygiene*.)

Soil-pipes, for carrying off sewage, are usually formed of drawn lead, circular in shape, about 4 inches in diameter, and seamless. They should be fixed outside the house, and for the purpose of ventilation should be carried in their full diameter above the eaves, away from windows, and protected by cowls or wires drawn across. If formed of lead they should be placed away from the sun as much as possible, because the heating may lead to twisting from the expansion of the metal. The soil-pipes are also frequently formed of cast-iron, but these are not so smooth in the interior and cannot be so efficiently jointed as lead pipes, in which the joints are made firm by soldering.

Traps are contrivances which prevent the sewer air from gaining entrance into the house from the drains, water being used for this purpose. The simplest form of trap is, therefore, simply a bend in the pipe which retains water. The water, however, may not be altogether efficient, for it may absorb some of the sewer gases and give them off from its surface. If, further, it is allowed to become stagnant, bubbles of gas may be discharged into the house. If, however, the water in the trap be renewed from time to time, and if the drain be well ventilated, there is little danger of the air accumulating in such quantities as to force the seal, and thus the 'Waterseal', as it is called, will be efficient.

Traps to be efficient must be self-cleansing as far as possible, smooth in the interior, free from angles, and have a sufficient depth of water, at least 1½ inches. A good type of trap is shown in the accompanying sketch (Fig. 480).

FIG. 480.—Diagram showing a suitable form of trap for disconnecting the house drain from the sewer. The opening on the house side is for ventilation, that on the sewer side for cleansing.

It is provided on the house side of the water-seal with a ventilating shaft, which is taken up to the surface of the ground away from the windows of the house, and covered with an iron grating. Beyond the seal is another shaft, which is used for inspecting the drain and for cleansing. This should be built up to the surface of the ground and covered with a slab, so that access may readily be obtained.

Buchan's trap is efficient and answers the chief requirements of a good trap. It has the ventilating pipe on the house side, the shaft for cleansing on the side next the sewer, a good fall for the sewage and a sufficient depth of the water-seal.

As a sample of a bad but sometimes-used form of trap, the one represented in Fig. 481 may be taken. There is no

FIG. 481.—Diagram of an unsuitable though common form of trap. The central opening does not give efficient ventilation, and does not admit of complete cleansing. The trap also is unprovided with a base on which to stand evenly.

provision made for ventilation on the house side of the trap, and no access is given beyond the seal for cleansing. The central shaft may, if covered with a grating, act as a ventilator, or, if

covered with a heavy slab, simply gives an opening for cleansing. This shaft at the bend, however, just tends to collect filth, which is also apt to be deposited on the side of the trap, as the 'dip' is not sufficient to wash out the trap.

One of the old types of traps still found is the 'dipstone' trap. It consists of a box with a partition, the sewage entering at one side of the box and leaving at the same height on the other. The water in the trap reaches a short distance up the partition, and thus forms the water-seal. Filth and waste matters tend to collect at the bottom, and as the force of water is not usually sufficient to wash out the trap, it simply becomes a miniature cesspool and requires cleaning repeatedly (Fig. 482).

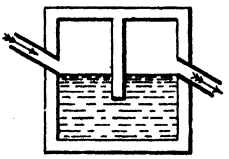


FIG. 482.—Diagram of a dipstone trap. An old and objectionable form of trap.

The D-trap so frequently found in connection with pan-closets is highly objectionable (Fig. 475). Its angles tend to prevent cleanliness and accumulate filth. Ministry of Health model by-laws, if adopted by sanitary authorities, prevent its employment in new buildings.

In the traps placed on the waste-pipes from baths and sinks generally, the simple siphon-S bend on the pipe is sufficient, and, on the bends, access screw plugs are usually placed, through

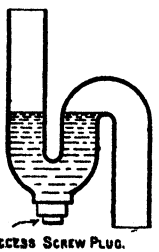


FIG. 483.—Diagram of a siphon trap attached to baths, wash-basins, and sinks.

which a suitable and easy entrance is obtained for cleansing (Fig. 483).

Sometimes, to prevent the admission of too much grease and sand to the drain, *a grease-intercepting chamber* is placed in connection with the pipe from the scullery sink (Fig. 484). It

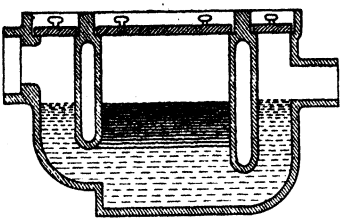


FIG. 484.—Diagram of a grease trap, sometimes attached to scullery sinks in large houses.

consists of a stoneware chamber, into which the waste water flows, and the grease rising to the surface and solidifying as it cools can be easily removed from time to time, while the sand sinks to the floor of the chamber, the water leaving by the mouth near the bottom. The grease trap can be opened periodically and cleansed, but, except in very large households, this trap is hardly necessary, and should not be used where its use can be dispensed with, as it is simply of the nature of a cesspool.

Gulley traps for waters from courtyards, rain-pipes, and waste waters from baths and sinks usually consist of the type shown in the sketch (Fig. 485).

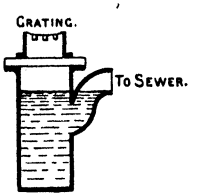


FIG. 485.—Diagram of a gulley trap for rain-water, etc. Solid refuse is deposited at the bottom and must be periodically removed.

They are easily cleaned and should be so treated periodically. All waste-pipes from baths and sinks, and all pipes for carrying off waste waters from a new building, should, according to the by-laws of the Ministry of Health, discharge over a channel leading to a trapped gulley at least 18 inches distant, in the external air (Fig. 486).

A trap may be rendered inefficient in several ways by the breaking of the water-seal. If the trap is but little

employed, the water may evaporate, while if the drain is not ventilated the pressure inside the drain may force

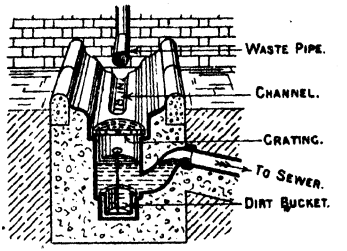


FIG. 486.—Waste-water pipe discharging over a channel leading to a trapped gulley, in accordance with the requirements of the Ministry of Health. The front of the figure shows a vertical section through the gulley. (Altered from Knight's *Annotated Model Bye-laws.*)

sewer air through the water-seal. Further, if the momentum of the water discharged is too great, the water may rush straight through the trap and leave it empty. When more than one pipe discharges into the same common pipe, or when the fall beyond is sudden and great in a pipe which is too small and running full, the water may be drawn out of the trap by siphonic action. To prevent these defects it is advisable to have a ventilating opening at the crown of the trap, and also to see that the pipe is not too small.

Drains are the pipes outside one house or building, which carry away as quickly as possible to the sewer or cesspool the ordinary sewage of the building. They must, to prevent pollution of the surrounding soil, be made water-tight, and, except for ventilating purposes at special points, air-tight as well. Drain-pipes are usually, therefore, formed of glazed stoneware or cast-iron, in sizes varying from 4 or 5 inches for ordinary houses up to 6 or 9 inches for large institutions. They should be laid, if possible, in a straight line, on a foundation made firm by a layer of concrete. Each pipe should fit firmly into the next, special sockets being provided on the pipes for this purpose, and the socket being always so placed as to point away from the sewer (Fig. 487, *a* and *b*). The joint should be made firm by cement. Drains should be provided with cleaning branches consisting of V-shaped junction pipes, by which ready access is given. Where two

drains meet, specially curved pipes must be employed according to the junction required, as no junctions of

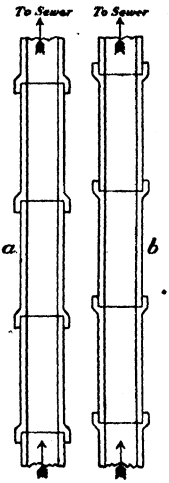


FIG. 487.—Diagram of the laying of drain-pipes. *a*, Shows correct manner; *b*, incorrect manner which leads to leakage.

drains at right angles are permissible, since they interfere too much with the flow of the sewage (Fig. 488, *a* and *b*).

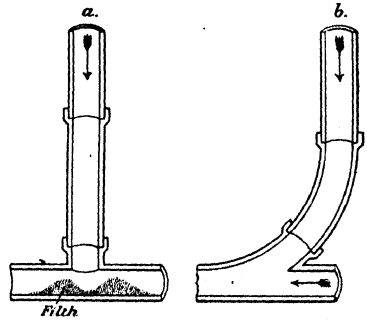


FIG. 488.—Diagram of the junction of a side drain with a main drain, showing the special junction pieces required. *a*, Shows an incorrect mode of junction liable to produce choking of the pipe; *b*, correct mode.

No drains should, if possible, be taken under a house, but if this must be done, the pipe should be placed in a bed of concrete at least 6 inches thick. Sufficient fall must be given to the drain to allow of the flow of the sewage. The gradient needed will vary with the size of the pipe, but as a rule a fall of

1 in 40 must be given for a 4-inch drain, and for a 9-inch drain 1 in 90 will be required. Where sufficient gradient cannot be obtained, flush tanks should be provided, working automatically, but with their water supply under control, so that they may discharge only at such regular intervals as may be desired (Fig. 489). Before using a

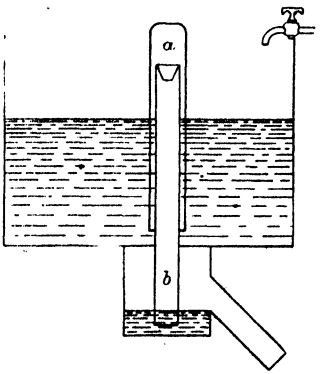


FIG. 489.—Diagram of Field's annular siphon flush tank, very frequently used for automatically flushing drains, public urinals, etc. *a*, Outer tube open at the bottom, enclosing *b*, the inner tube, which has a funnel-shaped opening above and free discharge below. (Modified from Parkes's *Hygiene*.)

new house-drain, the presence of leaks should be tested for. This can be readily done by various methods. Testing by plugging the lower end, filling the drain with water until it reaches a certain level in an inspection chamber, and watching if the water falls, is an effective but drastic method of detecting defects. Pumping smoke into the drain and soil-pipes after all natural outlets have been first stopped, and then watching for leakages betrayed by the issue of smoke, is another method now commonly employed. The custom of pouring some highly volatile oil down the soil-pipe and then washing it down with several gallons of water, the oil being smelt where any defect is present, is still occasionally used, though it is not so satisfactory as the test by smoke.

Sewers are underground channels used to carry off by gravitation the rainfall, waste waters from houses, the excreta of man and animals where the water-carriage system is in vogue, and the waste waters of trades and manufacturing processes. Originally sewers

were used only to carry off the rainfall, and as constructed at first of brickwork acted as drains for the subsoil waters, and had thus a beneficial effect. In some places, where the rainfall is excessive, separate sewers are provided, one set for the rain and waters used in washing the streets, the other set for the ordinary sewage. This method allows the formation of smaller sewers with the advantage of easier flushing, while the sewage to be dealt with is more uniform in character and so can be more easily treated. Where the separate system is not employed, sewers should therefore be made large enough for the general needs of the district, consideration being given to the possibility of rain-storms, and allowance in size being made accordingly. The fall of the sewer must be sufficient to give in large pipes, over 24 inches in diameter, a velocity of at least 2 feet per second, and a greater velocity for pipes that are smaller. The sewers should be laid as far as possible in straight lines, and, as in drains, should never join each other at right angles. The shape of large brick sewers in section should be that of an egg with the smaller end downwards (Fig. 490), thus giving a

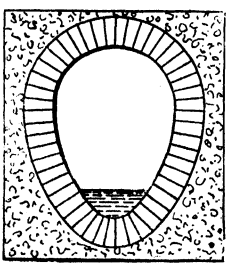


FIG. 490.—Cross-section of a large sewer, showing the egg shape.

greater depth of the sewage and producing a better cleansing effect; though for the largest outfall sewer the circular form may be used because of the greater strength thus given. The surface of the sewer should be smooth, glazed earthenware pipes set in cement being used for sewers up to 18 inches in diameter, while well-burnt impervious bricks are employed for sewers of greater dimensions. All bricks and pipes used in sewers should be firmly jointed with cement, as leakages must be prevented.

Sewage, particularly if it becomes stagnant from insufficient gradient, tends to give off foul gases, and therefore the sewer must be properly ventilated. Openings are made in the sewer, preferably at distances of about 100 feet, conducted up to the street level and covered there with a grating. Sometimes, to prevent any chance of nuisance arising from these sewer ventilators, the shaft is conducted into the chimney stalk of a furnace or led up the sides of the neighbouring buildings.

Flushing of sewers may be required where the fall is insufficient or the sewage is tending to quick decomposition in very dry seasons. The flushing may be carried out by means of a hose from the nearest hydrant. The sewage itself may be dammed up for a short time and then allowed to rush on, thus flushing the sewer, but it is better to employ some other method, as by the automatic flush siphon mentioned in the flushing of drains (Fig. 489).

Manholes, or disconnecting chambers, should be introduced whenever two sewers or drains join, or whenever there is a change in direction. They should be built of brickwork set in cement, and the drains or sewers passing through along the floor should consist of half-open pipes, the surface of the cement being raised a little above the pipes to prevent sewage flowing over on to the floor. The manholes should be provided at the street level with a perforated plate, while a trap below will

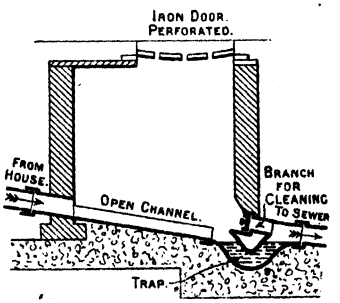


FIG. 491.—Diagram of a manhole for disconnection at a junction between drains, and for ventilation and cleansing purposes. (Modified from Notter and Firth's *Hygiene*.)

catch any dust or debris and prevent it entering the sewer (Fig. 491).

Defects.—Soil-pipes often exhibit defects in that they are frequently carried through the interior of houses, are imperfectly jointed, are made with seams, are unventilated, or are connected with the overflow pipe of cisterns for holding drinking water—a most objectionable process, as the foul air may gain access to the cistern and be absorbed by the water. The soil-pipe may be ventilated by too small a pipe, or the rain-pipe may be joined to the soil-pipe and made to act as the ventilator—a most unsatisfactory method, as during a period of rain-storm, when the rain-pipe is running full, there will be no exit at all for foul air.

Waste-pipes and rain-pipes are sometimes found joining each other and reaching the drain-pipe untrapped, and thus the drain air may readily enter the house.

Drains formed of porous material, such as bricks badly jointed, are sometimes found running under the dwelling, while a cesspool is occasionally got under the cellar. Drains are sometimes laid with straight pipes to form the bends, thus producing a leaky joint; often they have insufficient fall, or they may be found with junctions at right angles (Fig. 488, *a*), or with branches fixed so that the sewage entering from the small branch flows in the opposite direction to that in the main drain. The soil-pipes, waste-pipes, and house drains may be found to enter the main sewers without any traps intervening, or may be provided with inefficient forms of traps. Defective forms of water-closets are still sometimes seen in old houses, such as the pan-closet with its filthy receptacle and D-trap, while some water-closets may even be discovered receiving their supply direct from the water main—a system which may lead to pollution of the water through foul air being admitted to the water-pipes during an intermission in the supply.

WATERHAMMER PULSE is a name given to the peculiarly sudden pulse that is associated with incompetence of the aortic valve of the heart, and suggests the philosophical toy after which it is named. (*See* PULSE.)

WATERING-PLACES suited for the treatment of various diseases are mentioned under these headings, and the

general principles underlying the choice of a watering-place are described under CLIMATE IN RELATION TO DISEASE.

WATER ON THE BRAIN is a popular name for hydrocephalus and for meningitis. (*See* HYDROCEPHALUS, MENINGITIS.)

WATER SUPPLY.—Sources.—RAINFALL forms the primary source of all water supplies. If collected under careful conditions, the vessels in which it is received being free from contamination and filth, it constitutes the purest and softest of waters, containing only such impurities as it has washed down or dissolved in its course through the atmosphere. In its passage through the air it becomes highly aerated and, except in the neighbourhood of towns and densely populated districts, where manufactories abound, and the pollution of the atmosphere with impurities may be considerable, it is practically pure. The rainfall is usually collected from the roofs of houses and buildings by the gutters and rain-pipes, which should be regularly cleaned. These conduct the water to specially prepared cisterns or receptacles, preferably formed of slates or bricks set in cement. Sometimes special collecting surfaces are provided, portions of land being set aside, the surface of which is rendered impermeable with a layer of slates, and the water being conducted into a tank by a pipe to which the surface of the impermeable layer has been sloped. The first rain that falls should be rejected, as it will contain most of the impurities washed from the atmosphere and the collecting surface.

Rain-water, on account of its softness, is invaluable for washing. This quality of softness, however, renders it especially liable to dissolve lead, and consequently it should be stored in cisterns formed of slate or similar material. Its great disadvantage, as a sole source of supply, arises from the variability in the rainfall, and therefore it is advisable to have some other means of supply.

SPRINGS.—The portion of the rainfall which percolates through the soil absorbs from the ground-air carbonic acid, which aids it in dissolving many of the mineral constituents with which it comes in contact, thus rendering it in many instances unsuitable for drinking purposes. On the other hand, however, spring water is frequently rendered clear and bright by the purification it undergoes in moving through the strata of the earth before it reaches its point of issue, this natural filtration, if the water has penetrated far enough, being sufficient to remove completely the organic matter with which the water came in contact in the upper regions of the soil.

Springs are due to the water percolating through the soil and being prevented from going deeper by some impermeable stratum, above which the water accumulates as if in a reservoir. The point of issue of the spring is determined by the position where this impermeable layer crops out upon the surface of the soil. Where the collection of underground water is due to an impervious layer of clay just under a thin surface of gravel or sand, the springs are poor in their yield, subject to variations with the nature of the season, intermittent in their supply, and are therefore termed *land springs*. These intermittent springs are frequently found along the course of rivers in valleys bounded by hills, where the level of the underground water varies considerably with the seasons.

Main springs are deep-seated, where the water has percolated through thick masses of porous geological formations, such as chalk, overlying impermeable layers. Where the demand is not great, they usually yield throughout the whole year a sufficient supply of water, which is clear, sparkling, well aerated, and cool, due to the natural purification it has undergone. It may be impregnated with various mineral salts, which render it hard and so interfere with its value for washing and cooking, though it may still be extremely palatable for drinking.

As the water from springs may be contaminated at the point of issue, the spring should be walled in and provided with a discharging pipe that passes some distance below the surface, thus conducting the water to the surface.

WELLS consist of two main forms, 'shallow' and 'deep', a special form of the latter being known as 'Artesian'. The shallow wells (Fig. 492, *a*) reach the

same kind of water as was described in the case of 'land' springs, and are liable to pollution by soakings through the soil from leaking cesspools and drains, from surface washings and manure, from animal and vegetable debris spread on the fields, the depth of such a well not being usually sufficient to allow of natural purification. 'Deep' wells (Fig. 492, *c*), in which the water is usually brought to the surface by pumping, tap the same kind of water as 'main' springs, yielding usually an excellent, palatable supply, and, in order to protect them from pollution by surface and subsoil waters, they should be lined with bricks embedded

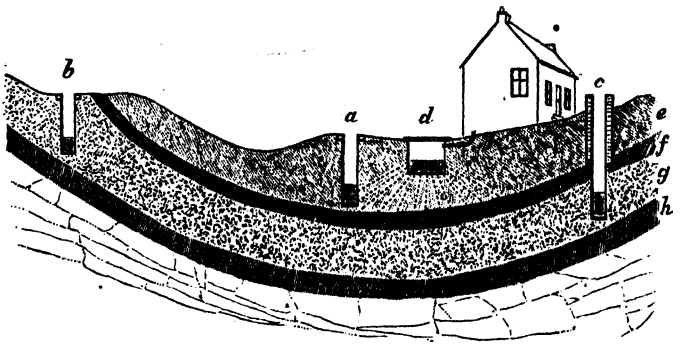


FIG. 492.—Diagram of a section across the bottom of a little valley, showing a water supply by wells. *a*, Surface well polluted by *d*, a neighbouring cesspool; *b*, surface well at a safe distance; *c*, deep well (safe) lined with masonry down to the first impervious stratum, and protected above ground; *e* and *g*, permeable strata; *f* and *h*, impervious strata.

in cement down to the depth of the impermeable layer, and built up and closed in above the ground to prevent them further from being contaminated at the surface.

Artesian wells pass through an upper impermeable layer to reach a store of water in a water-bearing stratum lying upon a second impermeable formation. This water-bearing permeable stratum has its 'outcrop' at a higher level than where the well has been sunk, and consequently the water in its endeavour to find its own level rises up the well and issues at the top.

Tube wells are made by driving tubes, one section of which is screwed on to the next, down into the soil, the first one being provided with a steel point and perforated at the bottom for about 2 feet. These can be used to provide a small temporary supply of water, the water entering the tube through the perforations and being pumped up if the pressure is not sufficient to raise the water to the surface.

RIVER WATER.—The quality of the water derived from rivers differs greatly according to the nature of the source from which it is obtained. Where the supply is drawn from a river high up near its origin, among granite-bound hills, the water may be perfectly potable and pure, but if it is obtained from a river after it has received the washings and drainage of manured fields, the soakage from cesspools, and the sewage of hamlets and towns, it may be highly suspicious and unfit for drinking purposes. Every river in its course tends naturally to purify its water. The bulk of water dilutes any sewage entering the river, the grosser impurities are broken up against the stones of the river's bed or destroyed by fish, and the oxygen which the moving water absorbs in large quantity from the air decomposes the organic matter into harmless substances. This natural purification is considerable where there is abundance of pure fresh water in the stream to mix with the sewage, but where there is extensive contamination from sewage, rivers and streams form a supply in which the process of natural purification will not have been sufficient to render the water free from danger.

UPLAND SURFACE WATER.—The supply of water from such a source is

usually good alike for domestic purposes and trade requirements. The water taken from streams near their source or from upland lakes closely resembles rain-water in composition, because it contains little dissolved solid matter, while the organic matter present is mainly of vegetable, not of animal origin. These waters are usually highly palatable and pure, with the additional advantage of softness, which renders them suitable for trade purposes. Peaty matter is frequently found in such upland waters, giving the water a slight yellow discoloration and imparting a peaty taste, but this does not interfere with its potability, and the peaty matter may be removed, if desired, by filtration through filters of sand.

These upland waters form such good sources of supply, being removed largely from danger of contamination by human excretions, that many of the principal towns in Great Britain now obtain their supplies in this manner. Glasgow, Manchester, and Liverpool, to mention three examples, have all tapped such sources of supply many miles from their boundaries, and the water thus obtained for the inhabitants has contributed in no small degree to the health and general prosperity of the cities.

Quality.—Apart from actual badness, or the tendency to convey diseases (*see below*), water may be either 'soft' or 'hard'. The hardness is usually described as either temporary or permanent. Temporary hardness is due to the presence of the carbonates of calcium and magnesium held in solution by carbonic acid gas, which may be driven off by boiling the water. This carbonic acid gas may also be got rid of by adding slaked lime to the water, which causes the production of still more carbonate of lime. This, however, settles, with the carbonate originally present, in a sediment; and thus the temporary hardness is removed (*see* FILTRATION *below*). Permanent hardness is due to the presence of the sulphates of calcium and magnesium, as well as iron and alumina, which cannot be got rid of by boiling.

In describing the quality of a given water, it is usual to express it in degrees of hardness which correspond to the number of grains of carbonate of lime or chalk in each gallon. Rain-water is the softest of all waters, containing seldom more than $\frac{1}{2}$ grain of carbonate of lime to the gallon, *i.e.* its hardness is about $\frac{1}{2}$ degree. Water is said to be hard when it contains more than 10 grains per gallon. The degree of hardness in a given water is estimated very simply by placing a measured quantity in a flask. A standard soap solution is then run in and the water shaken all the while, till finally a lather forms on the surface which remains permanent for five minutes. The number of cubic centimetres of soap solution which have been used give the number of degrees of hardness.

Soft water is invaluable for washing and cooking, since hard water forms a precipitate with the fats of the soap, and thus prevents it from lathering till all the hardness has been neutralised. Hard water, therefore, entails a great waste of soap, and it is said that each degree of hardness means the waste of a pound of soap in every 1000 gallons of water used. In cooking too, hard water deposits a layer on kettles and pots, and even on the food, thus preventing the boiling water from penetrating it. Among the minor diseases caused by unduly hard drinking-water are constipation and dyspepsia, while goitre and the formation of urinary calculi have also been attributed to this cause.

Storage.—In obtaining a supply of water for a town from gathering-grounds, it is customary to store the water in a reservoir so placed as to allow the water to pass into the distributing pipes by gravitation, and be so conveyed through the district supplied. The usual arrangement consists in carefully selecting the site for the impounding reservoir so that no leakage will occur, a dam being constructed across the valley to which the waters naturally flow, at such a place as will store up sufficient water for four to six months' supply, and where the construction of this barrier will entail as little expense as possible. The foundation of the dam consists in earthwork and masonry, a wall of puddled clay being carried down through the centre into a deep trench, so as to render the wall water-tight. Provision is also made to regulate the admission of

WATER SUPPLY

water into the reservoir, since compensation water must be allowed to flow on in the streams for the working of mills on their banks and other purposes, while an arrangement may be made to allow turbid storm water to pass on without entering the reservoir. Sluices and valves must be placed on the outlet culvert to regulate the discharge of the water to the town, and special service reservoirs for each district of the town may be formed at suitable places, so that the supply to each portion of the town may be known and regulated.

Filtration.—The water supplied to a district should be selected from a source as little liable to pollution as can be obtained, but if there is the slightest chance that it is contaminated in any form, filtration and purification should be carried out before distribution, while the consumer may, if he so desires, add to this public filtration, purification by domestic filters at his house. The main objects of filtration consist in the removal of deleterious ingredients such as mineral matters, *e.g.* the salts of magnesia and lime leading to hardness, suspended materials, dissolved organic matters, and micro-organisms. For the removal of the mineral matters and consequent reduction of hardness, lime in some form is added in the various processes in vogue (upon the principle known as 'Clarking'), the correct proportion of lime that must be added depending on the hardness of the water. The action of the lime depends upon the fact that the carbonate of lime already in the water is kept dissolved by carbonic acid gas. The newly added lime combines with this, so that both it and the carbonate of lime originally present become precipitated, and at the same time carry down other impurities. The water thus dealt with is rendered clear, either by allowing the suspended materials to settle, or, in the Porter-Clark system, by the water being forced through a series of linen cloths under high pressure.

PUBLIC FILTRATION on a large scale is usually carried out in sand filter-beds, which consist of layers of fine sand about 3 feet in thickness, resting on layers of fine gravel, gradually increasing in size from above downwards till the last layer of coarse gravel and pebbles is reached, in which are found the mouths of the outlet pipes. The water is conducted on to the surface of the filter-beds to a suitable depth (usually not more than 2 feet), and allowed slowly to percolate downwards. The upper layers

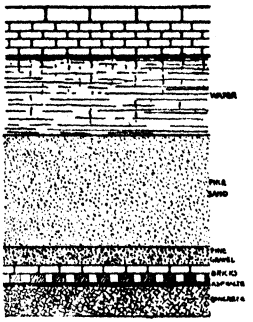


FIG. 493.—Filter-bed in section.

of fine sand become, after some time, coated with sediment, and must consequently be cleaned, which is done by scraping off the sand at the surface and having it thoroughly washed, while, to add to the efficiency of the filter-beds, they are allowed to remain empty from time to time to permit of aeration.

By this system of filtration, water is rendered pure and potable, the suspended matters being removed by the superficial layers of sand, mineral particles being detained in the same manner, while the organic matter present is, in the deeper portions of the filter, aerated and rendered innocuous to a certain extent. Such filters remove micro-organisms from the water in a large degree. This is accomplished by a gelatinous film which forms on the surface of the sand and consists of the suspended materials and masses of bacteria. If proper precautions as to aeration, rate of filtration, and cleansing of the sand are carried out, such sand filters remove bacteria from the water in satisfactory proportions.

DOMESTIC PURIFICATION may be carried out, where required, in various ways. *Distillation* provides an excellent, pure water, which is, however, insipid because deficient as to aeration, and which acts easily on certain metals, such as copper. The water may be aerated by passing it in a finely divided spray through the air. *Boiling* renders the water softer and destroys micro-organisms, but leaves the water insipid, and

therefore the water should be aerated again before use.

Domestic filters, so commonly employed, are frequently worse than useless, giving an idea of false security and rendering the water after so-called filtration more impure than it was before. Therefore, when a domestic filter is employed, it must be regularly and systematically cleansed, for in certain forms the organic matter, if not removed, accumulates and constitutes an excellent nidus for the growth of bacteria, which still further pollute the water that is being filtered.

Animal charcoal filters, the charcoal of which is obtained from bones calcined in closed boxes, oxidise to some extent the organic matters, but at the same time add phosphate of lime to the water and thus aid the growth of micro-organisms. This form of domestic filter therefore requires a great deal of attention and cleaning, and does not provide an efficient filtration.

Spongy iron has also been used in domestic filters, while other forms, such as the 'filtre rapide' of Maignen, are provided with a mixture of powdered charcoal and lime over a straining-cloth of asbestos. The ordinary forms of *'sponge' filters* simply remove suspended impurities, harbour organisms, and require constant cleansing. They do not protect against the passage of organisms into the filtered water, but may add considerably to the pollution.

Of the filters which remove micro-organisms from the water, the *Pasteur-Chamberland filter* forms an excellent example. Briefly, it consists of a cylinder or series of cylinders formed of specially prepared unglazed porcelain, porous to a certain extent, through which the water is forced under pressure such as is usually obtained from a water service main pipe. Such a filter removes the bacteria from the water, thus sterilising it and rendering it safe for domestic requirements. This filter can be cleansed by boiling and brushing under hot water. Another good filter is the *Berkefeld filter*, in which the filtering cylinder is made of compressed diatomaceous earth known as 'Kieselguhr'. It supplies filtered water in a similar method under pressure, and may also be sterilised by boiling. It may be washed by simply turning a second tap. (*See* Fig. 494.)

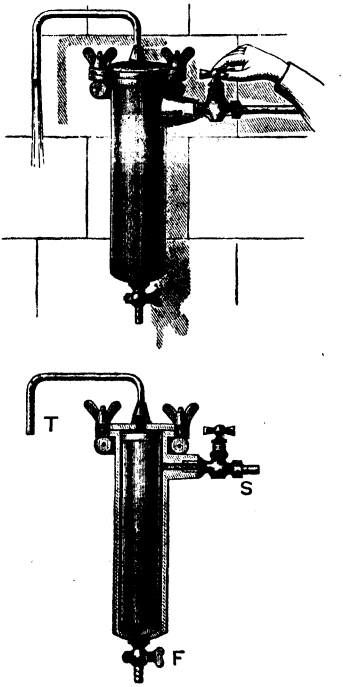


FIG. 494.—One of the effective forms of filter (Berkefeld Filter) removing bacteria as well as other solid impurities from the water. The upper figure shows the filter fixed to a wall. The lower figure shows it in section. *S*, Supply pipe from the main; *T*, tap through which the filtered water is delivered; *F*, flushing tap, by turning which the filter can be washed out and a free supply of unfiltered water obtained.

Distribution.—In some countries and districts where the conditions render it unavoidable, the water supply is still distributed by means of carriers, but, where the water is drawn from any distance, the method of distribution by pipes or aqueducts should be adopted. Where reservoirs are provided, the water is received into an outlet-pipe bent upwards at its commencement so as to receive none of the water near the bottom of the reservoir where the sediment is lying. This outlet or aqueduct may be in the form of an open channel, in which the water gets aerated to some extent, or may be, as is most usually the case, composed of large iron pipes, the dimensions of which will

vary with the supply required. These pipes are buried some feet under the soil, and in order to prevent the water acting on the pipes they are treated by some special process, such as by producing the magnetic oxide of iron on the surface or coating them with hot pitch or a vitreous glaze.

DISTRIBUTING PIPES, which run along the street, are similar in structure to those above mentioned, and should be similarly protected against the action of the water. Provision for fire-extinguishing is made on their course by hydrants. The *direct communication pipes* for the house come off from the street mains, the junction being effected by a brass screwed ferrule. These house pipes are usually formed of lead on account of the numerous turnings necessary in the piping inside the house, and are controlled by the provision of stop-cocks on their course where required.

Water is distributed to houses on two distinct systems—the constant and the intermittent systems. The difference between the two consists in the fact that where the supply is intermittent, or only for a certain period in the day, provision must be made at every house for storage, in the form of large cisterns holding at least sufficient supply for a day. In the constant system, small cisterns only need be made for the water-closets and kitchen boilers.

The advantages of a *constant system* include a free supply of good water, clear and unpolluted by storing in cisterns, fresh from the main, with an abundant supply in case of danger from fire, but the system is weak in the fact that there is a tendency to too great consumption and waste on the part of the user, the supply being so easily obtained; while during periods of scarcity, such as long drought or prolonged frost, the neglect of active central control may make the careful consumer suffer for the fault of the wasteful.

The *intermittent system*, which is gradually being abolished, though it regulates wastage, has the strong defect that cisterns are provided in which the water is apt to become stagnant and foul, the cistern being uncovered and receiving all forms of impurities from the air and the dust, and to become perhaps impregnated by sewer gas and liquid filth when the main pipes are empty. Especially is this the case when, in the houses of the poorer classes, the same cistern is made to do duty for flushing the water-closet and providing the drinking supply. It is also believed that the intermittent supply, in which the pipes are alternately full and empty, tends greatly to the solution of lead; while the cistern may be formed of galvanised iron, from which the zinc becomes dissolved so that the iron rusts and discolours the water. Lead cisterns at first allow some solution, but become later coated with carbonates which protect the lead from dissolving. In old, poor houses, cisterns may still be found constructed of wood, which forms an inefficient cistern, as the wood rots and aids in pollution.

If an intermittent system is in use, certain precautions must, therefore, be adopted. The cistern should be formed of slate, stoneware, or galvanised iron, large enough to hold an abundant supply, covered, well ventilated, easily accessible, not directly connected with the water-closet cistern, nor should it have its overflow pipe discharging directly into the sewerage system, but into the open air, where it can be easily seen. The cistern also must be periodically inspected and cleansed.

Diseases spread by water.—Impure water may cause disease simply in general forms such as diarrhœa, dysentery, sickness, and dyspepsia due to the suspended materials present, while excessive presence of mineral matters and hardness may lead to digestive disturbance and constipation. Peaty matters, if in excess, may give rise to similar disturbance, while the presence of polluting sewage may create severe abdominal disturbance in the form of colic, vomiting, and purging. A more serious mode in which water may give rise to disease is in its being able to convey the special germs of disease, such as enteric fever. Enteric fever epidemics have not infrequently originated by the water supply becoming infected from the undestroyed discharges of a patient, huge epidemics thus originating from a single case. Outbreaks of Asiatic cholera have frequently been proved to be due to the water supply of a district becoming

infected by the specific organism in the excreta from a cholera patient, and many of the towns in Great Britain owe their improved gravitation water supplies to the attention devoted to the water question in consequence of the cholera epidemics which formerly invaded that country. Various parasites may find their way into drinking-water and be received into the stomach of man in the form of eggs or embryos, such as the *Ascaris lumbricoides* or round-worm, the *Filaria dracunculus* or Guinea-worm, and the *Bilharzia hæmatobium*. (*See* PARASITES.)

Poisoning by various metals may arise from trade-washings that pass into a stream, or by the solution of the metallic constituents of the water-pipes. Lead-poisoning may arise from the latter cause, especially where the water contains a free acid, as in the case of peaty waters; but, if the water contains carbonate of lime, an insoluble protective coating is formed on the interior of the pipes. Many moorland waters have been found to act on lead, but this may be effectually prevented by treating the water with filters composed of sand and limestone. It is also possible to avoid the use of lead pipes where the water is known to act on the lead. It is calculated that $\frac{1}{10}$ of a grain of lead in a gallon of water may give evidence of lead-poisoning, while it is held that over $\frac{1}{20}$ of a grain to a similar quantity should be regarded as dangerous.

WATER TREATMENT (*see* BATHS; COLD, USES OF; DOUCHES; TYPHOID FEVER; WET PACK).

WAX is used in medicine as an ingredient of ointments, plasters, and suppositories. It is used either as yellow wax derived directly from honeycomb, or as white wax which is the same substance bleached.

For wax in the ear, see EAR, DISEASES OF.

WAXY DISEASE, also known as LARDACEOUS DISEASE, or AMYLOID DEGENERATION, is a condition in which the fibrous tissues undergo a peculiar degeneration into a substance of an albuminous nature, which resembles wax in certain of its chemical reactions. The disease was described first by Rokitansky in 1840. It is usually caused by one or other of three chronic diseases, viz. tuberculosis affecting the bones, lungs, or other organs; syphilis; and long-continued suppuration; and it forms one of the dangers that are apt to attend one of these diseases when it has lasted over a few months. The organs affected by waxy disease undergo a change which makes them larger, harder, heavier, more translucent, and so changed in consistence that they may be cut into the sharpest angles and edges and into extremely thin slices.

Though waxy disease may probably affect the liver, kidneys, or other organs to a considerable extent and yet recovery take place, if the original disease be cured, still its occurrence in the course of one of these serious diseases greatly diminishes the vital powers and lessens the chance of cure. The change in the blood-vessels and in the various glands is brought about probably by poisons, which develop as the result of the diseases named above, and circulate in the blood.

WEAKNESS (*see* ATROPHY, CACHEXIA, PARALYSIS, TONICS, and under the heads of various weakening diseases, *e.g.* CONSUMPTION, DYSPEPSIA, NEURASTHENIA.)

WEALS, or WHEALS, are raised white areas on the skin with reddened margins, which may result from sharp blows, or may be a symptom of nettle-rash.

WEANING (*see* INFANT-FEEDING).

WEBBED FINGERS or TOES constitute a deformity sometimes present at birth, and liable to run in families. The web may be quite a thin structure, or the fingers may be closely united by solid tissue. In any case, separation is a matter of considerable difficulty, because, if the web be simply divided, it heals up as before. A special operation is necessary, consisting in turning back a flap of the web upon each of the united fingers, or some other device to produce healing in the new position.

WEIGHT and HEIGHT. — The weight of a child at birth is about 7 to

WEIGHT AND HEIGHT

8 lb. (3200 grams), and the height 20 inches (50 cm.). During the first year the infant puts on weight at the rate of about 5 oz. per week if no illness occurs, and at the age of one year weighs from 18 to 24 lb. In the first year it increases in height about 10 inches, and measures almost 30 inches at one year old.

The following tables give the average weights for men and women in clothes and shoes according to age and height. A deduction of $\frac{1}{21}$ in the case of men and $\frac{1}{10}$ in the case of women may be made for clothing in order to obtain the actual weight. One seventh of the weight above or below the average is regarded as within healthy limits.

AVERAGE WEIGHT OF MEN IN POUNDS WITH CLOTHES

	Feet and Inches of Height with Shoes.																	
Age.	5-0	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	6-0	6-1	6-2	6-3	6-4	6-5
16	109	111	114	117	120	124	128	132	136	140	144	149	154	159	164	169	174	179
18	113	115	118	121	124	128	132	136	140	144	148	153	158	163	168	173	178	183
20	117	119	122	125	128	132	136	140	144	148	152	156	161	166	171	176	181	186
22	119	121	124	127	131	135	139	142	146	150	154	158	163	168	173	178	183	188
24	121	123	126	129	133	137	141	144	148	152	156	160	165	171	177	182	187	192
26	123	125	127	130	134	138	142	146	150	154	158	163	168	174	180	186	191	196
28	125	127	129	132	135	139	143	147	151	155	159	164	170	176	182	188	193	198
30	126	128	130	133	136	140	144	148	152	156	161	166	172	178	184	190	196	201
32	127	129	131	134	137	141	145	149	154	158	163	168	174	180	186	192	198	203
34	128	130	132	135	138	142	146	150	155	160	165	170	176	182	188	194	200	206
36	129	131	133	136	139	143	147	151	156	161	166	171	177	183	190	196	202	208
38	130	132	134	137	140	144	148	152	157	162	167	173	179	185	192	198	204	210
40	131	133	135	138	141	145	149	153	158	163	168	174	180	186	193	200	206	212
42	132	134	136	139	142	146	150	154	159	164	169	175	181	187	194	201	208	214
44	133	135	137	140	143	147	151	155	160	165	170	176	182	188	195	202	209	215
46	134	136	138	141	144	148	152	156	161	166	171	177	183	189	196	203	210	216
48	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
50	134	136	138	141	144	148	152	156	161	166	171	177	183	190	197	204	211	217
52	135	137	139	142	145	149	153	157	162	167	172	178	184	191	198	205	212	218
54	135	137	139	142	145	149	153	158	163	168	173	178	184	191	198	205	212	219

AVERAGE WEIGHT OF WOMEN IN POUNDS WITH CLOTHES

	Feet and Inches of Height with Shoes.																
Age.	4-8	4-9	4-10	4-11	5-0	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	6-0
16	102	104	106	108	109	111	114	117	120	124	128	132	136	139	143	148	153
18	104	106	108	110	112	114	117	120	123	126	130	134	138	141	145	150	155
20	106	108	110	112	114	116	119	122	125	128	132	136	140	143	147	151	156
22	107	109	111	113	115	117	120	123	126	129	133	137	141	145	149	153	157
24	109	111	113	115	117	119	121	124	127	130	134	138	142	146	150	154	158
26	110	112	114	116	118	120	122	125	128	131	135	139	143	147	151	155	159
28	111	113	115	117	119	121	123	126	130	133	137	141	145	149	153	156	160
30	112	114	116	118	120	122	124	127	131	134	138	142	146	150	154	157	161
32	113	115	117	119	121	123	125	128	132	136	140	144	148	152	155	158	162
34	115	117	119	121	123	125	127	130	134	138	142	146	150	154	157	160	163
36	116	118	120	122	124	126	128	131	135	139	143	147	151	155	158	161	164
38	117	119	121	123	125	127	130	133	137	141	145	149	153	157	160	163	166
40	119	121	123	125	127	129	132	135	138	142	146	150	154	158	161	164	167
42	120	122	124	126	128	130	133	136	139	143	147	151	155	159	162	166	169
44	122	124	126	128	130	132	135	138	141	145	149	153	157	161	164	168	171
46	123	125	127	129	131	133	136	139	142	146	150	154	158	162	165	169	172
48	124	126	128	130	132	134	137	140	143	147	152	156	160	164	167	171	174
50	125	127	129	131	133	135	138	141	144	148	152	156	161	165	169	173	176
52	125	127	129	131	133	135	138	141	144	148	152	157	162	166	170	174	177
54	125	127	129	131	133	135	138	141	144	148	153	158	163	167	171	174	177

Shortly after attaining the age of two years, the child reaches half its final adult height. Thereafter growth in weight and height are slower, but, on the average, up to the age of fourteen years height increases at the rate of 2½ inches each year. This increase is not uniform, however, and its rate depends upon family peculiarities, the development of the endocrine glands, the feeding of the child, the occurrence of illnesses, etc.

Growth is most rapid during the first five years of life, the rate being about the same in both sexes. From five to ten, boys grow more rapidly than girls, but from ten to fifteen, girls grow more rapidly than boys, and about the end of this period they are actually taller and slightly heavier than boys of corresponding age. From fifteen to twenty, boys again increase more rapidly than girls, and while girls reach their full height about twenty, boys continue to grow slightly up to the age of twenty-four. Increase in weight is more marked during winter and increase in height during summer. During the period from five to ten years, growth in weight proceeds at the rate of 4 or 5 lb. yearly, but from ten to fifteen, 8 or 10 lb. weight may be added in one year. After the full height is reached, growth in weight continues at an average rate of about ¼ lb. each year until the age of fifty, when the increase in weight should cease in both sexes, and thereafter diminish somewhat if health and activity are to be maintained and long life is to be achieved.

For reduction of excessive weight, see CORPULENCE.

WEIGHTS AND MEASURES.—

APOTHECARIES' WEIGHT

						Metric Equivalent in Grams.
Troy grains	20			= 1 scruple (℈)	=	1·29
,, ,,	60	= 3 scruples		= 1 dram (ʒ)	=	3·88
,, ,,	480	= 8 drams		= 1 ounce (℥)	=	31·1
,, ,,	5760	= 12 ounces		= 1 pound (lb.)	=	373

AVOIRDUPOIS WEIGHT

					Metric Equivalent in Grams.
Troy grains	437·5	= 16 drams	=	1 ounce (oz.)	= 28·35
,, ,,	7000	= 16 ounces	=	1 pound (lb.)	= 453·60

APOTHECARIES' FLUID (WINE) MEASURE
(Used in America)

					Metric Equivalent in Cubic Centimetres.
Minims (♏)	60		=	1 fluid dram (fl. ʒ)	= 3·55
,,	480	= 8 fluid drams	=	1 fluid ounce (fl. ℥)	= 30·00*
,,	7680	= 16 fluid ounces	=	1 pint (O)	= 454·6
,,	61,440	= 8 pints	=	1 gallon (C)	= 3636·7

* More accurately, 28·412 c.c. or mils. 1 pint = 27·7 cubic inches.

IMPERIAL FLUID MEASURE
(Used in Great Britain)

				Metric Equivalent in Cubic Centimetres.
Minims (♏)	60	=	1 fluid dram (fl. ʒ)	= 3·55
,,	480 = 8 fluid drams	=	1 fluid ounce (fl. ℥)	= 30·00*
,,	9600 = 20 fluid ounces	=	1 Imperial pint	= 568·25
,,	19,200 = 2 Imperial pints	=	1 Imperial quart	= 1136·5
,,	76,800 = 4 Imperial quarts	=	1 Imperial gallon	= 4546·0

N.B.—1 Imperial pint = 1 pint 4 fluid ounces Apothecaries' Measure.
* More accurately 28·412 c.c. or mils.

METRIC WEIGHT AND MEASURE UNITS

The metre or unit of length = 39·370432 inches (approx. 40 inches)
The litre or unit of capacity = 35·196 fluid ounces (approx. 35 fluid ounces)
The gram or unit of weight = 15·4323 troy grains (approx. 15½ grains)
The cubic centimetre or mil = 16·896 minims Imperial (approx. 17 minims)

WEIGHTS AND MEASURES

Metric Measures of Length

1 Kilometre (Km.)	= 1000·0 metres	=	0·6214 mile
1 Hectometre (Hm.)	= 100·0 metres	=	109·36 yards
1 Dekametre (Dm.)	= 10·0 metres	=	32·81 feet
1 **Metre** (M.)	= 1·0 metre	=	39·37 inches
1 Decimetre (dm.)	= 0·1 metre	=	3·93 inches
1 Centimetre (cm.)	= 0·01 metre	=	0·394 inch
1 Millimetre (mm.)	= 0·001 metre	=	0·039 inch

Metric Measures of Weight

*1 Kilogramme (Kgm.)	= 1000·0 gm.	=	2·205 pounds (avoirdupois)
1 Hectogramme (Hgm.)	= 100·0 gm.	=	3·527 ounces (avoirdupois)
1 Dekagramme (Dgm.)	= 10·0 gm.	=	154·323 grains
1 **Gramme** or **Gram**	= 1·0 gm.	=	15·432 grains
1 Decigramme (dgm.)	= 0·1 gm.	=	1·543 grains
1 Centigramme (cgm.)	= 0·01 gm.	=	0·154 grain
1 Milligramme (mgm.)	= 0·001 gm.	=	0·015 grain

* Commonly called 1 kilo.

Metric Measures of Capacity

1 Kilolitre (Kl.)	= 1000·0 litres	=	220·15 Imperial gallons
1 Hectolitre (Hl.)	= 100·0 litres	=	22·01 Imperial gallons
1 Dekalitre (Dl.)	= 10·0 litres	=	2·2 Imperial gallons
1 **Litre** (L.)	= 1·0 litre	=	35·196 Imperial fluid ounces
1 Decilitre (dl.)	= 0·1 litre	=	3·5 Imperial fluid ounces
1 Centilitre (cl.)	= 0·01 litre	=	0·35 Imperial fluid ounce
1 Millilitre (mil)	= 0·001 litre	=	16·89 Imperial minims
1 Decimil (dml.)	= 0·0001 litre	=	1·68 Imperial minims
1 Centimil (cml.)	= 0·00001 litre	=	0·16 Imperial minim

N.B.—1 Millilitre is one cubic centimetre (c.c.), also called 1 mil.

Factors for converting from one Scale to the other

To convert grammes into grains	× 15·432
„ „ „ ounces, avoirdupois	× 0·03527
„ kilogrammes into pounds	× 2·2046
„ grains into grammes	× 0·0648
„ avoirdupois ounces into grammes	× 28·35
„ troy ounces into grammes	× 31·104
„ cubic centimetres into fluid ounces, Imperial	× 0·0352
„ litres into fluid ounces, Imperial	× 35·2
„ fluid ounces into cubic centimetres	× 28·42
„ pints into litres	× 0·568
„ metres into inches	× 39·37
„ inches into metres	× 0·0254

Imperial Measures of Mass with Approximate Metric Equivalents

Imperial.	Metric.	Imperial.	Metric.
gr. $\frac{1}{100}$	= 0·0006 gm.	gr. 10	= 0·6 gm.
„ $\frac{1}{64}$	= 0·001 „	„ 15	= 1·0 „
„ $\frac{1}{2}$	= 0·03 „	„ 20	= 1·3 „
„ 1	= 0·06 „	„ 25	= 1·6 „
„ 2	= 0·12 „	„ 30	= 2·0 „
„ 3	= 0·2 „	„ 40	= 2·5 „
„ 4	= 0·25 „	„ 60	= 4 „
„ 5	= 0·3 „	„ 90	= 6 „
„ 6	= 0·36 „	„ 120	= 8 „
„ 7	= 0·45 „	oz. $\frac{1}{4}$ (avoir.)	= 7·5 „
„ 8	= 0·5 „	„ $\frac{1}{2}$ „	= 15 „
„ 9	= 0·58 „	„ 1 „	= 30* „

* More accurately 28·3 gm.

WEIGHTS AND MEASURES

Imperial Measures of Capacity with Approximate Metric Equivalents

Imperial.	Metric.	Imperial.	Metric.
min. ½	= 0·03 c.c.	min. 25	= 1·5 c.c.
,, 1	= 0·06 ,,	,, 30	= 1·8 ,,
,, 2	= 0·12 ,,	,, 50	= 3·0 ,,
,, 3	= 0·18 ,,	,, 60	= 3·6 ,,
,, 4	= 0·2 ,,	,, 90	= 6 ,,
,, 5	= 0·3 ,,	drams 2	= 8 ,,
,, 8	= 0·5 ,,	,, 4	= 16 ,,
,, 10	= 0·6 ,,	,, 6	= 24 ,,
,, 15	= 0·9 ,,	ounce 1	= 30 ,,
,, 20	= 1·2 ,,		

Metric Measures of Mass with Approximate Imperial Equivalents

Metric.	Imperial.	Metric.	Imperial.
1 mgm. (0·001 gm.)	= $\frac{1}{64}$ gr.	2 gm.	= 30$\frac{1}{2}$ grains
2 ,, (0·002 ,,)	= $\frac{1}{32}$,,	3 ,,	= 46$\frac{1}{4}$,,
3 ,, (0·003 ,,)	= $\frac{1}{20}$,,	4 ,,	= 61$\frac{3}{4}$,,
4 ,, (0·004 ,,)	= $\frac{1}{16}$,,	5 ,,	= 77$\frac{1}{2}$,,
5 ,, (0·005 ,,)	= $\frac{1}{13}$,,	7·5 ,,	= 115$\frac{3}{4}$,,
8 ,, (0·008 ,,)	= $\frac{1}{8}$,,	10 ,,	= 154$\frac{1}{2}$,,
1 cgm. (0·01 ,,)	= $\frac{1}{6}$,,	15 ,,	= 231$\frac{1}{2}$,,
2 ,, (0·02 ,,)	= $\frac{1}{3}$,,	20 ,,	= 308$\frac{3}{4}$,,
3 ,, (0·03 ,,)	= $\frac{1}{2}$,,	30 ,,	= 1 oz. 25$\frac{1}{2}$ grains
5 ,, (0·05 ,,)	= $\frac{3}{4}$,,	40 ,,	= 1 ,, 179$\frac{1}{2}$,,
10 ,, (0·1 ,,)	= 1$\frac{1}{2}$,,	50 ,,	= 1 ,, 334 ,,
1 dgm. (0·1 ,,)	= 1$\frac{1}{2}$,,	75 ,,	= 2 ,, 282$\frac{1}{2}$,,
2 ,, (0·2 ,,)	= 3 grains	100 ,,	= 3 ,, 230$\frac{3}{4}$,,
3 ,, (0·3 ,,)	= 4$\frac{1}{2}$,,	150 ,,	= 5 ,, 127$\frac{1}{2}$,,
4 ,, (0·4 ,,)	= 6$\frac{1}{2}$,,	250 ,,	= 8 ,, 358 ,,
5 ,, (0·5 ,,)	= 7$\frac{3}{4}$,,	500 ,,	= 1 lb. 1 oz. 278 gr.
10 ,, (1·0 ,,)	= 15$\frac{1}{2}$,,	750 ,,	= 1 ,, 10 ,, 200 ,,
1 gm.	= 15$\frac{1}{2}$ (15·432) gr.	1 kgm.	= 2 ,, 3 ,, 120 ,,

Metric Measures of Capacity with Approximate Imperial Equivalents

Metric.	Imperial.	Metric.	Imperial.
1 c.c.	= 17 (16·9) min.	25 c.c.	= 7 fl. dr. 2 min.
2 ,,	= 33$\frac{1}{2}$ min.	30 ,,	= 8 ,, 27 ,,
3 ,,	= 50$\frac{3}{4}$,,	40 ,,	= 1 fl. oz. 3 fl. dr. 16 min.
4 ,,	= 1 fl. dr. 7 min.	50 ,,	= 1 ,, 6 ,, 5 ,,
5 ,,	= 1 ,, 24 ,,	75 ,,	= 2 ,, 5 ,, 7 ,,
6 ,,	= 1 ,, 41 ,,	100 ,,	= 3 ,, 4 ,, 10 ,,
7 ,,	= 1 ,, 58 ,,	125 ,,	= 4 ,, 3 ,, 12 ,,
8 ,,	= 2 ,, 15 ,,	150 ,,	= 5 ,, 2 ,, 15 ,,
9 ,,	= 2 ,, 32 ,,	200 ,,	= 7 ,, 0 ,, 20 ,,
10 ,,	= 2 ,, 49 ,,	300 ,,	= 10 ,, 4 ,, 30 ,,
15 ,,	= 4 ,, 13 ,,	500 ,,	= 17 ,, 4 ,, 50 ,,
20 ,,	= 5 ,, 38 ,,	1 litre	= 35 ,, 1 ,, 34 ,,

Note.—The *British Pharmacopœia* renders 1 c.c. as 1 millilitre or 1 mil.

Approximate Value of Domestic Measures

Tumbler	= 10 fluid ounces	Table-spoon (small)	= ½ fluid ounce
Breakfast-cup	= 8 ,, ,,	Dessert-spoon	= 2 fluid drams
Tea-cup	= 5 ,, ,,	Tea-spoon	= 1 fluid dram
Wine-glass (large)	= 2½ ,, ,,	Drop (of water)	= 1 minim

Note.—When medicine is measured this should be done by means of a standardised measure, because domestic utensils vary greatly in size.

WEIL'S DISEASE is a form of jaundice due to infection with a *Spirochæte*, also known as infectious jaundice and as SPIROCHÆTOSIS ICTEROHÆMORRHAGICA (*q.v.*).

WEIR MITCHELL TREATMENT is a form of treatment which consists in absolute rest of body and mind, administration of highly nutritious and easily digestible food in large quantities, and massage to take the place of muscular exercise. (*See* NEURASTHENIA.)

WELLS (*see* WATER SUPPLY).

WENS are small cystic tumors in the skin, consisting of a collection of sebaceous material, due to blockage of the outlet from a sebaceous gland. They occur most commonly about the face and scalp, where they form smooth, rounded, elastic tumors often of a considerable size, but give rise to no trouble save that occasioned by their position, by their unsightliness, and by the fact that they are liable to become inflamed from the pressure of the hat, etc.

Treatment consists in opening the cyst, squeezing out its fatty contents, and carefully removing the lining membrane. If any part of the membrane lining the interior be left behind, the wound heals in such a way that the wen is apt to refill. On the scalp this membrane is tough and can generally be pulled out entire, but on the face greater care is necessary, and the thin skin over the wen, to which the lining membrane is adherent, is also removed. The little operation is usually performed under a local anæsthetic, and is accompanied by very little pain.

WET BRAIN is a term applied to an œdematous state of the brain caused by chronic alcoholism and associated with mental failure and delusions.

WET CUP is a form of cupping in which the cupping glass is applied after scarification of the skin (*see* CUPPING).

WET PACK is a method of treatment much in vogue in some countries and with some physicians, for the purpose of applying a moderate degree of cold or of heat, for some time, to a patient's skin.

Uses.—The conditions in which cold is beneficial are detailed under COLD, USES OF, and the wet pack is a specially convenient method of applying cold when it is desired to exert a gentle cooling influence over a prolonged period, one hour or more, and at the same time to maintain the patient in a condition of absolute quiet and rest. It is used, for example, in such conditions as neurasthenia, and exhaustion due to heat. When a more rapid degree of cooling is desired, the patient is changed from one wet pack to another every quarter of an hour or thereabout, two beds being placed near one another for this purpose. Very rapid cooling may be achieved by wrapping the patient in a wet pack and rubbing down the sheet in which he is enveloped with pieces of ice.

Hot wet packs are also applied, *e.g.* in Bright's disease.

Method of application. — (1) COLD PACK.—A mackintosh sheet covered by a large blanket is spread upon the bed, and, when the patient is ready, a sheet is dipped in cold water, wrung out fairly dry, and laid over the blanket. The patient, stripped, is laid upon the sheet, which is quickly turned over him from both sides, and pushed between his legs and between each arm and the chest, so that skin does not touch skin anywhere. This must be done quickly, and the sheet being neatly tucked in round the neck and folded beneath the feet, every part of the body is covered saving the head and face. The head may also be wrapped in a wet towel. Finally the sides of the blanket are turned over the patient, and wrapped round him so as to lie smoothly everywhere. The patient, enveloped in this pack, lies absolutely helpless and should on no account be left by the attendant till the pack is removed, when he is put back into bed.

(2) HOT PACK.—A mackintosh sheet is spread on the bed as for a cold pack. Upon this is laid a dry blanket. A second blanket (which retains heat better than a sheet) is placed in a pail and boiling water is poured over it. The blanket is then taken out of the pail, wrung, shaken and rolled up. It is next applied to the patient in the same way as the sheet in the case of

FIG. 495.—Requisites for hot pack.

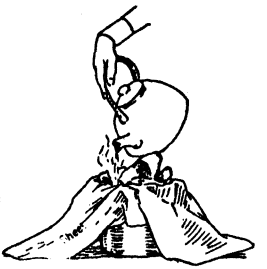


FIG. 496.—Hot pack, first stage. Pail containing sheet for wringer and blanket for pack.

FIG. 497.—Hot pack, second stage. Wringing out the blanket inside the sheet.

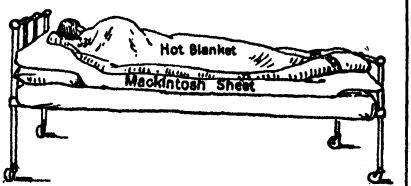


FIG. 498.—Hot pack, third stage. Applying the hot wet blanket.

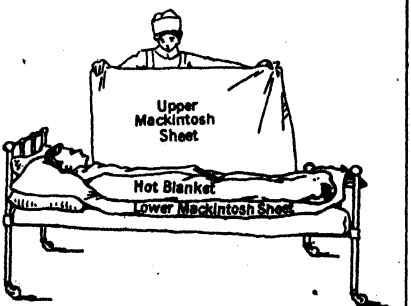


FIG. 499.—Hot pack, fourth stage. Blanket tucked round patient, and upper mackintosh being laid over.

the cold pack. The dry blanket is then also wrapped round the patient outside the wet blanket; a second mackintosh sheet is spread over him; hot-water bottles, if desired, are placed alongside him; and several more blankets are laid on top of the mackintosh sheet. The patient may lie enveloped in the hot pack for twenty minutes, and he is then quickly dried with warm towels, a warm flannel nightdress re-applied, and he is put back in bed. The patient must on no account be left alone while he is in the hot pack.

(3) WHISKY PACK.—(*See* ALCOHOL.)

(4) MUSTARD PACK.—A pack containing mustard is sometimes used as a last resort in cases of collapse or of failure of breathing in young children. The pack is made by mixing mustard with warm water to the consistency of cream and saturating a smooth hand-towel with a breakfast-cupful of the mixture. The child is laid on a mackintosh, and the towel is wrapped round its chest, abdomen, and limbs, the face being meantime protected by the hand of the nurse or by a dry towel. A second mackintosh is laid over the pack and a strip of cotton-wool is tucked round the neck to keep the fumes from the face and eyes. The child, after 10 or 15 minutes, is transferred to a warm bath, the skin is thoroughly rinsed to remove the mustard, and an ordinary hot wet pack is applied for 20 or 30 minutes. In the latter, a marked reaction should take place.

WHEEZING is a popular name applied to the various sounds produced in the chest when the bronchial tubes are inflamed. It is applied particularly to the long-drawn breathing of asthma, and to the whistling or purring noises that accompany breathing in cases of bronchitis. (*See* ASTHMA, BRONCHITIS.)

WHELK is a term applied to a wheal, and also to a red protuberance on the face or nose seen in the case of a hard drinker. (*See* ACNE ROSACEA.)

WHEY (*see* JUNKET).

WHIPWORM is a popular name for *Trichocephalus dispar*. (*See* PARASITES.)

WHISKY (*see* ALCOHOL).

WHITE LEG is a fairly common and well-known condition in which a limb, usually one of the lower limbs, becomes enlarged, white, and painful.

Causes.—Most commonly the condition occurs after childbirth, sometimes during convalescence from an acute febrile disease, especially typhoid fever or pneumonia. It is usually due to inflammation in and blocking of the veins of the limb, or may be caused by the spread of infection into the lymphatics of the limb from those within the pelvis, or to some morbid change in the blood causing it to clot.

Symptoms.—The disease comes on during convalescence from one of the conditions mentioned above, beginning with slight feverishness and pain down the leg which is to be affected. The limb gradually swells, and in a few days may be greatly enlarged, hard, glossy, and of a strikingly white colour. The veins can generally be felt as solid lines down the inner side of the thigh, and the affected parts may be very tender to the touch. These symptoms persist for a week or so, but generally begin to subside within a fortnight from the onset, and about three-fourths of all cases recover completely in a few weeks. In other cases, some degree of muscular weakness, swelling, or aching of the limb remains permanently, but the condition, though a serious one demanding most careful treatment, is very seldom fatal.

Treatment consists chiefly of rest in bed with the affected limb supported on a pillow. Absolute quiet is essential, on account of the dangers mentioned under VEINS, DISEASES OF. Pain is relieved by laudanum fomentations or simply by wrapping the limb in cotton-wool, and various tonics are administered at a later stage in order to improve the general condition.

WHITE PRECIPITATE is the popular name for ammonio-chloride of mercury, a substance much used in ointment for application to various skin diseases. (*See* MERCURY.)

WHITES, or LEUCORRHŒA, is a symptom of many diseases peculiar to women, and may be of an acute nature, when the discharge is thick and white, consisting mainly of pus, or is more often chronic and catarrhal, when the discharge is usually thinner, sometimes of a clear mucous nature, in other cases acrid and offensive. In slighter cases, the discharge precedes or follows the menstrual flow, in severer cases it continues throughout the whole intervening periods. Persons affected in this manner are generally unhealthy in appearance, the face is pale and sallow, weariness is felt easily upon exertion, and a dull gnawing pain is often experienced in the lower part of the back.

Causes.—Almost all the diseases peculiar to women that are of inflammatory nature are accompanied by this symptom, and among them may be mentioned the following. The commonest cause is some chronic inflammation of the womb following on childbirth, and associated with some displacement of this organ or some laceration of its neck. The condition often occurs as a symptom of general debility accompanied by congestion of internal organs, and is said also to arise in consequence of rheumatism or gout. An occasional cause of very offensive discharge is found in the irritation set up by the presence of a foreign body, such as a pessary that has been introduced for the support of a displaced womb, and then forgotten. In young children the condition is not common, but may arise from the irritation set up by thread-worms, as the result of general debility combined with want of cleanliness or following upon some acute infective disease. The condition should, however, be regarded more as a symptom than as itself a disease. A similar purulent discharge is also a symptom of gonorrhœa.

Treatment.—Constitutional remedies are of importance in almost all cases, and include good diet, tonics of iron, bracing treatment, such as the daily cold bath. Frequently, change of air is recommended, and patients troubled by this condition betake themselves especially to Kissingen, Ems, and other bathing-places where the water is supposed to possess special value in relieving internal congestion. As regards local measures, the careful regulation of the bowels is of great importance, and the cleansing and soothing action of the

warm douche is the chief method of treatment. (*See* DOUCHE.) In simpler cases it is often sufficient to use plain water for the douche, or water tinted to a pink colour with permanganate of potassium. The douche should be large in amount, at least a quart, and should be regularly used, either once or twice daily. In more intractable cases, various astringents such as alum, sulphate of zinc, and vegetable infusions containing tannin, or antiseptic substances such as perchloride of mercury, are added to the water of the douche.

If, however, the condition be due to some definite disease, these measures are no more than palliative, so long as it remains untreated, and some special form of treatment becomes necessary. (*See* UTERUS, DISEASES OF.)

WHITE SWELLING is a popular name applied to tuberculous disease of joints. (*See* JOINTS, DISEASES OF.)

WHITLOW is a popular term applied to all acute inflammations of the deep-seated tissues in the fingers, whether the structure affected be the root of the nail, the pulp of the finger-point, the sheaths of the tendons that run along the back and front of the fingers, or the bone. Acute inflammation of the bones in the finger is very rare, and in general a whitlow begins in the last part of one finger, being, when situated towards the back, a small abscess at the root of the nail, and when commencing in front, an abscess in the fat and fibrous tissue that compose the pulp of the finger. Suppuration may also commence in the sheath of the tendon, generally in front of the finger.

WHOOPING-COUGH, also known as HOOPING-COUGH, PERTUSSIS, and CHINCOUGH, is an infectious disease of the mucous membrane lining the air passages, which manifests itself by frequently recurring attacks of convulsive coughing followed by peculiar, loud indrawing of the breath, and often by vomiting. It occurs for the most part in children, and seldom more than once in a lifetime.

Causes.—The direct cause of whooping-cough is a bacillus discovered by Bordet and Gengou in 1906 and found in the sputum. It is often referred to as the 'bacillus of Bordet Gengou', but generally goes under the name *Hæmophilus pertussis*. Although specially a disease of childhood, whooping-cough is by no means limited to that period, but may occur at any time of life, even to old age, should there have been no previous attack. It is most common between the ages of one and four, and is rare after ten. Whooping-cough is a dangerous disease in infants, though but a trivial malady in older children. It has been occasionally observed in newly born infants, and is more common in female than in male children. Whooping-cough is infectious during any stage of its progress, but chiefly at its commencement. It is not only communicated by the breath, but may, as has been clearly proved, be conveyed by the medium of clothing. It prevails mostly in spring and autumn, doubtless owing to these seasons increasing the predisposition to affections of the respiratory passages. Epidemics of whooping-cough have often been noticed to succeed or to accompany those of measles, although no causal connection between these diseases appears to be traceable.

Symptoms.—With respect to the symptoms of whooping-cough, three stages of the disease are recognised, viz. (1) the catarrhal stage, (2) the spasmodic stage, (3) the stage of decline.

The *first stage* is characterised by the usual symptoms of a catarrh, with sneezing, watering of the eyes, irritation of the throat, feverishness and cough, but in general there is nothing in the symptoms to indicate that they are to develop into whooping-cough. The catarrhal stage usually lasts from ten to fourteen days.

The *second stage* is marked by the abatement of the catarrhal symptoms, but at the same time by increase in the cough, which now occurs in irregular paroxysms both by day and by night. Each paroxysm consists in a series of violent and rapid expiratory coughs, succeeded by a loud sonorous or crowing inspiration—the 'whoop'. During the coughing efforts, the air is driven with great force out of the lungs, and, as none can enter the chest, the symptoms of impending asphyxia appear. The patient grows deep-red or livid in the face, the eyes appear as if they would

burst from their sockets, and suffocation seems imminent till relief is brought by the 'whoop'—the louder and more vigorous the better. Occasionally blood runs from the nose or mouth, or is extravasated into the conjunctiva of the eyes. A single fit rarely lasts beyond from half to three-quarters of a minute, but after the 'whoop' another recurs, and of these a number may come and go for several minutes. The paroxysm ends by the coughing or vomiting up of a viscid tenacious secretion, and usually after this the patient seems comparatively well, or, it may be, somewhat wearied and fretful. The frequency of the paroxysms varies according to the severity of the case, being in some instances only to the extent of one or two in the whole day, while in others there may be several in the course of a single hour. Slight causes serve to bring on the fits of coughing, such as the acts of swallowing, talking, laughing, crying, etc., or they may occur without any apparent exciting cause. In general, children come to recognise an impending attack by a feeling of tickling in the throat, and they cling with dread to their mother or nurse, or take hold of some object near them for support during the paroxysm; but, although exhausted by the severe fit of coughing, they soon resume their play, apparently little the worse. The attacks are on the whole most severe at night. This stage of the disease usually continues during four to seven weeks, but it may be shorter or longer. It is during this time that complications are apt to arise which may become a source of danger greater even than the malady itself. The chief of these are inflammatory affections of the bronchial tubes and lungs, and convulsions, any of which may prove fatal. A milder but very frequent complication is the formation of a small ulcer under the tongue from rubbing against the teeth in coughing. Hernia and prolapse of the rectum sometimes are produced by the strain of violent coughing.

When, however, the disease progresses favourably, as it usually does, it passes into the *third* or *terminal stage*, in which the cough becomes less frequent and generally loses in great measure its 'whooping' character. The patient's condition altogether undergoes amendment, and the symptoms disappear in from one to three weeks. It is to be observed, however, that for a long period afterwards in any simple catarrh from which the patient suffers the cough often assumes a spasmodic character, which may suggest the erroneous notion that a relapse of the whooping-cough has occurred.

In severe cases it sometimes happens that the disease leaves behind it such structural changes in the lungs (emphysema, etc.) as entail permanent shortness of breathing, or a liability to attacks of asthma. Occasionally the violence of the cough may rupture a blood-vessel in the brain, with hemiplegia as a result. Further, whooping-cough is one of those diseases of early life which are apt to give rise to a weakened and vulnerable state of the general health, or to call into activity any tendency to disease, such as that towards consumption.

Treatment.—As regards the treatment of whooping-cough in mild cases, little is necessary beyond keeping the patient warm and carefully attending to the general health. The remedies applicable in the case of catarrh or the milder forms of bronchitis are of service here, while gentle counter-irritation to the chest by stimulating liniments may be employed all through the attack. In mild weather the patient may be in the open air. In the more severe forms, efforts have to be employed to modify the severity of the paroxysms. Numerous remedies are recommended, the chief of which are the bromides of ammonium or potassium, chloral, belladonna, etc. During convalescence, where the cough still continues to be troublesome, a change of air will often effect its removal. A vaccine has now been prepared which seems to be effective as a prophylactic: it is not thought to be of use in treatment.

WIDAL'S TEST (*see* AGGLUTINATION).

WINDPIPE is the popular name for the trachea, which extends from the larynx above to the point in the upper part of the chest where it divides into the two large bronchial tubes, one to

each lung. It thus extends through the lower part of the neck and upper part of the chest, and is about four inches in length. It consists of a fibrous tube kept permanently open by about twenty strong horizontally placed hoops of cartilage, each of which forms about two-thirds of a circle, but is defective behind where the two ends are united by muscle-fibres. This fibro-cartilaginous tube is lined by a smooth mucous membrane, richly supplied with mucous glands and covered by a single layer of ciliated epithelium. (*See also* AIR PASSAGES.)

WIND SUCKING is the name applied to a habit which some persons, especially when suffering from dyspepsia, contract of swallowing mouthfuls of air. This at first gives relief to the discomfort and pain of indigestion, but later prolongs and aggravates it. The resulting breathlessness can be relieved to some extent by taking peppermint water or chloroform water in doses of a tablespoonful, but the chief necessity is to overcome the habit of swallowing air.

WINE (*see* VINUM *and* ALCOHOL).

WINTER COUGH is a name sometimes given to chronic bronchitis which affects old people specially. The cough passes off during summer and returns with the damp weather each winter. (*See* BRONCHITIS.)

WINTERGREEN (*see* GAULTHERIA).

WISDOM TOOTH is a popular name for the last molar tooth on either side of each jaw. These teeth are the last to appear and should develop in early adult life, but frequently they do not cut the gum till the age of twenty or twenty-five, or indeed they may sometimes remain permanently impacted in the jaw-bone.

WITCH-HAZEL is a preparation of the bark, twigs, and dried leaves from *Hamamelis virginiana*, a plant of the United States possessed of strong astringent properties. It is used to check hæmorrhages and excessive mucous discharges, and also for piles. The most commonly used preparation is the liquid extract, which is sometimes given internally and more often used in the strength of 1 dram to 3 ounces of cold water, either as a lotion for bruises or as an enema for bleeding piles. Extract of hamamelis is employed as an application for varicose veins and ulcers; and ointments known as hazeline snow, hazeline cream, etc., are much used as applications for irritable states of the skin.

WOLF'S-BANE is another name for aconite.

WOMB (*see* UTERUS).

WOOD ALCOHOL is another name or methyl-alcohol. (*See* SPIRIT.)

WOOD WOOL is the name of a fabric prepared from wood fibre, and much used for padding splints and other surgical purposes where the more expensive and softer cotton-wool is not necessary.

WOOLSORTERS' DISEASE is another name for anthrax. (*See* ANTHRAX.)

WORD BLINDNESS is the term applied to a condition in which, as the result of disease in the brain, a person becomes unable to associate their proper meanings with words, although he may be quite able to spell the letters. WORD DEAFNESS is an associated condition in which, though hearing remains perfect, the patient has lost the power of referring the names he hears to the articles they denote. (*See* APHASIA.)

WORMS (*see* PARASITES).

WORMSEED is a popular name for santonin. (*See* SANTONIN.)

WORMWOOD (*see* ABSINTHISM).

WOUNDS.—A wound is any breach suddenly produced in the tissues of the body by direct violence. An extensive injury of the deeper parts without corresponding injury of the surface is known as a bruise or contusion.

Varieties.—Classified according to the immediate effect produced, four varieties are usually described, viz. *incised*, *punctured*, *lacerated*, and *contused*.

INCISED WOUNDS are usually inflicted with some sharp instrument, and are clean cuts, in which the tissues are simply divided without any damage to parts around. The bleeding from such a wound is apt to be very free, but it can be readily controlled.

PUNCTURED WOUNDS, or stabs, are inflicted with a pointed instrument. These wounds are the most dangerous, partly because their depth involves the danger of wounding vital organs, partly because bleeding from a stab is hard to control, and largely on account of the difficulty of purification. The wound produced by the modern nickel-nosed bullet is a puncture, much less severe than the ugly lacerated wound caused by an expanding bullet, or by a ricochet, and, if no clothing has been carried in by the bullet, the wound is clean and usually heals at once.

LACERATED WOUNDS are those in which great tearing takes place, such as injuries caused by machinery. The blood-vessels being torn and twisted, little bleeding is apt to result, and a limb may be torn completely away without great loss of blood. Such wounds are, however, specially liable to the danger of suppuration.

CONTUSED WOUNDS are those accompanied by much bruising of surrounding parts, as in the case of a blow from a cudgel or poker. In these wounds also there is little bleeding, but healing is slow on account of damage to the edges of the wound.

Any of these varieties may become infected by pus-forming germs and develop into a POISONED WOUND.

First-aid treatment.—The first duty of a bystander who renders help to a wounded person is to check any bleeding. This may be done by pressure upon the edges of the wound with a clean handkerchief, or, if the bleeding is serious, by putting the finger in the wound and pressing it upon the spot from which the blood is coming. If necessary, the person may then at his leisure apply other methods described under HÆMORRHAGE and TOURNIQUET.

If a medical man is to see a wound within a few hours, it should not be interfered with further than is necessary to stop the bleeding and to cover the wound with a clean dry handkerchief or piece of lint. In cases where expert assistance is not soon obtainable, one of the following procedures may be adopted. The bleeding being checked, the next step is to cleanse the wound and surrounding skin.

This may be done:

(*a*) *By painting freely with tincture of iodine* the wound and the surrounding skin, and covering with a piece of clean dry lint; this answers well in the case of small wounds and abrasions. A small piece of sterilised lint attached to a strip of sticking plaster may be purchased ready for use and forms a convenient and quickly applied dressing.

(*b*) *By washing with clean water* (preferably boiled). For this purpose, one requires two *clean* bowls scalded out quickly with boiling water, and filled with *clean* warm water; also several *clean* cloths, which may be handkerchiefs, squares of lint (preferably boracic lint), or newly washed rags.

(1) First, it is essential that the person who is to dress the wound should wash his own hands, and especially the nails, thoroughly with soap and water.

(2) Press a clean cloth upon the wound to prevent the entrance into it of dirty water, and carefully wash the skin around the wound with water from one of the bowls, using soap if necessary.

(3) Wring out a fresh cloth from the clean water in the second bowl, and with it gently dab the wound. Remove, replace by another clean cloth similarly wrung out, and fix it on the wound with a folded handkerchief. (*See* BANDAGES.)

(4) The injured part is finally fixed so that movement is prevented or minimised. A wounded hand or arm is fixed with a sling (*see* SLINGS), a wounded leg with a splint.

(5) If the injury has caused severe shock, stimulants may be necessary. (*See* SHOCK.)

Healing of wounds.—The reaction of the tissues to an injury is similar to that produced by any other irritation, viz. an inflammation which finally heals the part. If the wound has been accompanied by loss of substance which has to be made good, or by death of a piece of tissue which has to be cast off as a slough, or by infection with bacteria which has to be overcome, the process of repair is tedious and in some cases permanent damage is produced. The new tissue formed in the wound is mainly

fibrous tissue, like that composing the supporting framework of the body.

HEALING BY FIRST INTENTION.—In a clean, incised wound of moderate severity, the immediate effect is bleeding from the ends of the vessels which have been cut. This, however, is soon arrested by the contraction and retraction of the coats of the divided vessels, and by the formation of blood-clots in their open ends. A small quantity of blood remains in the wound and clots. The blood-vessels round the injured part dilate, the blood flow becomes slowed, and there passes out from the blood a fluid known as 'lymph', which coagulates upon the surface of the wound, forming a sticky layer of fibrin which, if the injured surfaces are in contact, causes them to adhere to one another. This forms the temporary scaffolding within which the tissues of repair will be

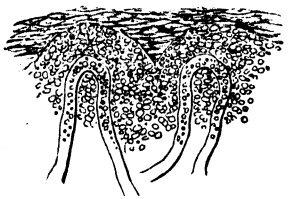


FIG. 500.—Section showing two granulations. The capillary loops are surrounded by corpuscles, of which those next the surface are engaged in the formation of delicate fibrous tissue. (Miller's *Surgery*.)

built, and possesses the other valuable property of being strongly germicidal to any organisms which may come in contact with it. White corpuscles also migrate through the walls of the dilated blood-vessels and pass into this exudate in the wound. This fact is of the greatest importance, since the white corpuscles eat up and destroy any foreign or dead substance which has to be removed in the process of repair. (*See* PHAGOCYTOSIS.) They remove the minute portions of tissue which have been killed by the injury, and the small quantity of blood which has accumulated in the wound. Following the entrance of the white blood corpuscles, within twenty-four hours after the infliction of the wound, there comes a host of cells produced by the rapid multiplication of the cells in the tissues around the wound. Some of these also have the power of phagocytosis, and

others, called 'fibroblasts', become transformed into delicate fibrous tissue. Next, minute buds shoot in from the walls of the smallest blood-vessels and form minute blood channels, which pass from side to side of the wound, or form loops if a gap has been left. The tissue so formed is known as 'granulation tissue', because, when its surface is closely examined, it has a red, granular appearance due to these loops of vessels covered by masses of the cells mentioned

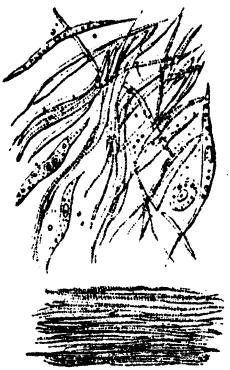


FIG. 501.—White fibrous tissue. The upper figure shows the delicate network formed by cells in the repair of a wound; the lower figure shows the dense fully formed state. (Miller's *Surgery*.)

above. The same form of tissue is readily seen on a healing ulcer. Epithelial cells from the surface of the skin now grow over and cover the wound, the whole process being completed usually in less than a week. The delicately formed tissue of the healed wound is gradually replaced by firm fibrous tissue containing fewer blood-vessels, and in less than a year the angry, red scar of the recently healed wound is replaced by a white scar. With minor modifications, this process of repair takes place in all healing wounds.

HEALING BY SECOND INTENTION takes place where the granulation tissue is exposed to view. It occurs in wounds which have broken down owing to suppuration, or where there is an ulcer, and the edges are gradually drawn together by the contraction of the newly formed fibrous tissue. This results in a wider, weaker, and more noticeable scar.

HEALING BY SCAB FORMATION occurs where the lymph dries up, and union is continued under the dry cake so formed.

HEALING OF POISONED WOUNDS.—Where a wound becomes poisoned, the multiplication of the germs in it dissolves the fibrin and destroys many of the cells engaged in repair. The reaction of the tissues becomes intense, and the inflammation is so evident that the wound is popularly said to be 'inflamed'. As a result of the destruction, many of the cells are discharged as pus. Granulation tissue is gradually formed around the site of infection, the bacteria are cast off in the pus, and healing by second intention takes place. A certain amount of the poison produced by the bacteria, however, escapes into the circulation and causes the symptoms of general ill-health which are present with a poisoned wound.

Dangers of wounds.—BLOOD-POISONING usually means that the germs themselves have entered the circulation, which is a very grave occurrence and is frequently fatal. (*See* BLOOD-POISONING.)

ERYSIPELAS, TETANUS, and GAS GANGRENE are conditions in which germs

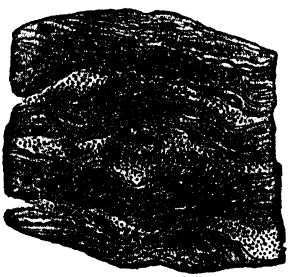


FIG. 502.—Streptococcus of erysipelas growing in the connective-tissue spaces of the skin. The small dots indicate masses of the microbe. Magnified by 250. (Thoma's *Pathology*.)

enter the lymphatics and produce widespread effects. (*See* ERYSIPELAS, TETANUS, *and* GANGRENE.)

HÆMORRHAGE. — *Primary hæmorrhage* means bleeding which occurs at the time of the injury. A large vein or artery may have been divided and may require to be tied. (*See* HÆMORRHAGE.) A wound of a large vessel like the femoral or the popliteal artery may cause death in a few minutes if untreated. *Reactionary hæmorrhage* takes place sometimes from wounds which do not bleed much when they are first inflicted. The explanation is that the shock caused by the injury enfeebles the action of the heart, and, when the wounded person recovers from the shock in a few hours, the increased force of the heart's beating causes bleeding to recommence in the wound. *Secondary hæmorrhage* occurs only in the case of poisoned wounds. The spread of the infection breaks down the blood-clot which has formed in the open end of a blood-vessel and allows the escape of blood. It is usually preceded by a slight oozing of blood, which serves to forewarn the medical attendant. This form of bleeding seldom occurs earlier than a week from the date of the injury.

PARALYSIS.—In a wound of a limb, one of the nerves may be divided. When this has happened, a definite area of skin is found to have lost the sense of touch and pain, and the muscles supplied by the divided nerve have completely lost their power. The tendons, which attach the muscles to the bones, may also be divided, as, for example, by a wound behind or in front of the wrist, causing loss of power in the injured part. If either or both of these complications be present, it is of the greatest importance that the divided ends should be stitched together as early as possible, or a permanent loss of power may result.

SCALP WOUNDS usually heal well, but in deep scalp wounds there is a danger that suppuration may result and may pass within the skull. Again, a severe blow producing a scalp wound may cause fracture of the skull and concussion or compression of the brain. (*See* BRAIN DISEASES.)

CHEST WOUNDS.—Stabs of the chest are serious chiefly because of the fatal bleeding likely to follow any wound of the heart or large vessels; and a less serious danger attends wounds of the pleural cavity causing collapse of the lung or empyæma.

ABDOMINAL WOUNDS.—A penetrating wound of the abdomen, particularly when the bowel has been cut, is frequently fatal from the acute general peritonitis which it causes.

WOUNDS

General treatment of wounds.—The treatment of wounds was revolutionised between 1918 and 1939 by two measures. The first was the closed-plaster technique of treating open wounds, especially when associated with a fracture of bone. In this, the wound was excised and drained and then enclosed in plaster of Paris, the idea being to give the injured tissues complete rest. The second measure was the local application to wounds of one of the sulphonamide drugs or of penicillin. Propamidine and proflavine are other 'antiseptics' applied locally to the wound with successful results. The first-aid treatment, already described, has for its chief objects the arrest of bleeding and the covering of the wound by a clean dressing, so as to prevent the entrance of germs and to get rid of those which have gained entrance from the skin, or upon the object that inflicted the wound.

To prevent infection of a wound at an operation or in applying a permanent dressing, everything which comes in contact with it must be sterilised or rendered germ-free. To destroy the germs, the best and most easily obtained material is boiling water or steam. If subjected to the action of boiling water for one hour, all known germs are killed, while five minutes' boiling is found sufficient for practical purposes. Chemical agents, such as carbolic acid or perchloride of mercury, when used in solutions of given strength, are antiseptics or germicides, and are employed where heat is not applicable. The antiseptic method of treatment for a wound, as originally laid down by Lord Lister, was carried out by using, in addition to the preliminary sterilisation of everything which could possibly contaminate the wound, antiseptic lotions with which to douche it. The disadvantage of this form of treatment is that an antiseptic, powerful enough to kill any germs in the wound, will also kill the tissue cells. The aseptic method of treatment, on the other hand, is carried out when everything that can possibly convey infection to the wound is rendered free from germs, but none of the fluids or dressings which come in contact with the wound contain antiseptics. In hospitals it is usual to employ the aseptic method, and all gauze, lint, wool, and bandages are treated in a steam steriliser before use, and kept covered till required.

CHANGING THE DRESSING.—If the wounded surfaces are in contact, the dressing should not be changed unless pain is felt in the wound, discharge from the wound soaks through the dressing, a rise of temperature occurs, or the part feels uncomfortable, until the tenth day, when the dressing is removed.

DRESSINGS AND LOTIONS.—One of the most convenient and economical dressings for direct application to a wound is boracic lint. Another is cyanide gauze, *i.e.* gauze impregnated with the double cyanide of mercury and zinc; it usually contains free particles of this substance, and therefore should always be moistened before use. Iodoform gauze and xeroform gauze are also used, partly for their mildly antiseptic action, but mainly because they stimulate the tissues and hasten union.

Of the many lotions, 1 part of carbolic acid in 20 parts of water possesses the advantage of being a powerful antiseptic which is volatile and soothing. It should not be applied to a large surface owing to the risk of absorption and carbolic acid poisoning. Perchloride of mercury in a strength of 1 part to 1000 parts of water, or lysol 1 part in 100 of water may be used. Immediately before their application to a wound, *these lotions are usually diluted with an equal quantity or more of warm water.*

Other useful antiseptics are flavine and dettol (see beginning of this section).

STITCHES.—If the wound be of the incised variety, with wide separation of the edges, it may require to be stitched. Horse-hair, silkworm gut, silver wire, silk, or catgut may be employed for this purpose. One of the first three is used in cases where there is a risk that the wound may become poisoned. Catgut, which is prepared from the intestine of the sheep, possesses the advantage over all the others that it is absorbed by the tissues, and thus does not require to be removed. Where stitches of any of the others have been used, they are generally removed about the tenth day. Sometimes a continuous suture is used for a long wound, but more commonly each stitch is put in and tied singly.

DRAINAGE TUBES.—Sterilised india-

rubber tubing is inserted down to the bottom of the wound in all cases where suppuration is likely to occur in a deep wound, when there is much bruising of the tissues or when blood is liable to accumulate in the wound. If the wound remains clean, the drainage tube will be removed on the third day. If suppuration occurs, it will be replaced and kept in until the discharge ceases, or the deep wound closes up so far as to become a healing ulcer. For small wounds, a strip of gauze or a few strands of worsted or a folded strip of thin rubber tissue is often used as a drain instead of a tube.

Treatment of discharging wounds.—If, on account of inefficient treatment, or owing to constitutional weakness of the patient, a wound should suppurate, it must receive treatment which will enable the pus to escape freely while the wound slowly closes. This is provided by inserting a drainage tube into the wound. To prevent the pus drying up and retaining the discharge, and to draw the pus out of the wound, a moist dressing is applied. A piece of lint soaked in sterilised water, or boracic lotion (1 in 60), or perchloride of mercury lotion (1 in 3000), is applied to the wound. The lint is covered with a larger piece of waterproof material, such as gutta-percha tissue, oil-silk, or tinfoil; over this a still larger piece of cotton-wool is applied, and the whole is fixed by a bandage. This dressing is changed daily until the discharge ceases. If the pus is abundant and not escaping freely, the wound is, in addition, washed out with sterilised water or with lotion at each dressing. When improvement is very slow a warm boracic fomentation, changed every four hours, is to be recommended. Should blood-poisoning develop, special treatment may be directed against the infection which is present throughout the blood.

WRIST is the joint situated between the arm above and the hand below. The region of the wrist contains the eight small carpal bones, which intervene between the arm bones and the five metacarpal bones in the hand, and which have the effect of diminishing jars communicated to the hand in virtue of a certain amount of sliding movement over one another, of which they are capable. These small bones are closely bound to one another by short, strong ligaments, and the wrist-joint is the union of the composite mass thus formed with the radius and ulna in the forearm. Three of the nearer row of carpal bones —the scaphoid, lunar, and pyramidal bones—form the lower surface of the joint, while the radius and a triangular cartilage that covers the end of the ulna form the upper surface. These two surfaces are united by strong outer and inner lateral ligaments, and by weaker ligaments before and behind, while the powerful tendons passing to the hand and fingers give it a great measure of strength.

The joint is capable of movement in all directions, and, on account of its shape and its numerous ligaments, is very little liable to dislocation, although stretching or tearing of some of these ligaments is a very common accident, constituting a sprain. (*See* JOINTS, DISEASES AND INJURIES OF.) Inflammation of the tendon-sheaths before and behind the wrist, causing the presence of fluid, also results occasionally from an injury, and produces a sense of weakness in the wrist. A fairly common condition is that known as a ganglion, in which an elastic swelling full of fluid develops on the back or front of the wrist in connection with the sheaths of the tendons. (*See* GANGLION.)

WRIST-DROP (*see* DROP-WRIST).

WRITER'S CRAMP (*see* CRAMP).

WRY-NECK is a condition in which the head is twisted to one side. It may be caused by the contraction of a scar, such as that resulting from a burn, or by paralysis of some of the muscles, but in the great majority of cases it is a spasmodic condition due to excessive tendency of certain muscles to contract. (*See* CRAMP *and* SPASMODIC TORTICOLLIS.)

X

X-RAYS, OR RÖNTGEN RAYS.—The discovery of these was recorded in January 1896 by Professor Röntgen, at that time professor of physics at Würzburg. This epoch-making discovery had been preceded by a series of experiments carried out by Crookes and Lenard. Crookes, employing vacuum tubes with residual air at $\frac{1}{1,000,000}$ of an atmosphere, produced cathodal rays from the negative pole on the passage of a high-potential electric current. Lenard passed these rays into the air through an aluminium window in the tube, and found that they could produce fluorescence of certain bodies, would pass through certain substances opaque to ordinary light, and would act on a photographic plate. Röntgen, using a still higher vacuum, succeeded in producing X-rays from the walls of the tube, these rays being unaffected by a magnet, and possessing greater power of penetration.

From these simple beginnings the science of Radiography and Radiotherapy has been slowly developed, until at the present day countless sets of apparatus are in daily use in X-ray departments of hospitals throughout the world. The uses of X-rays are, however, manifold. Hardly any scientific laboratory of the present day is complete without an X-ray installation. In industry the X-rays are used in work of investigation; with high-tension apparatus giving up to 300,000 volts, steel is examined for faults, and hidden faults can be discovered in the wood used for aeroplane construction.

Apparatus.—Electricity of high potential is the first essential, and it can be produced by (1) an induction coil; (2) a static machine; (3) a set of about 20,000 galvanic cells (*see* ELECTRICITY IN MEDICINE); (4) the continuous current mains of an electrical supply; or (5) the alternating mains of an electrical supply. Low-tension current from any of these sources is converted into a current of high potential, which is essential for the energising of an X-ray tube. This current may be obtained from:

(1) INDUCTION COILS giving 1- to 2-inch sparks between the terminals of the secondary wire in the coil were used in the early experiments in X-ray work, but one possessing a spark of 6 to 20 inches is generally employed to excite the X-ray tube. The current may be derived from a main-electric circuit led through a switch-board with shunt resistances, and as a rule this is the source of supply used. For portable apparatus, accumulators are generally employed; even galvanic cells might be used.

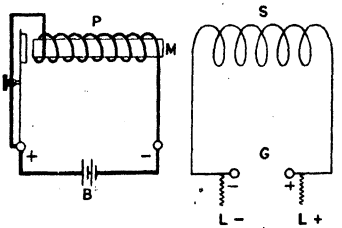


FIG. 503.—Diagram of induction coil. *P*, Primary coil, with *M*, magnet, and *B*, battery or other source of electrical energy; *S*, secondary coil, with *G*, spark-gap, and *L*, *L*, leads to X-ray tube.

Where convenient, a switch-board with voltmeter and ammeter and arrangements to vary the current from, say, 10 to 100 volts and 3 to 15 amperes, is the most satisfactory arrangement. Accumulators or galvanic cells should have a strength of 12 to 24 volts. The interruptor is one of the most troublesome parts. The old-fashioned Neef's hammer will not work with high voltages, and is generally replaced with advantage by a motor mercury, electrolytic, or other interruptor.

(2) A STATIC MACHINE (Wimshurst or Holtz) is also frequently used as a means of exciting the X-ray tube. In some hands these machines do good work, but they are suited only for dry climates and are apt to be rather large and cumbersome

(3) GALVANIC CELLS in large numbers (20,000 or thereabout) might be used, but are far too expensive to be ever of any practical value.

Of these methods, the induction coil seems to meet all purposes best. If the interruptor is thoroughly understood and carefully kept in repair, little difficulty is met with. Recently an advance has been made by eliminating even this,

the current being led from an alternating dynamo through a closed-circuit transformer. A high-voltage *equally alternating* current is thus produced—differing from the current of an induction coil, which, although alternating, has the current made at breaking the circuit so much more powerful than that produced on making the circuit that the latter can practically be ignored. To make the current unidirectional it is passed through valve vacuum tubes, such as the Soupape type, which only allows passage of one phase, or a mechanical rectifier may be used.

A more recent method is to use hot cathode valve tubes similar to those used in 'wireless'. These cut out one phase of the alternating current and so produce a unidirectional current (Coolidge type of tube).

THE VACUUM OF X-RAY TUBE.—The X-rays were originally produced from the walls of the tube, but Jackson improved upon this by using the anode or + pole as the reflecting target for the

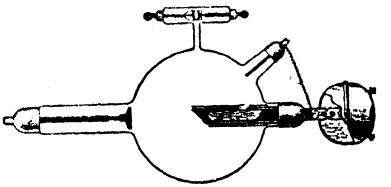


FIG. 504.—Diagram of vacuum tube for production of X-rays. In this type there is a water-jacket to cool the anode, and, above, an accessory tube for regulating the vacuum.

X-rays. Alterations in the vacuum within the tube produce variations in the ray production; for, with a low vacuum, the rays have less penetrating power than those produced by a tube in which the vacuum is very high.

In this type of tube when the current is passing correctly, fluorescence of the half of the bulb opposite the reflector is observed—this being generally apple-green in colour, as the tube is made of soda-glass, but varying if other ingredients are used. If this half be not distinctly marked, and fluorescence at other parts be more evident, probably the negative and positive poles are not connected to the corresponding poles on the coil, and the current should be reversed or the tube turned round. With the tube now in position and fixed on a stand, the ray effects can be tested either by the fluorescent screen or the photographic plate.

COOLIDGE TUBE. — The standard Coolidge tube consists of a bulb 7 in. in diameter with the usual hot cathode consisting of a spiral wire, heated by a current of 3 to 5 amperes at about 12

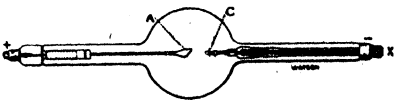


FIG. 505.—Diagram of a Coolidge X-ray tube. *A*, Anode; *C*, cathode; *X*, *X*, connections to heating circuit.

volts, supplied through a screw cap fitting at the end of the cathode neck, and an anticathode in the form of a block of tungsten. This tube is capable of withstanding heavy discharges through it.

FLUORESCENT SCREEN.—Fluorescence is produced in various substances by the action of X-rays, but the two most used are barium platinocyanide and calcium tungstate, one of which, sprinkled on cardboard, forms the fluorescent screen in common use. In a darkened room, if a hand be placed close against the screen, between it and the tube which is emitting the rays, the screen will appear brightly illuminated, except in the region where, owing to the obstruction of the rays, there is a faint shadow of the flesh, a denser shadow of the bones, and, if there be a ring on the finger, a still darker shadow from the ring. It has been stated that the ray-production varies with the condition of the vacuum, and the effect can now be carefully studied.

(1) The spark-gap varies directly with the vacuum. A movable rod runs between the terminals of the secondary coil, and gives an alternative path for the current. If the tube be very resistant, owing to a high vacuum (small residue of air), the electric discharge will prefer to spark over a space of 6 or more inches; on the other hand, if there be a low vacuum (large residue of air), it may not even spark over a space of ½ inch.

(2) The screen-shadow, when the vacuum is low, is very black, owing to the lessened penetration of the rays, and there is little differentiation of the bones

to be made out. If the vacuum is raised, this differentiation becomes more evident, until, if carried too far, the penetration may be so great that very little shadow is observable, and details of the bones are lost owing to too great penetration.

(3) A milliamperemeter, in circuit with the tube and the secondary wire, indicates the number of milliamperes passing through. This quantity varies considerably with the voltage in the primary circuit; for instance, a *hard tube* (*i.e.* one with a high vacuum) may only allow ·25 milliampere, and a soft tube (*i.e.* one with a low vacuum), as much as 3 or 4 milliamperes to pass with 20 volts, but if the voltage be raised to 80, the hard tube may allow 1 milliampere and the soft tube 5 or 6 milliamperes.

Applying the three tests to a medium tube, with pressure of 20 volts in the primary coil, we would find probably that there was an alternating spark-gap of 2 inches, that the bones of the hand threw clear, black shadows on the screen, and that about 1·5 milliamperes were passing through.

After X-ray tubes of the gas type have been worked for some time, they tend to get harder, although, with high voltages, they may become temporarily softer owing to heating of the anode. The explanation of this hardening is that the residual air accumulates on the anode, and many devices are used to prevent it. Heating the tube does well as a temporary measure, but rest for a month or so is more satisfactory. Many ingenious arrangements are also in use, which, up to a certain point, are successful, and of these the chief are side tubes containing a chemical salt, which, when heated, gives off gas, or mica, which, when heated by the current, gives off absorbed air.

To counteract the heating of the anode, it is often made of thick metal, or has a water-cooled tube behind it.

Radiography.—X-rays act on a sensitised photographic plate in the same manner as ordinary light, but, as they penetrate paper, the exposure can be made in daylight by enclosing the plate in a black paper envelope, through which the daylight cannot pass. It must be remembered that the X-ray photograph differs from a photograph taken by ordinary light in that it is really a shadow-picture or skiagram. A skiagram differs from an ordinary photograph in that no lens is used; the X-rays pass in parallel lines from the focus spot on the anticathode. X-rays cannot be focused upon the object as in ordinary photography for the above reason. Briefly, in order to obtain a skiagram, the method is as follows. The plate—a rapid one—is placed first in a yellow envelope, this again in a black one, the whole being placed close beneath the part to be photographed. The tube is situated directly opposite, with the limb or other object to be photographed a little distance off, but between the tube and the plate. The tube must be arranged so that the rays fall as perpendicularly as possible on to the part, careful centering by a plumb-line and weight being used where suitable. The distance of the tube from the object and the duration of exposure are matters of experience; but the farther apart they are, the less chance there is of distortion. At two metres or more the amount of distortion is practically negligible; so that when working at that distance between the anticathode of the tube and the surface of the film or plate, the actual size of an organ within the body can be measured. This is taken advantage of in cardiac examinations when measurements of the size of the heart can be obtained, an important point in practical medicine.

In order to show the position, shape, etc., of the stomach and intestine, some opaque but harmless material, such as carbonate of bismuth or sulphate of barium, is administered by the mouth. This throws a dense shadow, corresponding to the interior of the organ examined, upon the screen or photographic plate. For examination of the lungs, gall-bladder, etc., other opaque substances, such as harmless compounds of iodine, are injected so as to pass into their interior.

For examination of other organs, such as the brain and abdominal organs, oxygen is sometimes injected into the cavities in the brain or the peritoneal cavity so as to render the outlines sharper when an X-ray photograph is taken.

THE EXPOSURE IN RADIOGRAPHY.—

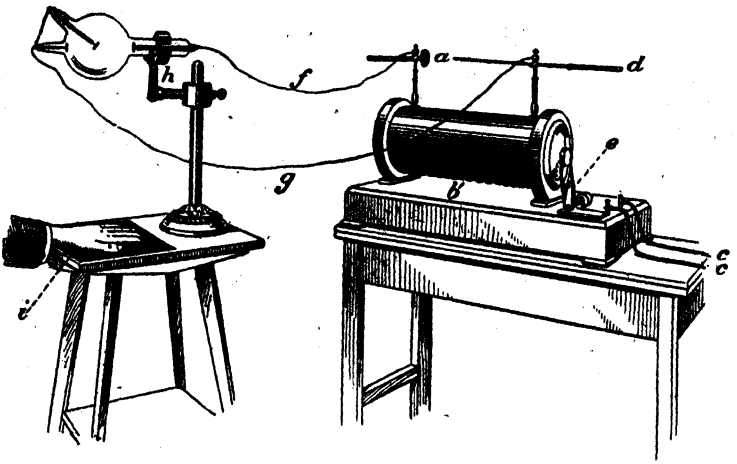


FIG. 506.—Apparatus of some thirty years ago for making an X-ray photograph, or for exposing a part of the skin to the action of the rays. *a*, Spark gap; *b*, coil; *cc*, wires bringing current from the source of supply; *d*, movable rods for increasing width of spark gap; *e*, handle for closing primary circuit and starting the apparatus; *f*, *g*, wires connecting ends of secondary circuit through the vacuum tube; *h*, support carrying the vacuum tube; *i*, photographic plate in black paper envelope placed under the part to be photographed. For the purpose of a clear demonstration of the apparatus the tube is shown in the open. In radiological practice the tube is always enclosed in a chamber the walls of which contain lead or other X-ray proof material; this is necessary if the operator is to avoid the disastrous effects of X-rays upon the skin and other structures of the body.

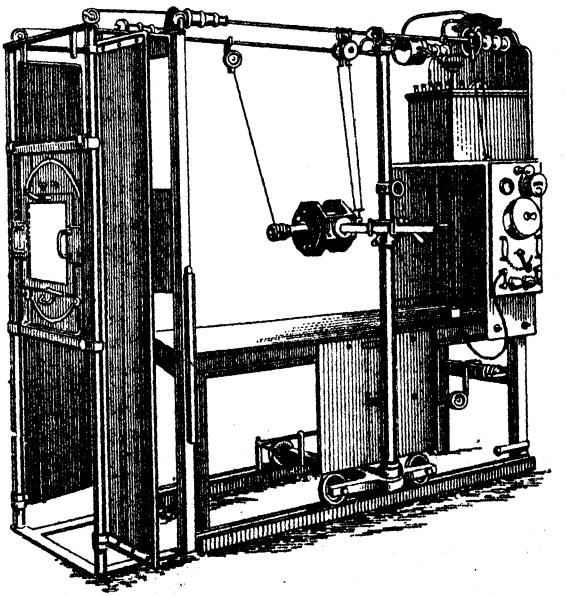


Fig. 507.—A modern X-ray installation with movable screen on stand for examining the patient upright, and couch for recumbent position. The tube is well encased in a protective holder.

The nearer we can get to an instantaneous exposure, the clearer is the outline, especially when we are dealing with the abdomen or thorax. In the early days, very long exposures were required because of the very low currents available and the imperfect development of the X-ray tube. At the present time it is possible to get exposures in as short a time as $\frac{1}{100}$ of a second through the thickness of the body of an average patient. Pictures obtained in this way are of great value in diagnosis.

Amongst other uses for X-rays in diagnosis attention must be called to the localisation of foreign bodies in various parts of the body. For this purpose localisers of various patterns and arrangements for taking stereoscopic photographs have been devised. These are of great importance in surgery for the purpose of fixing the position of foreign bodies, like steel chips in the eye or bullets in the body, and also give valuable aid in determining the nature and position of fractures and other injuries of the bones.

Recently, accelerating screens made of cardboard covered with fluorescent material have come into use. This screen is placed in contact with the photographic plate. Being caused to glow, where the light falls upon it, the screen still affects the plate after the exposure is over. When the apparatus is not powerful enough to give very short exposures the accelerating screens are used. In this way an instantaneous photograph can be made in $\frac{1}{100}$ second or less from a distance of several feet. Thus the beating heart or the contractions of the stomach in digestion can be taken in a series of flashes and demonstrated on a cinematograph film.

Radiotherapy or treatment by X-rays.—X-rays are being used more extensively in treatment, so much so that there are not many diseases in which the method has not been tried. The development of X-ray apparatus to carry out the elaborate technique required for diseases, particularly of a malignant nature, has been progressively steady. Coils are used as well as high-tension transformers. The latest oil equipment generates currents of very high potential, up to 300,000 volts. Powerful X-ray tubes with water cooling devices are necessary to withstand the very high potential current. With such equipment it is possible to run the apparatus for several hours continuously, or with very short intervals between the exposures.

Radium gamma-rays are equal to a potential estimated at between one and two million volts. Physicists are assured that X-ray apparatus can be manufactured which would give such a high potential, but up to the present only voltages up to 300,000 have been actually tried in treatment. The use of these very high voltages has led to the development of a highly specialised technique which has been devised for the treatment of cancer and like diseases.

Like the photographic effect, the therapeutic effects were discovered almost accidentally—it being observed that prolonged exposures to the rays caused inflammation, and even ulceration of the skin, and further, that they caused loss of hair, and that they improved various diseased conditions. Repeated exposures, for example, of the hands of physicians using this method of treatment, have been observed to produce permanent baldness, pigmentation of the skin, excessive growth of its horny layer, and even epithelioma. X-rays are particularly hurtful to the testes and ovaries of young persons; and when these are exposed to the rays repeatedly, the genital glands must be covered by sheet-lead or some such protection, lest sterility result. Too severe a reaction to the irritating effect of the rays upon the patient's skin at a single sitting must also be avoided. It is important to protect the surrounding areas, and this is done by the use of masks of sheet-lead, with a hole cut out over the affected area, and by enclosing the tube in a metal-lined box, with an opening opposite the affected spot. By the last-mentioned means, as well as by wearing lead-lined gloves, and by frequently anointing the skin with some simple ointment, persons constantly applying the rays are effectually protected.

Nævus, warts, cheloid, chronic eczema, epithelioma are all benefited, and in many cases cured, by this procedure. Of recent years, inoperable tumors, such as cancer, have been successfully treated by exposure to rays from very hard tubes. An extraordinary diminu-

tion in size of the tumor frequently results with healing of the skin even after extensive ulceration has occurred, and life may thus be prolonged for many years. Simple tumors, *e.g.* fibroids of the uterus, as well as inoperable malignant tumors of the abdomen, may also be greatly diminished in size by this method. For this purpose, special apparatus has been introduced, providing 'deep-penetration' X-rays by means of very high voltage current, and working in such a way as to cause little damage of superficial parts.

In simple conditions, particularly superficial ones, the X-rays have been used very successfully; for example, in order to remove the diseased hairs in ringworm and favus of the scalp. The duration of the single exposure may be measured by a pastille of alkaline salt (Sabouraud and Noire or Holtznecht's), which changes its colour to a recognised tint after a certain length of exposure. Kienböck is responsible for the introduction of a photographic method in which strips of sensitised paper are subjected to the rays; when these are developed a degree of darkening is seen. This can be graded to a standard colour and used as a measure of the exposure. In about three weeks after the exposure the hair falls out, and with it the fungus, while the scalp is kept clean by antiseptic lotions and ointments till fresh unaffected hair grows in. Unsightly hairs upon the face or other parts are treated similarly.

Leucocythæmia and other conditions, in which the spleen is enlarged, are often greatly benefited by exposure of the spleen or long bones to X-rays or radium.

Amongst general diseases, rheumatism, locomotor ataxia, and tuberculosis of glands and joints have been treated by the application of the X-rays, although in general these diseases yield more readily and more satisfactorily to other methods. Still the place of X-rays, as one of the most powerful adjuncts to modern therapeutics, must be definitely granted.

XANTHOMA, also known as XANTHELASMA and VITILIGOIDEA, is a rare skin disease in which yellow plates form in the surface of the skin, especially on the eyelids.

XERODERMA (ξηρός, dry; δέρμα, skin) is the name applied to a rough, dry condition of the skin accompanied by the copious formation of scales.

XEROFORM is a substance composed of bromine, carbolic acid, and bismuth, and sometimes used as a substitute for iodoform in surgical dressings.

XEROPHTHALMIA. — A dry thickened state of the conjunctiva associated with chronic conjunctivitis as a result of deficiency of vitamin A in the diet.

XEROSIS (ξηρός, dry) means abnormal dryness, especially of the eye.

XIPHISTERNUM, or XIPHOID CARTILAGE, is the lowest part of the breastbone lying among the abdominal muscles.

Y

YATREN is an organic compound of iodine. It is a yellow powder and is used as an intestinal antiseptic, especially in treatment of dysentery, in doses of 15 grains.

YAWS (*see* FRAMBŒSIA).

YEAST is a ferment consisting of *Saccharomyces cerevisiæ* obtained in the brewing of beer, making of bread, etc. It may be used in its natural form as a remedy, of which a tablespoonful or thereabout is stirred up in milk or water. It can also be obtained in a dry powder, of which a teaspoonful is similarly taken. Its value as a medicine is supposed to lie partly in the fact that it contains a large amount of vitamin B, and partly because it has a large amount of nucleic acid. The latter substance is believed to stimulate the formation of white blood-cells, and therefore to help to defend the body against micro-organisms. It is, accordingly, much used internally in the treatment of boils, also as an application to ulcers, and occasionally in typhoid fever and other infective conditions.

YELLOW FEVER, also known as YELLOW JACK and VOMITO AMARILLI, is an acute disease of certain tropical localities, characterised by fever and jaundice.

Distribution. — The disease has a curious geographical limitation. It is endemic in the West Indies, some parts of the Spanish Main, such as at Vera Cruz and Rio de Janeiro, and in West Africa. From these parts it occasionally spreads in epidemics to neighbouring regions. In 1793 a very serious epidemic spread over the Northern United States, and, in Philadelphia alone, over 10 per cent of the total population were swept off in the course of four months. Numerous other epidemics invaded the States in the end of the eighteenth and during the course of the nineteenth centuries, the last severe one taking place in 1878. In Europe the disease has from time to time invaded some of the Portuguese and Spanish ports, but it has never gained any permanent hold. When cases of yellow fever arrive at British or other northern European ports, no spread of the disease takes place. It is also quite unknown in the Far East.

Causes.—Every person sick of yellow fever becomes a centre for the spread of infection. Much was done by the U.S. Army Commission to determine the nature of the poison. It exists undoubtedly in the blood of yellow-fever patients during the first three days of the fever, is carried in general from one case to another by the bite of the *Stegomyia calopus* mosquito, and is of so minute a size that it can pass through the pores of some fine unglazed porcelain filters, and is invisible with the most powerful microscope constructed. The nature of the poison and its method of spread were discovered by performing experiments upon persons who submitted voluntarily to be bitten by infected mosquitoes, and the name of Lazear, who died from yellow fever following the experimental bite of an infected mosquito, deserves to be recorded in this connection. It appears, like the malaria parasite, to go through some phase of its development in the body of the mosquito, though the blood of one yellow-fever patient is also directly infectious to another.

Apart from the direct cause, many factors are of known importance in assisting to spread the disease or to render it more severe. Thus all epidemics take place during the hot season, and it is much more dangerous for a susceptible person to visit some centre of yellow fever during the hot months than during the cooler ones. Further, a threatened epidemic is sometimes cut short by a spell of cool weather or by heavy rains. The disease is usually limited to the sea coast and to the sides of swampy rivers, and seldom rises above an altitude of 1000 feet. No race or age is exempt, although negroes are believed to be rather more seldom attacked than white men. A slight attack of yellow fever, however, and even prolonged residence in an infected district, is believed to confer a considerable degree of immunity from further attack.

Symptoms. — Different cases vary greatly in severity, but the disease is

apt to be especially serious during the prevalence of an epidemic, or when it affects persons newly arrived from healthier parts.

Two stages are usually described in a severe case. The *first stage* begins suddenly with headache, chill, pains in the back and limbs, and rise of temperature. Vomiting also comes on, the tongue is furred, and the bowels are constipated. A very important point is that the urine decreases in amount, and, if tested, is found to contain albumin, the result of inflammation of the kidneys. The degree in which these signs are present forms a valuable indication of the severity of the case and of the need for special treatment. These symptoms last for about three days and then sometimes abate to some extent and the patient appears better.

The *second stage* begins usually about the fourth day. The patient now becomes very weak and the 'black vomit' comes on. This consists in bringing up constantly from the stomach a clear fluid containing black flakes formed of blood that has been acted upon by the gastric juice. Although this black vomit is regarded as an alarming sign, it is by no means an index that the patient is sure to die. Jaundice also appears with the second stage, and is the symptom to which the disease owes its name. Usually it amounts only to a pale yellow discoloration of the skin, but it may even become mahogany brown in hue, and small hæmorrhages under the skin and mucous membranes are also common. In fatal cases examined after death, the principal changes found are fatty degeneration of the liver, acute inflammation of the kidneys, and an inflamed and congested state of the stomach, which contains some of the black fluid mentioned above.

Treatment. — PREVENTIVE TREATMENT is important, and consists of quarantine for persons arriving from an infected locality till the incubation stage of the disease (eight days) is passed; the sick must be kept for the first three days of illness in rooms protected by mosquito-netting, so that they may not infect mosquitoes which would pass on the disease to healthy persons. Uninfected persons should sleep in mosquito-proof houses, but it may be noted that for some hours in the middle of the day, when mosquitoes are quiescent, infected places are safe. The same general measures as in the case of malaria should be taken against mosquitoes. A yellow fever vaccine now affords considerable protection against this disease.

CURATIVE TREATMENT must be directed towards checking symptoms as they arise. Vomiting is allayed by sucking ice or sipping iced water, and by the administration of dilute hydrocyanic acid in doses of two drops in water. Food should be, to a great extent, withheld in the early stage, though the patient may have plenty of water in small draughts. Later on, the only food should be milk, thin soups, and similar liquid nourishment. When the patient is greatly prostrated, alcohol must be given, and, of this, champagne is the most approved form. The high temperature, which sometimes shows itself, is relieved by sponging or by the wet pack. One of the most important symptoms to treat is stoppage of the urine, and for this hot-air baths are employed, as in acute Bright's disease.

YOGHURT is the name applied to curdled milk prepared with the Bulgarian bacillus producing lactic acid. It is believed that it is possible, by introducing this bacillus in a living state into the bowels, to destroy harmful bacteria and prevent intestinal putrefaction.

YOHIMBINE is an alkaloid obtained from the bark of *Pausinystalia yohimba*, which is frequently used as an aphrodisiac.

Z

ZANDER APPARATUS is a collection of machines devised by J. G. W. Zander, a Swedish physician, for permitting within the limits of a gymnasium of various active forms of exercise usually attainable only out of doors. It includes devices for exercising the muscles employed in rowing, those used in bicycling, horseback riding, etc., as well as apparatus for moving individual joints and so increasing their suppleness after injury or disease.

ZINC is a metal of which several salts are used in medicine for external application. Its salts fall into two classes: soluble and insoluble. The important soluble salts are the acetate of zinc, sulphate of zinc, and chloride of zinc, of which the first two, in a concentrated form, are powerfully irritating, while the third corrodes any tissues with which it comes in contact. All, and especially the chloride, are powerful antiseptics. The insoluble salts that are of importance are the oxide and carbonate, which have simply an astringent action.

Uses.—The acetate or the sulphate of zinc is much used in the strength of about 2 grains to each ounce of water, to form a lotion for inflammation of the eyes or an astringent douche. The chloride of zinc forms the basis of Sir W. Burnett's disinfectant solution. It was formerly used either dissolved in its own weight of water to form a liquor, or made up with flour into a paste, as a caustic for destroying foul ulcers or cancers whose removal by excision was, for some reason, impossible.

Oxide of zinc, stearate of zinc, and carbonate of zinc are made up in dusting powders, in ointments, or suspended in water as lotions for the astringent action they exert upon abraded surfaces of the skin.

Internally, oxide of zinc is frequently administered in pills designed to exert an astringent action on the bowels. Sulphate of zinc, administered in doses of 20 grains in water, forms a valuable emetic.

ZONA and ZOSTER (*ζώνη*, *ζωστήρ*, a girdle) are two names for the eruption popularly known as shingles. (*See* HERPES.)

ZYGOMA (*ζύγωμα*) is the name given to a bridge of bone formed by the union of a process from the temporal bone with one from the malar bone. It lies in the region of the temple, gives attachment to the powerful masseter muscle which moves the lower jaw, and forms a protection to the side of the head.

ZYMOTIC DISEASES (*ζύμη*, ferment) is a term in medicine applied by some authorities to the class of acute infectious maladies. As originally employed by Dr. Farr of the British Registrar-General's department, the term included the diseases which were 'epidemic, endemic, and contagious', and owed their origin to the presence of some morbific principle in the system acting in a manner analogous to, although not identical with, the process of fermentation. A very large number of diseases were accordingly included under this designation. The term, however, has come to be restricted in medical nomenclature to the chief fevers and contagious diseases (*e.g.* typhus and typhoid fevers, smallpox, scarlet fever, measles, erysipelas, cholera, whooping-cough, diphtheria, etc.), but is not much used nowadays on account of the theory which it suggests.

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