11. *Physiological Classes of Medicines.*

In order to prevent repetition in the subsequent parts of this work, I have thought it necessary to make a few general observations on some of the more important and generally admitted physiological classes of medicines.

Class 1. Cerebro-Spinants.—I have considered it best to include in one class all those agents whose primary and specific effect is a disorder of one or more of the functions of the cerebro-spinal system (the cerebral and true spinal systems of Dr. M. Hall). To this class, therefore, are referred all those substances which occasion sleep, insensibility, erroneous perceptions, judgments, and volitions, or delirium, sopor or coma, paralysis, convulsion, &c.

Some of them produce very slight local effects, as opium; others occasion numbness and tingling, as aconite; conia causes local paralysis, the substances termed by toxicologists acro-narcotics or narcotico-acrids (as squills, tobacco, foxglove, &c.) when swallowed, occasion inflammation of the gastro-intestinal tube; alcohol, the preparations of arsenic, of copper, of zinc, of bismuth, and of silver, act as powerful local irritants or caustics.

The cerebro-spinants may be thrown into groups or orders founded on their effects:—

a. The *first group* includes those cerebro-spinants which occasion *tetanic convulsions*, and which have, in consequence, been termed *tetanics*. Here belong strychnia and brucia, and all substances containing one or both of these alkaloids, as the seeds of *Strychnos Nux vomica;* the bark of this plant (commonly termed false Angustura bark); St. Ignatius's bean; snake-wood (*lignum colubrinum*); and the *Upas Tieuté* poison; to which probably ought to be added the celebrated Tanghin poison. The substances of this order are principally employed in certain torpid or paralytic conditions of the muscular system, under regulations which will hereafter be pointed out.

b. The *second group* is made up of those cerebro-spinants which produce *paralysis of the muscles*, and is principally composed of conia, an alkaloid obtained from hemlock, whose physiological effects would point it out as the remedy for tetanus, and as the counter-poison for strychnia and brucia, and for the substances containing these alkaloids.

c. The *third group* includes those agents which occasion *paralysis of the sentient nerves*. Aconite or monkshood belongs to this group. It is the remedy, therefore, for neuralgia.

d. The *fourth group* is made up of those agents which, in large doses, occasion sudden loss of sensation and consciousness, with violent convulsions; in other words, an *epileptic paroxysm*. It includes hydrocyanic acid, the cyanurets of zinc and potassium, the bitter almond and its volatile oil, and the cherry-laurel and its distilled water. In a concentrated form, and in large doses, hydrocyanic acid sometimes occasions death without convulsions. This order contains the poisons which are the most rapidly fatal of any known. The similarity between the effects of large doses of hydrocyanic acid and an epileptic paroxysm are deserving of especial attention: moreover, we ought not to lose sight of the fact that a condition precisely analogous to, if not identical with, this state, is frequently produced by a large blood-letting. As therapeutic agents, the

substances of this group are valuable in certain painful affections of the alimentary canal (of the stomach especially) unaccompanied by inflammation.

d. The *fourth group* includes those cerebro-spinants which occasion *sleep* or *stupefaction*, and, when given in large quantities, *apoplexy*. They are the *narcotics properly so called*. The most important is opium, to which perhaps may be added henbane and lactucarium. In small doses they frequently cause excitement; in larger ones they diminish the contractility of the muscular fibre, or even occasion actual paralysis, lessen the sensibility of the body generally, and give rise to sleep or stupor. The apoplectic condition caused by the use of poisonous doses of opium has been denominated *narcotism*. In this state the pupils are usually contracted. The uses of this group may be inferred from its effects. In small doses opium is employed as a stimulant: in larger doses opium, henbane, and lactucarium, are employed to relieve pain, in which case they are denominated *anodynes* (from *α*, *privitive*, and *ὀδύνη*, *pain*) or *paregorics* (from *παρηγορέω*, *to soothe* or *alleviate*); they are also used to diminish inordinate muscular contraction (convulsion or spasm) when they are termed *antispasmodics;* and, lastly, to procure sleep, when they are called *hypnotics* (*ὑπνοτικος*, from *ὕπνος*, *sleep*) or *soporifics* (from *sopor*, a *deep sleep*, and *facio*, *I make*.)

e. The *fifth group* is closely allied to the fourth, from which perhaps it ought not to be separated. It includes those agents which cause *inebriation*, followed by *sleep* and *stupefaction*, and, when large doses have been swallowed, *apoplexy*. This group, therefore, has been denominated *inebriants* or *intoxicants*. It contains alcohol, wine, and ether. These agents are remarkable for their great exciting properties, as well as for the peculiar delirium which they occasion, by both of which effects they are principally distinguished from the preceding group. By long-continued use, alcohol occasions the disease termed *delirium tremens*, and which is characterized by wakefulness, delirium, and tremor. Inebriants are used in medicine on account of their stimulant qualities.

Musk, valerian, and some other substances usually denominated *nervines*, though closely related to this group, may with more propriety be noticed under the head of stimulants.

f. The *sixth group* is a provisional one to contain belladonna and perhaps stramonium, the mode of operation of both of which substances is less perfectly understood than of some of the before-mentioned medicaments. The first of these causes dilatation of the pupil, obscurity of vision, dryness of the throat, difficult or impossible deglutition, aphonia or difficulty of articulation, faintings, and delirium, followed by sopor or lethargy: convulsions are rare. Laennec (*Dr. Forbes's Translation*, p. 77, 1827) says that it relieves dyspnœa by diminishing the necessity for respiration. In a case related by my friend Dr. T. Davies (*Lectures on Diseases of the Lungs and Heart*, p. 496) a plaster of belladonna applied to the abraded skin cured a severe form of angina pectoris. Oculists employ belladonna to dilate the pupil.

g. The *seventh group* includes tobacco and foxglove, both of which are remarkable for their depressing influence on the circulating organs, in consequence of which they are denominated *sedatives*. When taken internally, in large doses, they give rise to nausea, vomiting, giddiness,

feebleness and irregularity of pulse, faintings, convulsions, and insensibility. Tobacco is remarkable for producing excessive feebleness of the muscular system. Foxglove sometimes causes salivation. Both substances have been employed to reduce the frequency and force of the heart's action, and to cause diuresis; tobacco has been used as a purgative in hernia and intus-susception.

h. The *eighth group* contains certain metallic preparations which act specifically on the nervous system, such as the preparations of arsenic, bismuth, copper, silver, and zinc. Their local action is irritant or caustic. Their influence over the cerebro-spinal system is shown by their remedial power in some disorders of this system, as epilepsy and chorea (in consequence of which they have been termed *antispasmodics*), and by the giddiness, cramps or convulsions, paralysis, coma, &c. when taken in poisonous quantities. In small doses they are considered to act as *tonics*, principally on account of their beneficial agency in periodical diseases, especially ague. This group corresponds very nearly to that called by Vogt, *nervino-alterantia*.

i. The *ninth group* contains the plumbeous preparations, which are remarkable for producing colic and paralysis. These compounds are usually called *astringents*.

k. The *tenth group* is formed to include mercurial compounds, which by long-continued action in small quantities, cause a convulsive movement of the muscles (*tremor mercurialis*) as in chorea.

Notwithstanding the numerous groups or subdivisions of the class cerebro-spinants, which I have thought it necessary to make, more probably ought to be added. If, as Dr. Hall believes, the tone of the muscular system is derived from the true spinal system, the substances called *tonics* should form a group of cerebro-spinants rather than a distinct class. Moreover, the medicines known as *antispasmodics* (such as asafœtida) ought perhaps to be placed in this class, on account of their remarkable influence in hysteria and infantile convulsions.

Cause or mode of death.—The immediate cause or mode of death from the use of cerebro-spinants is not always the same,—in some instances it is an affection of the respiratory organs, in others of the heart.

a. Paralysis of the muscles of respiration. — In some cases the respiratory muscles do not receive their proper supply of nervous energy, in consequence of which respiration is performed with increasing difficulty, until, ultimately, asphyxia is produced. This kind of death is caused by opium, and sometimes by dilute hydrocyanic acid. Before the cessation of life we observe the breathing to become laborious or even stertorous, as in cases of apoplexy; and if the body be opened immediately after death, the heart is found beating, oftentimes with considerable force and for some minutes. These are the cases in which it has been proposed to prolong life by artificial respiration until the cerebral disorder has passed off. The proposition is not supported merely by its ingeniousness and plausibility, but by experience. The following is a case in point related by Mr. Whateley, and quoted by Dr. Christison (*Treatise on Poisons*, p. 680, 3d ed.) A middle-aged man swallowed half an ounce of crude opium, and soon became lethargic. He was roused from this state by appropriate remedies, and his surgeon left him. But the poison not having been sufficiently discharged, he fell again into a state of stupor; and when the surgeon returned, he found

the face pale, cold, and deadly, the lips black, the eyelids motionless, so as to remain in any position in which they were placed, the pulse very small and irregular, and the respiration quite extinct. The chest was immediately inflated by artificial means, and when this had been persevered in for seven minutes, expiration became accompanied with a croak, which was gradually increased in strength till natural breathing was established; emetics were then given, and the patient eventually recovered. Another most interesting case of recovery, from poisoning by opium, by artificial respiration, has been detailed by Mr. Howship (*Medico-Chirurgical Transactions*, vol. xx. p. 86). I have several times restored animals apparently dead from the use of hydrocyanic acid, merely by keeping up artificial respiration, and Sir Benjamin Brodie has done the same with animals apparently killed by the oil of bitter almonds.

b. Closure of the larynx.—When an attempt is made to inspire pure carbonic acid, as well as some other gases, the larynx spasmodically closes, and death results from asphyxia. In a case of complete insensibility from intoxication related by Mr. Sampson (*Medico-Chir. Trans.* vol. xx. p. 46), the comatose state was thought to arise, not from apoplexy, "but from torpor of the brain, in consequence of that organ being imperfectly supplied with blood not duly oxygenated; for the shrill tone and extreme difficulty of respiration shewed the existence of collapse of the glottis, and imperfect transmission of air into the lungs, which might be accounted for by a paralysed state of the eighth pair of nerves and recurrent branches." Tracheotomy was performed, and with complete success: in about half an hour the respiration was regular and easy through the wound.

c. Convulsion or spasm of the respiratory muscles.—Another cause of death brought on by cerebro-spinants is spasm of the respiratory muscles, whereby the function of respiration is stopped, and asphyxia produced. We have an example of this mode of operation in death by strychnia, brucia, and the substances containing these alkaloids.

d. Paralysis of the heart.—In some instances the immediate cause of death appears to be paralysis of the heart. Thus in some cases of poisoning, the heart ceases to beat before respiration has stopped,—as when the alcoholic extract of aconite is applied to wounds in dogs. If the chest be opened, the heart does not contract as usual when irritated by a needle. Sir Benjamin Brodie says the infusion of tobacco kills dogs and cats by paralysing the heart.

In the case of poisons acting in this way, it has been proposed to stimulate the heart by slight galvanic shocks in order to avert the fatal termination. Even acupuncture has been advised, if the patient appeared *in articulo mortis*. Bretonneau (*Bayle, Travaux Thérapeutiques*, t. i. p. 432) has repeatedly punctured the brain, heart, lungs, and stomach of young dogs, without the least inconvenience; and Carraro (*Expériences sur des animaux asphyxiés et ramenés à la vie par l'acupuncture du cœur*, in Bayle, *op. cit.* t. i. p. 495) has successfully tried this practice on a imals in a state of asphyxia.

Seat and nature of the action of cerebro-spinants.—Those cerebro-spinants which, by their primary action, occasion lesions of the mental functions, of sensibility, and of volition or voluntary motion (such as pain or insensibility, erroneous perceptions, judgments, and volitions or deli-

rium, or a total deficiency of these faculties, or coma, or continual voluntary actions or paralysis) are presumed to act specifically on the cerebral, or sentient and voluntary system. Opium, alcohol, and aconite, may be mentioned as examples of agents acting on this part of the nervous system.

On the other hand, those cerebro-spinants which occasion convulsions or spasms affect the true spinal or excitomotory system of Dr. Hall. Thus strychnia, hydrocyanic acid, belladonna, and most of the metallic cerebro-spinants, act on this portion of the nervous system.

The precise pathological condition of the brain or spinal marrow produced by cerebro-spinants has not been satisfactorily ascertained. Some of them (as opium) give rise to a congested state of the cerebral vessels, but this may be a secondary effect.

Active principles.—The active principles of each of the cerebro-spinants will be examined separately in a subsequent part of this work; but as several of the vegetables of this group owe their activity to alkaloids, it will be useful to point out here the general properties of these bodies.

The *vegetable* or *organic alkalies*, or the *alkaloids*, have only been recognised during the present century. They are salifiable and inflammable compounds of carbon, hydrogen, nitrogen, and oxygen. Most of them are solid, inodorous, and crystallizable, but conia is odorous and liquid at ordinary temperatures. They are usually fixed; but some of them, as cinchonia and daturia, are volatile at elevated temperatures. They react on vegetable colours as alkalies, and unite with acids, to form salts; but their saturating power is very low, that is, their atomic weights are very high. Each atom contains one equivalent of nitrogen. Those alkaloids which are best known are only slightly soluble in water; but, in general, they readily dissolve in hot alcohol, and frequently separate in a crystalline state from this liquid, as it cools. Their taste is bitter or acrid.

Tannic acid unites with them to form tannates, which usually are very slightly soluble only in water. Hence the infusion of galls (which contains this acid) is employed for detecting the alkaloids, and as an antidote in poisoning by them. Iodic acid, in excess, precipitates several of them; but is decomposed by morphia, iodine being set free. Concentrated nitric acid reddens morphia, strychnia, and brucia, and gives a yellow tinge to narcotine; but a green one to aricina. Bichloruret of mercury precipitates the hydrochlorates of some of these alkaloids, forming with them double salts. The sulphates, nitrates, hydrochlorates, and acetates of the alkaloids, are generally soluble in water. Ammonia and magnesia decompose these solutions, and precipitate the alkaloid.

The usual method of obtaining the vegetable alkalies is to digest and boil the substances yielding them in water, acidulated with hydrochloric acid. To the filtered liquor add ammonia, lime, or magnesia, and subsequently purify (by repeated solutions in alcohol) the precipitated alkaloid.

Raspail (*Nouveau Système de Chimie Organique*, p. 488) maintains that the alkaloids are artificial combinations of a vegetable acid (benzoic ?) and excess of ammonia, with perhaps a resinoid substance. But there are no just grounds for such a conclusion. It is, however,

deserving of notice that each atom of the alkaloid contains precisely the quantity of nitrogen which exists in one atom of ammonia.

The vegetable alkaloids act powerfully on the animal economy; but they present too much diversity in their mode of operation to allow of any general remarks being made thereon. Some are most energetic poisons; for example, strychnia and aconitina: others, which cannot be called poisonous, are powerful and valuable remedies, as quinia.

Class 2. Stimulants, Incitants, or Excitants.—An agent which increases the vital activity of an organ is termed a *stimulant* (from *stimulus*, a *goad* or *spur*), or sometimes an *incitant* (from *incito*, to *incite* or *spur on*), or *excitant*. Those which affect all the organs or functions of the system are termed *general stimulants;* while others, which influence one or two organs only, are called *special stimulants*. Those which excite the parts to which they are applied are frequently denominated *local stimulants*, or *irritants;* though the term local is used by Murray (*System of Materia Medica*) to indicate the substances which I have here termed special stimulants.

The vital or vivifying stimuli (a certain degree of external heat, atmospheric air, water, and nutriment) are to be distinguished from the agents used in medicine under the name of stimulants. The former are essential to vitality: they renovate the tissues, by entering, in a manner indispensable to life, into their composition; and, lastly, their continued action does not give rise to exhaustion. The latter, on the other hand, are not necessary to life: they have no renovating action; but, by causing reaction, give rise to exhaustion. Moreover, the so-called stimulants do not merely excite; most of them act as alteratives, and many of them, by long-continued use, or by employment in too large quantities, destroy life.

Stimulants, for the most part, produce their effects by the agency of the nervous system (*i. e.* the true spinal and ganglionic systems), and probably in a considerable number of instances by a reflex action. Many of them become absorbed, and have been recognised in the blood and secretions.

Stimulants are closely related to some other classes, especially to cerebro-spinants, tonics, and some of the evacuants. Thus, alcohol and ether are at the same time stimulant and narcotic; myrrh, cascarilla, and the ferruginous compounds, possess both stimulant and tonic qualities; lastly, several of the stimulants are sudorific, diuretic, emmenagogue, &c.

Most stimulants are odorous,—many of them indeed powerfully so. Their taste is warm, acrid, and pungent. Swallowed in moderate quantities, they give rise to a sensation of warmth in the stomach, expel gaseous matters, and assist digestion. In larger quantities, they excite thirst, and often give rise to nausea or vomiting. Many of them increase the force and frequency of the heart's action, and promote the warmth of the surface of the body.

They may be arranged in groups, founded in part on their chemical composition, and in part also on their effects.

a. The *first group* is one which was termed by the late Dr. Duncan (*Supplement to the Edinburgh Dispensatory*, p. 229), *volatile pungent stimuli*. It includes the officinal substances belonging to the order *Cruciferæ* (such as mustard and horse-radish) and certain bodies of *Liliaceæ* (garlic, the onion, and the leek). These substances contain a

volatile acrid principle (oil) which renders them local irritants. Several of them are employed as condiments. In medicine, we use mustard as a rubefacient and emetic; horse-radish as a masticatory; and garlic as a stimulating expectorant. From their beneficial effects in scurvy, the substances of this group have been denominated *antiscorbutics*.

b. The *second group* contains the aromatic plants of the family *Labiatæ*, several of which are used in cookery under the name of *sweet* or *savoury herbs*, and the carminative fruit of several umbelliferous plants. Volatile oil is the active principle of the whole group. In the labiate plants this resides in small receptacles in the leaves, while in the umbelliferous fruit it is contained in clavate vessels called *vittæ*, situated in the pericarpial coat. Cooks employ some of the substances of this group to form seasoning for certain kinds of dishes or meats. The liqueur-maker uses some of them for flavouring his cordials. In medicine we employ them principally as flavouring or carminative substances. Thus they are added to many other medicaments, the unpleasant odour or taste of which they are intended to cover, and whose nauseating properties they check. They are also useful in flatulency, and in spasmodic affections of the alimentary canal, especially the flatulent colic of children.

c. The *third group* consists of the substances called *spices* (*aromata*.) These are the products of warm climates, as the Molucca or Spice Islands, Ceylon, the West Indies, &c., and are obtained from the orders *Scitamineæ*, *Lauraceæ*, *Myrtaceæ*, *Piperaceæ*, *Myristaceæ*, &c. They owe their strong and grateful odour and taste principally to an acrid volatile oil. When applied to the skin, some of them (as pepper) act as powerful acrids, and excite local inflammation. Taken internally, in moderate quantities, they stimulate the stomach, create a sensation of warmth in this viscus, and promote digestion and assimilation. In larger quantities they occasion thirst, increase the fulness of and accelerate the pulse, and produce a febrile condition of body. In doses of two drachms, nutmegs have acted as narcotics.

Spices are distinguished from the last group of stimulants by their more agreeable flavour, by their greater acridity, by their less tendency to occasion nausea, and by their more powerful agency in promoting the assimilation of substances reputed difficult of digestion. Both groups, however, yield condiments.

In domestic economy spices are employed, partly for their agreeable flavour, and partly to promote the digestion of those kinds of food which, experience has shown, are not by themselves easily or readily digested.

In medicine they are used as flavouring ingredients, as carminatives, as antispasmodics, and as cordials or stimulants. Thus they are added to other medicines to correct their nauseous flavour, or their griping qualities. They are given to relieve flatulency and cramp at the stomach; to assist digestion in enfeebled or relaxed habits; to allay griping pains of the bowels, and to check purging in some mild forms of diarrhœa. Some of them (pepper and ginger) are applied to the skin as rubefacients, or are chewed as masticatories. Pepper has been successfully employed in intermittents, cubebs in gonorrhœa. The volatile oil of some of the spices (as of cloves or allspice) is occasionally placed in the hollow of a carious tooth to allay tooth-ache.

On account of their acrid and heating properties, spices are objectionable in inflammatory conditions of the alimentary canal, and in febrile conditions of system.

d. The *fourth group* includes four sub-groups formed respectively by the *solid resins*, the *oleo-resins*, the *balsams*, and the *fœtid gum-resins*. As these differ not only in their chemical composition, but also to a certain extent in their effects and uses, they will require separate examinations. But being so closely related to each other, they could not, with propriety, be formed into distinct groups.

α. Resins (*resinæ*).—Under this head I include elemi, mastic, and guaiacum, obtained respectively from the orders *Burseraceæ*, *Anacardiaceæ*, and *Rutaceæ*. They exude either spontaneously or from incisions made into the stems of the plants yielding them. Common resin obtained as a residue in the distillation of the turpentines, may, in regard to its chemical and medicinal qualities, be placed in the same sub-group with the natural resins. These bodies agree in the following properties:—They are fusible and inflammable, and consist of resin principally combined with a small quantity of volatile oil: they are insoluble in water, but dissolve either completely, or nearly so, in alcohol, ether, and volatile oils: they combine with alkalies, saturating them as weak acids. Their local action is irritant: applied to the skin they act as rubefacients, and when swallowed in large doses, produce heat of stomach, nausea, vomiting, or even purging. Their constitutional effects are those of stimulants. Thus they occasion thirst, quicken the pulse, raise the temperature of the surface, and promote the secretions, especially of the skin and kidneys. Elemi and mastic are rarely employed in medicine: their effects are analogous to the turpentines, but much milder. Guaiacum is used as a stimulant and sudorific.

β. Oleo-resins (*oleo-resinæ; liquid resins; balsams devoid of benzoic acid; terebinthinates*).—These are oleo-resinous, semi-liquid, or glutinous juices, which flow spontaneously, or by incisions, from various vegetables, especially those belonging to the orders *Coniferæ*, *Burseraceæ*, *Anacardiaceæ*, and *Amyridaceæ*. Their liquidity or semi-liquidity, their odour, and most of their medicinal activity, are owing to the volatile oil which they contain, and which may be procured from them by distillation. From the true balsams they are distinguished by the want of benzoic acid. They have a strong odour, which, in some, is very fragrant,—in others, so peculiar as to be taken as the type of certain odours under the name of terebinthinate. Those oleo-resins, employed in medicines, are the turpentines, copaiva, and opobalsamum (commonly termed Mecca balsam). Their taste is hot and acrid. They are all local irritants, causing rubefaction when applied to the skin; and some of them giving rise to active inflammation. When swallowed they occasion more or less irritation of the alimentary canal, according to the dose in which they are taken; the symptoms being epigastric heat, loss of appetite, nausea, or even vomiting; and, sometimes, when the quantity swallowed is large, griping or purging.

The constitutional effects are thirst, dryness of the mucous membranes, increased frequency and fulness of pulse, and great heat of skin, frequently accompanied with sweating. The oleo-resins exercise a stimulant influence over the urinary organs, which is manifested by uneasiness in the region of the kidneys, increased desire of passing the urine, heat

in the urethra, and sometimes strangury and bloody urine. Under the influence even of small doses of the oleo-resins the urine acquires a remarkable odour; and when any of the turpentines have been taken, it is that of violets. The mucous membranes generally are stimulated, and have their secretions diminished by the oleo-resins. We observe this not only in the case of the urino-genital mucous membrane, but also in the membrane lining the air-passages. By the repeated use of the oleo-resins an eruption sometimes appears on the skin. In large doses oil of turpentine causes an affection of the nervous system, which will be noticed hereafter.

The oleo-resins are principally employed in medicine to modify diseases of the mucous membranes, especially that lining the urino-genital apparatus. Thus they are employed, and with great benefit, in gonorrhœa, leucorrhœa, gleet, and chronic catarrh of the bladder. In chronic pulmonary catarrhs they are sometimes advantageously employed. Oil of turpentine has been used in neuralgia, against tape worm, in puerperal peritonitis, and in other cases which will be noticed when speaking of that substance in a subsequent part of this work.

γ. *Balsams* (*balsama naturalia: balsams containing benzoic acid*).—The term balsam was formerly applied to all liquid vegetable resins, as well as to many pharmaceutical preparations. But to avoid confusion, the French chemists confine the term balsam to vegetable substances composed of resin and benzoic acid, with more or less volatile oil. The objection to this is, that the substances usually and popularly known by the name of copaiva and Mecca *balsams* are, therefore, excluded from the list of balsams. Hence most of the German chemists retain the old acceptation of the term, and divide balsams into those which do, and those which do not, contain this acid.

Balsams (under which term I include those only which contain benzoic acid) are solid, soft, or liquid substances, according to the quantity of volatile oil which they contain: they have an aromatic, usually agreeable, odour, and a warm, acrid taste. They dissolve in alcohol; and the solution, when mixed with water, becomes milky, owing to the deposition of resin. By sublimation, as well as by other methods, they yield benzoic acid.

Those employed in medicine are benzoin, styrax, tolu, Peruvian balsam, and liquidambar. They are obtained from the orders *Styraceæ*, *Amyridaceæ*, *Balsamaceæ*. They owe the principal part of their medicinal activity to the contained benzoic acid. The liquid balsams (of styrax and Peru) are sometimes applied to chronic indolent ulcers, to allay pain, to improve the quality of the secreted matter (*detergents*), and to promote cicatrization (*epulotics* or *cicatrisantia*). Taken internally the balsams act as stimulants, their operation being principally directed to the mucous membrane of the air-passages; on this account they are termed expectorants, and are employed in chronic catarrhs. MM. Trousseau and Pidoux (*Traité de Thérapeutique*, t. i. p. 467) assert, from their own experience, that "there are few substances in the materia medica so powerful in combating chronic pulmonary catarrhs and old laryngeal inflammations as the balsams." In chronic inflammation of the larynx, whether accompanied or not by ulceration, balsamic fumigations are more serviceable than the internal exhibition of the balsams. The air of the patient's chamber may be impregnated with balsamic vapours by

placing a little benzoin or tolu in some live coals, and allowing the vapour to escape into the room: or the patient may inhale the vapour of boiling water to which a drachm or two of the balsams have been added.

δ. Fœtid or *antispasmodic gum-resins (gummi-resinæ fœtidæ)*. The gum-resins, usually denominated fœtid or antispasmodic, are asafœtida, ammoniacum, galbanum, sagapenum, and opoponax, all of which are obtained by incision from plants of the order *Umbelliferæ*, growing, for the most part, in Persia. They are composed principally of gum and resin, but with a small quantity of volatile oil, to which they are mainly indebted for their odour. Rubbed with water, they form a milky fluid or emulsion. They are not completely soluble in pure alcohol, though they form therewith a clear tincture, which becomes milky on the addition of water, by the precipitation of the resin as a white powder. They dissolve, however, in boiling dilute alcohol. They are likewise soluble in vinegar. Their odour is strong and remarkable; their taste warm and acrid. Applied to the skin they act as mild stimulants. Taken internally they give rise to a sensation of warmth in the stomach, and cause eructations. The odorous particles of asafœtida become absorbed, and may be recognised in the blood and secretions. The fœtid gum-resins have been principally, and most successfully, employed in hysteria, flatulent colic, spasmodic asthma, chronic bronchial affections, and in uterine disorders. From their beneficial influence in the first of these diseases, they are inferred to possess a power of specifically affecting the nervous (the true spinal) system.

Myrrh is a gum-resin procured from a plant of the order *Burseraceæ*. It does not possess the antispasmodic power of the fœtid gums, but approaches nearer to the tonics.

Olibanum is also a gum-resin obtained from the same order as myrrh. Its stimulant properties are principally directed to the mucous membranes; and, in this respect, it is analogous to the resins, or rather to the oleo-resins.

ε. The *fifth group* includes ammonia and its salts, the empyreumatic oils, phosphorus, musk, and castoreum. It is termed by Vogt (*Lehrb. d. Pharmakodyn.*) *volatile nervines* (*nervinia volatilia*). All the substances of which it is composed agree in producing a primary and specific effect on the nervous system, the energy and activity of whose functions they exalt. According to Vogt (*op. cit. Bd.* i. p. 186) the more volatile the remedy, the more it increases the *activity* of the nervous functions, and the more fixed, the more it raises their *energy*. Thus, according to the same writer, the preparations of ammonia raise the activity more than the energy of these functions; the empyreumatic oils somewhat less; musk still less; while castoreum increases the energy of the functions principally. However, I shall hereafter show that the last-mentioned remedy really possesses very little power.

These remedies act as excitants to the organs of circulation, increasing the force and frequency of the pulse, augmenting the warmth of skin, and promoting diaphoresis. On account of the latter effect they have been termed *diaphoretica calida*. Though the particles of some of them pass into the blood, yet the constitutional effects cannot be regarded, in all cases, as the result of absorption, since, in several, they occur too speedily to admit of this conclusion. And, as these effects are not always proportionate to the local irritation and pain produced, they

cannot be referred to the latter. We therefore ascribe them to their specific impressions on the nerves of the part to which they are applied.

The effects of the substances composing this group are very quickly produced, and soon disappear. Consequently these remedies are adapted to urgent and acute cases, when the danger is imminent, and an immediate effect desired: for the same reason they require to be frequently repeated in order to keep up their effects. From their exciting operation they are indicated in cases of debility and sinking of the vital powers. Thus they are employed in syncope, low fevers, cholera, &c. On account of their specific influence over the nervous system they are administered in various spasmodic or convulsive diseases, especially in hysteria, and also in epilepsy and chorea.

f. The *sixth group* contains camphor, the roots of serpentary, contrajerva, and valerian, the oil of cajuputi, &c. It corresponds with that division of *volatile excitants* called by Vogt, *ætherio-oleosa;* it is a less perfect group than any of those already mentioned. To a certain extent it agrees in its effects with the last mentioned: thus it specifically stimulates the nervous system, increases the activity of the vascular system, and produces diaphoresis. Its effects, however, are much less powerful, are not so speedily produced, nor are they so fleeting. Some of the substances of this group (for example, serpentary and contrajerva) are serviceable in low nervous fevers; others are used in spasmodic diseases, as valerian in epilepsy.

g. The *seventh* and last *group* is the *spirituosa* of Vogt. It comprehends those substances already mentioned under the head of cerebro-spinants, as inebriating; namely, alcohol, wine, and ether. Their effects and uses will be fully described in a subsequent part of this work.

Active principles.—Volatile oil and resin are the most common constituents of the foregoing groups.

1. *Volatile oil* (*oleum volatile*, vel *æthereum*, seu *essentiale*).—Volatile oil is found in both the inorganised and organised kingdoms of nature: it is most common in vegetables. Petroleum and naphtha are examples of volatile oil in the mineral kingdom. Among animal substances castoreum may be referred to as containing it. It is found in various parts of vegetables—as in the cortical parts of their stems, in cinnamon and cassia; in their rhizomes, as in ginger and *Acorus Calamus;* in the root, as in valerian and horse-radish; in the leaves, as in buchu, *Labiatæ*, and *Myrtaceæ;* in buds, as in the bulbs of garlic and onions; in fruits, as the orange and *Umbelliferæ;* and sometimes, though very rarely, in the seeds, as in the nutmeg. From these different parts it is occasionally obtained by pressure, but more commonly by distillation.

The volatile oils may be solid or liquid at ordinary temperatures; when solid they are crystalline. They may be lighter or heavier than water; their sp. gr. varying from 0·627 to 1·094 (*Gmelin*). They may be coloured or colourless; if the former, the tint is various in different oils. All the essential oils have a strong odour, and a hot acrid taste. They are easily volatilised by heat; are combustible, in consequence of the large quantity of carbon and hydrogen which they contain; and are decomposed by chlorine, iodine, bromine, and the acids. Some of them (as the oil of turpentine) combine with hydrochloric acid. They are very

slightly soluble only in water. The *distilled waters* of the Pharmacopœia are saturated solutions of them. If the oils be previously rubbed with sugar they dissolve more readily in water. The mixtures or compounds of volatile oils and sugar are called *elæosacchara*. According to the Prussian Pharmacopœia they consist of one drop of oil to a scruple of sugar. Volatile oils dissolve readily in alcohol, ether, pyroxilic spirit, and naphtha, and easily mix with the fixed oils and resins.

The volatile oils, as ordinarily met with, usually consist of two oils—the one liquid, at ordinary temperatures (*volatile oil*, properly so called; the *éleoptène* of Berzelius; the *hygrusin* of Bizio)—the other solid (*stéaroptène* of Bezelius; *stereusin* of Bizio; *camphor* of the German chemists). When the latter predominates, the oil readily concretes in cold weather—as the oil of anise and the oil of star-anise. The camphor of the shops is the solid volatile oil (*stéaroptène*) of *Camphora officinarum*.

In regard to ultimate composition the volatile oils vary. Some consist of carbon and hydrogen only—as those of turpentine, juniper, savin, lemon, and bergamot. Others contain also oxygen—as lavender, anise, mint, and rosemary: while a third class contain no less than five ingredients; namely, carbon, hydrogen, oxygen, sulphur, and nitrogen; as the volatile oil of mustard. It is remarkable that all the volatile oils which contain carbon and hydrogen only, (10 C + 8 H) have the same ultimate composition; or, at least, they consist of the same elements in the same relative proportion.

The volatile oils undergo chemical changes when exposed to the air. They become deeper coloured and thicker, absorb oxygen, and give rise to the formation of carbonic acid and resin. The resins of turpentine and copaiva appear to be simple oxides of their respective oils.

2. *Resin* (*resina*).—This is rarely found in the mineral kingdom, or in animal substances; but is common in vegetables. In the latter it exists almost invariably, if not universally, in combination with volatile oil, from which, perhaps, it may be formed by the action of the oxygen of the air. It is a transparent or partially opaque, hard, soft, or elastic solid; coloured or colourless; lighter or heavier than water, its sp. gr. varying from 0·93 to 1·2 (*Gmelin*); fusible and combustible. It is a bad conductor of electricity, and becomes strongly negatively electrical by friction. As commonly met with it is odorous, but probably, if completely deprived of volatile oil, would be inodorous. Its taste is usually more or less acrid; sometimes bitter, and, occasionally, is not perceptible. It is not soluble in water, though some resins form hydrates with this liquid. It is soluble in ether and volatile oil, and frequently more or less so in alcohol; and on the addition of water to the alcoholic solution the resin is thrown down as a white powder, which gives a milky appearance to the fluid.

Most resins possess acid properties; that is, they redden litmus, and combine with alkalies and other metallic oxides. This is the case with the two resins (pinic and sylvic acids) of which colophony is composed; as well as the resin of copaiva (copaivic acid); of guaiacum (guaiacic acid); of gamboge (gambogic acid), &c. The compounds formed by the union of resins with alkalies, or other basic substances, are called *resinous soaps*. The *sapo-guajacinus* and *sapo-jalapinus* of the Prussian Pharmacopœia, as well as the *savon de térébinthine* (*Starkey's soap*) of the French Codex, are soaps of this kind, and will be noticed hereafter.

The resins are composed of carbon, hydrogen, and oxygen. In some cases they appear to be oxidized essential oils, (1 oil of turpentine + 1 oxyg.) as will be shown when speaking of turpentine and copaiva resins. It is not improbable that the first degree of oxygenation of the volatile oils forms resins insoluble in cold alcohol, while the most oxygenated are soluble in this liquid.

Class 3, Tonics.—Under the denomination of tonics are usually comprehended those therapeutic agents which, by continued administration in debilitated and relaxed conditions of the body, increase gradually and permanently the tonicity or insensible contractility of the whole system, and thereby render the fibres tenser and stronger, and give greater firmness and density to all the tissues and organs. They have received their names from τόνος, *tone* or *vigour*, on account of their strengthening or invigorating properties; and by some they have been termed *corroborants*.

Tonics produce their proper or real tonic effects in certain conditions of the system only; that is, they do not invariably strengthen. In some cases they give rise to no obvious results—in others they act as irritants and stimulants. In the healthy state moderate doses produce no sensible effects, or, perhaps, a slight excitement of the appetite merely, while large quantities give rise to nausea and vomiting. In irritation or inflammation of the stomach and intestines, and in febrile conditions of system, attended with a hot and dry skin, and a furred and dry tongue, tonics act as local irritants and excitants, and add to the severity of all the morbid symptoms. In a weak and debilitated condition of body, tonics act very differently. Their immediate effects are to increase the appetite and assist digestion. After they have been administered for some time, the soft solids (as the muscles, cellular tissue, &c.) become firmer, the muscular system more powerful, and the pulse stronger, though not quicker. In fact, all the functions are performed with more energy, and the patient is capable of greater exertion.

Tonics sometimes purge, at others constipate. When diarrhœa arises from, or is kept up by, a weakened state of the intestinal tube, tonics, by restoring strength, may produce constipation. On the other hand, when constipation depends on a debilitated and torpid condition of this tube—a circumstance not uncommon in females, tonics, not unfrequently, occasion alvine evacuations. Dr. Cullen having noticed how frequently bitters act as laxatives and purgatives, has inserted them in his list of cathartics.

Tonics are closely connected with the last-mentioned class of medicines: indeed, on many occasions, the so-called tonic substances act really as stimulants. Thus in weak but irritable subjects just recovering from a protracted state of fever, sulphate of quinia will frequently act both as a local irritant and stimulant, and produce nausea, vomiting, furred tongue, a febrile state of system, headache, &c. In fact, the two classes (tonics and stimulants) mutually approach and gradually pass the one into the other, and several substances may with equal propriety be arranged under either.

Tonics are also closely related to the cerebro-spinants. Several of the vegetable bitter tonics specifically affect the cerebro-spinal system (for example, quassia); while some of the cerebro-spinants (as strychnia), in very small doses, act as tonics. Moreover, the beneficial influence of some of the vegetable tonics (as cinchona) in intermittent diseases, should

probably be referred to the specific effects of these agents on the nervous system. And, in the same way, we ought to explain the power of tonics to increase the tone of the muscular system; for it appears, from Dr. Marshall Hall's experiments, that one function of the true spinal or excito-motory system is to give tone to the muscles.

The preparations of arsenic, silver, copper, bismuth, zinc, &c., are usually, but, as I think, most improperly, denominated tonics. They are agents which, in small and repeated doses, as well as in large and poisonous doses, specifically affect the nervous system, and I have already noticed them as cerebro-spinants. They have been called tonics principally for the following reason:—cinchona, the most powerful of the vegetable tonics, and in fact the type of the class, has long been celebrated as a curative agent in ague and other periodical diseases; hence it has been assumed that any substances capable of fulfilling the same indication must be possessed of the same properties, and thus arsenic has been called a tonic. But the conclusion is erroneous; it is indeed true that cinchona and arsenic have, in common, the power of curing an ague, but the same effect is frequently produced by many other very dissimilar substances: for example, by bloodletting, by alcohol, and by mental influences. If, therefore, arsenic be a tonic, so also must bloodletting, &c. If we admit this, it follows tonics can no longer be regarded as substances promoting strength, but merely as agents curing particular diseases. Before we have any right to associate arsenic among tonics, we must completely alter our definition of these substances, or show that arsenic improves the appetite and promotes the strength of the body.

Tonics may be arranged in groups, as follow:—

a. The *first group* includes those vegetable tonics which possess bitterness with little or no astringency; and which have been termed the *bitters* (*amara*), or sometimes the *pure* or *simple bitters* (*amara pura* seu *simplicia*). To this group are referred quassia and simaruba, obtained from the order *Simarubaceæ;* gentian, American calumba (*Frasera*), chirayita, common centaury, and buckbean, from *Gentianaceæ;* calumba and *Pareira brava* from *Menispermaceæ;* and *Cetraria Islandica*, from *Lichenaceæ.* These remedies are employed to promote the appetite and assist digestion in atonic and enfeebled conditions of the stomach; as general tonics in feebleness and debility of the whole system, and especially of the muscles; as antiperiodics in intermittent diseases; and as anthelmintics. Their beneficial operation in expelling intestinal worms has been referred to their poisonous influence over these parasitical animals, but ought perhaps rather to be ascribed to their improvement of the condition of the alimentary canal, and to their removal of those states which favour the production of these beings. The power which bitters possess of retarding the acetous fermentation may, perhaps, contribute to their beneficial operation in some dyspeptic cases accompanied with acidity and flatulence.

b. The *second group* comprehends those vegetable tonics which possess considerable astringency (from the contained tannic acid) with little or no bitterness. These are the *pure astringents* (*astringentia pura*). In this group are contained oak-bark and nut-galls, from the order *Cupuliferæ;* uva ursi, from *Ericaceæ;* catechu and log-wood, from *Leguminosæ;* rhatany, from *Polygalaceæ;* tormentilla, from *Rosaceæ;* the pomegranate-rind, from *Myrtaceæ;* bistort, from

Polygonaceæ; and to these may be added kino. These agents are principally remarkable for causing local contraction and corrugation (or astriction) of the tissues. They contract and give greater density to muscular fibres; diminish the calibre of the blood-vessels and exhalents, and thereby check hæmorrhage (whence their denomination of *styptics*), and diminish secretion and exhalation when applied to mucous membranes or other secreting surfaces. In the mouth they give rise to a peculiar sensation of roughness and stypticity. Some writers have ascribed these effects to a physical or chemical agency. Thus Dr. Cullen places astringents among substances acting on the simple solids, though, in another part of his treatise, he admits that they act on the living, as well as on the simple solids. The late Dr. Adair Crawford (*An Experimental Inquiry into the Effects of Tonics*, &c., 1816) ascribed the effects of both astringents and bitters to their influence in promoting the cohesion of the animal fibre. He immersed some pieces of intestines, of skin, &c., in various bitter and astringent infusions, while others were placed in water, merely as a standard; and he then observed the comparative weights required to break them, from which he inferred the relative strength of different tonics. But this mode of reasoning naturally leads to erroneous inferences, since the vital powers of the system are quite overlooked. The relaxed state of parts, which astringents are useful in obviating, depends not on a mere mechanical or chemical alteration, but in some change in the state of vital powers; and, therefore, the agents which counteract it, must have some other than a mere physical action. Moreover, the results obtained by Dr. Crawford depended probably on the different degrees of antiseptic power possessed by the substances employed. Astringents produce the constitutional effects of the bitter tonics: administered in moderate doses, they promote the appetite, assist digestion, and increase the tone and vigour of the general system. They are capable of fulfilling the same therapeutic indications as the bitter tonics. Thus they have the power of preventing the occurrence of a paroxysm of intermittent fever, and in cases of debility are often useful, independently of their power of checking debilitating discharges. But this group is principally employed for its local effects; to obviate relaxation of fibres and tissues, and to prevent or check excessive discharges.

c. The *third group* contains those vegetable tonics which possess both bitterness and astringency in an eminent degree; it may, therefore, be denominated *astringent bitters*. It includes cinchona bark, from *Cinchonaceæ*; spigelia, from *Spigeliaceæ*; elm-bark, from *Ulmaceæ*; and willow-bark, from *Salicaceæ*. It combines the effects of both bitters and astringents, and is by far the most important group of the class, since it contains cinchona bark, the most powerful of the vegetable tonics.

d. The *fourth group* contains the *aromatic bitters*, which possess bitterness, with an aromatic flavour (derived from the presence of volatile oil), and, in some cases, astringency likewise. This group contains wormwood and elecampane, from the order *Compositæ*; cascarilla, from *Euphorbiaceæ*; angustura bark, from *Rutaceæ*; and hops, from *Urticaceæ*. They possess the combined properties of aromatics and bitter tonics, and are, therefore, useful where these are indicated.

e. The *fifth group* contains the *acid tonics*; namely, the mineral acids, to which, perhaps, may be added alum. These, taken in the

dilute state, allay thirst, promote the appetite and digestive process, and augment the secretion of urine. By continued use, they reduce the heat of the body, diminish the fulness and quickness, but increase the firmness of the pulse, check the cutaneous and pulmonary exhalation and secretion, and heighten the general tonicity of all the fibres and organic tissues. If their employment be continued for too long a period, the digestive functions become much disturbed, chronic inflammation of the mucous lining of the alimentary canal is set up, accompanied with wasting and disorder of the whole system. They are employed as cooling and temperant means in fevers, especially of the hectic kind, and likewise as tonics. They are useful adjuncts to some of the bitter infusions.

f. The *sixth group* includes the *metallic tonics*, and consists principally of the preparations of iron. These combine tonic and stimulant properties, and will be noticed hereafter.

Active principles.—The substances contained in the vegetable tonics, and on which their activity depends, are alkaloids, crystalline substances analogous to the alkaloids, tannic and gallic acids, and extractive.

1. *Tonic alkaloids.*—These are quinia, cinchonia, and aricina: their properties will be examined hereafter.

2. The *crystalline substances analogous to vegetable alkalies* found in the vegetable tonics, and which possess medicinal activity, are salicine, gentianine, quassine, &c. These are too imperfectly known to permit any general account to be given of them.

3. *Tannic acid* (*acidum tannicum*).—As this substance is employed in medicine, it will be described in a subsequent part of this work. It will be sufficient, therefore, here to state that its presence in the astringent tonics is shown by the whitish, or yellowish white precipitate, (*tannogelatin*) which infusions of these substances form with a solution of isinglass, and by the blue or green precipitate *(pertannate of iron*) which they give on the addition of a perferruginous salt. The following astringents produce a *bluish black* precipitate with the persalts of iron: bistort, oak-bark, nutgalls, logwood, pomegranate-rind, red rose leaves, and uva ursi. The persalts of iron give rise to a *green* precipitate with the barks of cinchona, willow, elm, and cinnamom, with catechu, kino, tormentilla, rhatany, and wormwood. Tannic acid usually causes precipitates (*tannates*) with the vegetable alkalies.

4. *Gallic acid* (*acidum gallicum*).—The properties of this acid are very similar to those of tannic acid. From this circumstance, as well as from the fact that gallic acid is easily produced by the action of air on tannic acid, it is difficult to prove whether certain vegetable substances contain both these acids, or only tannic acid. Gallic acid agrees with tannic acid in producing a deep blue colour with the persalts of iron, but it does not precipitate gelatine or the vegetable alkalies. Though obtained from several vegetables, yet it probably either does not exist in many of them, or is present in very small quantities only: it is to be regarded, in most cases, as a product rather than an educt. Thus, though nutgalls yield one-fifth of their weight of gallic acid, Pelouze thinks that, originally, they contain none of it, but that what is procured is obtained by the action of atmospheric air on the tannic acid. Taken internally, in small doses, gallic acid causes no inconvenience. It was once given in the dose of from 15 to 30 grains, against the *Tænia Solium*, but without any

benefit. Swallowed to the extent of 24 grains, it gave rise to a sweetish taste and a slight feeling of internal heat, but no other symptom.—(*Dict. des Drogues.*)

5. *Extractive.*—Some of the vegetable tonics are said to owe their bitterness and medicinal activity to a principle to which the terms *materia hermaphrodita*, *materia saponacea*, and *extractive matter*, have been applied. It is described as being of a brown colour, soluble in water and alcohol, insoluble in ether, and becoming insoluble in water by long-continued boiling and by exposure to light and air. That a substance, or mixture of substances, possessed of these properties, may be obtained from various plants, cannot be doubted, but it is not probable that chemists have yet succeeded in obtaining a proximate principle to which the term extractive can with propriety apply. What has hitherto been procured is a mixture or compound of several principles, such as vegetable acids and their combinations with potash and lime, colouring matter, sugar, gum (rendered soluble in alcohol by its combination with other substances), vegetable bases, &c.

Class 4.—Emollients.—The substances called emollients diminish the tonicity or insensible contractility of the living tissues to which they are applied, and thereby occasion local relaxation and weakness. They have an operation diametrically opposite to tonics,—especially to those which are astringent. They relax, soften, and swell the tissues, and render them more flexible. Applied to inflamed parts they diminish heat, tension, and pain, and oftentimes assist in producing the resolution of the disease; and when the inflammation is too violent, or too far advanced, for this to be effected, they are useful by promoting suppuration. They have a relaxing effect on the muscular fibre, and are, therefore, employed to relieve spasm. These effects have been referred by some to a physical, by others to a vital agency. During life the particles of the body are kept in approximation by two forces—attraction and the vital principle; and as emollients render the parts to which they are applied soft and flexible, that is, produce relaxation, it becomes a question whether they operate by overcoming the cohesion of the molecules, or by modifying the vital properties. Most writers have regarded them as mechanical agents, and explain their influence just as they would the action of warm water, or oil, on inorganic substances—leather, for example. But we should always be cautious in applying physical explanations to vital phenomena; and in the present instance this is particularly necessary. That emollients act on physical principles on inorganised parts of the body (the cuticle, for example) cannot be doubted, though we cannot admit this explanation in reference to living parts. Cold water diminishes the cohesion of dead parts, and renders softer and more flexible, but it has not the same effect on living tissues. Moreover, Dr. A. Crawford (*op. cit.*) ascertained that some medicinal agents diminish the cohesion of dead animal tissues, and have an opposite effect on the living tissues.

The constitutional effects of emollients are for the most part those of nutrients, not of medicines; though the continued use of some is said to diminish the tone or vigour of the system generally—an effect ascribed by Barbier (*Traité Elémentaire de Matière Médicale*), to their absorption and local action on all the fibres of the body. This statement, however, is unsupported by fact in the case of gum, starch, sugar, gelatine, albu-

men, and other principles, though it may hold good to a certain extent with respect to the oils.

Emollients are used to prevent the action of irritating matters on the body, by involving them, or by sheathing or defending surfaces from the action of substances capable of acting injuriously. When used for these purposes they are denominated *demulcents* (*demulcentia*, from *demulceo*, *to mitigate* or *soften*). Thus we administer them when acrid poisons have been swallowed. They are applied externally in the form of local baths, poultices, fomentations, &c. both as emollients and demulcents, in local inflammations, painful ulcers, &c. In irritation, inflammation, and ulceration of the alimentary canal, (as in gastritis, enteritis, diarrhœa, dysentery, &c.) they are taken either by the mouth, or in the form of clyster. In catarrh, peripneumony, and pulmonic affections in general, where the cough is dry and harsh, and the expectorated matters are acrid, the use of emollients is often attended with very beneficial effects. By their lubricating and soothing influence on the nerves distributed to the fauces, they probably affect the bronchial membrane and pulmonic structure by a reflex action. In affections of the urinary passages, as ardor urinæ, emollients (especially aqueous fluids) are very serviceable.

Emollients may be arranged in the following groups:—

a. The *first group* contains water, the principal and most important substance of the class. In order, however, that it may act as an emollient, it must have a certain temperature; for neither very cold nor boiling water has any emollient effect. Dr. Cullen fixes 62° F. as the lowest temperature at which this fluid can be emollient; and observes, that the greater its warmth the greater will be its emollient power, provided that pain or scalding be not produced. Aqueous vapour is for two reasons more emollient than liquid water: in the first place it penetrates the organic tissues more powerfully; and, secondly, a greater degree of heat can be applied by it than by liquid water. Dr. Cullen was doubtful whether advantage could be gained by any addition made to water.

b. The *second group* contains the *mucilaginous* emollients. This group has been subdivided into the pure mucilaginous emollients (as gum arabic, tragacanth, mallow, marshmallow, &c.), the sweets (as figs), the bitters (as *Cetraria islandica*, coltsfoot, and sarsaparilla), and the oily (as linseed, sweet almonds, poppy seeds, &c.)

c. The *third group* embraces the *farinaceous* or *amylaceous* emollients; as wheaten flour, oatmeal, barley, arrow-root, sago, tapioca, ordinary starch, &c.

d. The *fourth group* consists of the *saccharine* emollients; as ordinary sugar, honey, liquorice, &c.

e. The *fifth group* includes the *waxy*, *fatty*, and *oily* emollients; such as the animal fats, &c. (as lard, mutton suet, butter, wax, and spermaceti), and the vegetable oils (as olive, almond, sesami, palm, poppy, linseed, &c.)

f. The *sixth group* contains the *albuminous* emollients; as the white and yelk of eggs, and milk. Saliva and gastric juice are employed on the continent for medical purposes.

g. The *seventh group* comprehends the *gelatinous* emollients; as gelatine in its pure form, isinglass, hartshorn shavings, &c.

Class 5, Refrigerants or Temperants.—Under this head are in-

cluded those medicinal agents which diminish the temperature of the body when preternaturally increased. The only agent which in all cases reduces animal heat is cold, used in the form of ice, cold air, cold baths, cold lotions, cold drinks, &c. Its agency is obvious: it abstracts heat, and thereby lowers the intensity of the vital movements, diminishes vascular action, and reduces the calorific functions. But there are certain medicinal substances which, by continued internal use, allay febrile heat, and usually promote the secretions, though they have no power of diminishing the ordinary or healthy temperature, and to these the term *refrigerant* (or *temperant*) is usually applied. How they act is not completely understood. Dr. Murray thought they furnished oxygen to the system, and in that way prevented so large a quantity of it being consumed in the process of respiration,—an explanation borne out by the observations of Mr. Spalding and Dr. Fyfe, that vegetable diet reduces the consumption of oxygen gas in respiration.

Refrigerants may be arranged in the following groups:—

a. The *first group* contains the mineral and vegetable (sulphuric, hydrochloric, acetic, citric, tartaric, &c.) acids, as well as the acid- or super-salts (alum and bitartrate of potash).

b. The *second group* includes certain neutral salts; namely, the nitrate and chlorate of potash.

c. The *third group* comprehends certain fruits (as oranges, lemons, mulberries, tamarinds, prunes, fruit of the dog-rose, &c.), and herbs (as wood sorrel, common sorrel, lettuce, &c.)

d. The *fourth group* comprises the animal refrigerants; as butter-milk (*lac ebutyratum*), and acid whey (*serum lactus acidum*).

Class 6, Evacuants.—These are medicinal agents which provoke a discharge by some emunctory. They are termed *vito-secerning* agents by the late Dr. Nuttall (*Lancet*, vol. ix. for 1825-26, p. 578); and *vital agents which operate on the secerning system*, by Dr. A. T. Thomson (*Elements of Materia Medica and Therapeutics.*)

Evacuants act *by the skin* (diaphoretics or sudorifics); *by the mucous membranes* (errhines, expectorants, emetics, cathartics, emmenagogues); *by the glands* (diuretics, sialogogues).

1. *Diaphoretics or Sudorifics.*—Therapeutic agents, which promote the cutaneous transpiration, are called either diaphoretics or sudorifics. When the insensible perspiration is increased, they are termed *diaphoretics* (*diaphoretica*, from διαφορέω, *to transpire*): when sensible perspiration or sweat is augmented, they are called *sudorifics* (*sudorifica*, from *sudor*, *sweat*, and *facio*, *I make.*) But most modern physiologists regard the insensible perspiration and the sweat as productions of the same set of vessels, and as differing only in their physical form: the one existing as a vapour, the other as a liquid. In fact it is supposed that if the cutaneous transpiration be moderate, it is converted into vapour as fast as it is formed, and hence is termed the insensible perspiration. If, however, it be exhaled more quickly than the atmosphere can take it up, an accumulation is the result, and it appears on the skin in the form of drops, called sweat. Adelon (*Physiologie*, tom. iii. p. 517, ed. 2nde), however, states that sweat contains less carbonic acid, and more salts, than the insensible perspiration; but the correctness of this assertion is very questionable, on account of the difficulty of obtaining the insensible perspiration for comparison, and, perhaps, from its properties varying at

different times. It is highly probable that sweat differs from the insensible perspiration only in its physical form; and, assuming this view to be correct, we easily perceive that sweating may be induced in two ways; first, by increasing the cutaneous transpiration; secondly, by altering the hygrometric state of the air, so as to render this fluid less capable of holding watery vapour in solution. Hence sudorifics and diaphoretics are not essentially different: the former are generally regarded as being more powerful than the latter, or as being the same substances exhibited in larger doses. This statement, however, is not absolutely correct, inasmuch as a diaphoretic may act as a sudorific merely from a change in the hygrometric state of the air.

The most powerful means of exciting the cutaneous exhalation are,—the external application of heat, and the copious use of diluents. A variety of solid substances have been used as media for the application of heat; as hot sand, bran, ashes, earth, plaster, saline mud, dung, refuse of the grape, &c.

The hot sand bath (*arena calida*) is a very old remedy. Celsus (lib. i. cap. 17), Dioscorides, and Galen, speak of it. It is a powerful excitant, reddening the skin, and producing copious perspiration. Schwilgue (*Traité de Matière Médicale*) states that it is used in the maritime departments of the south of France. The saline mud found on the sea-shore has been employed in very hot weather, as a bath, by the inhabitants of Crimea, and especially by the Tartars, against hypochondriasis, scurvy, scrofula, &c. It increases the heat of the body, and excites sweat—(*Bull. des Sc. Méd. de Ferussac*, xiii. 179). Hot dung is sometimes used in France, as a kind of bath, against rheumatism, and by the Poles against syphilis. The husk of the grape and the refuse of the olive, from which the oil has been drawn, undergo fermentation, and in this state have been successfully employed in France against acute rheumatism (*Dict. de Mat. Méd.*: art. *Bain*). Water in a liquid form, or in the state of vapour and dry air, are also used as media for the application of heat. Friction, warm clothing, exercise, and cold affusion, are among the numerous means that may have been resorted to to produce diaphoresis. Most of the medicinal agents administered for the same purpose are stimulants, and, therefore, the constitutional effects (such as excitement of the vascular system, &c.) of the two classes are the same. But the excitement of the system, and the production of sweating, are not always in the same ratio; and it must be admitted that the sudorific effects of the compound powder of ipecacuanha and of the antimonial preparations, considerably exceed their stimulant effects on the system generally.

The agents or means employed to produce diaphoresis are various and even opposite. In febrile complaints, when the skin is hot and dry, the best diaphoretics are cooling drinks, acids, and emollients. But in other diseases, when the skin is cold and dry, and there is great prostration of strength, unaccompanied with any local inflammation, diffusible stimulants (as ammonia) are the best sudorifics. In both of these instances the agents employed are relative; that is, they remove or obviate causes which impede diaphoresis. As the substances usually denominated diaphoretics or sudorifics frequently fail to act as such, that is, to increase perspiration, some writers have been led to doubt the exist-

ence of any distinct class of agents of this kind. But on the same ground the existence of several other well-established groups or classes of medicines might be denied.

I ought perhaps here to state that, by the term diaphoretic, or sudorific, I mean a substance which increases the organic or vital action of the cutaneous exhalents. This explanation is necessary, since Dr. Edwards (*De l'Influence des Agens Physiques sur la Vie*, Paris, 1824) has shewn that cutaneous transpiration is effected in two ways; namely, by a physical action or evaporation, and by an organic action or transudation. *Evaporation*, or the physical action, is the consequence of the porosity of bodies, and takes place equally in the dead and living state. It is influenced by the hygrometric states of the surrounding air, by its motion or stillness, by its pressure, and by its temperature. Thus dryness, agitation, and diminution of the weight of the air, increase it. *Transudation*, or the organic action of transpiration, being a vital process, depends essentially on causes inherent in the animal economy, although it may be influenced to a certain extent by external agents. Thus elevating the temperature of the surrounding air, preventing its frequent renewal, and covering the patient with warm clothing, are means which promote the organic, but check the physical action of transpiration.

The vital activity of the cutaneous exhalents may be promoted in one or both of two ways,—by increasing the force of the general circulation, or by exciting the cutaneous vessels. Ammonia, violent exercise, and alcohol, operate by increasing vascular action generally, while heat and friction act by exciting the cutaneous vessels. Certain medicinal agents, when swallowed, have been supposed to act as diaphoretics, by entering the blood-vessels, and stimulating the cutaneous vessels by local contact.

The operation of diaphoretics is promoted by the exhibition of large quantities of warm mild diluents, and by keeping the skin warm. Moreover, these agents are more effective when given at bed-time, since there appears to be a greater disposition to sweating during sleep than in the waking state. The exhibition of diuretics and purgatives should be avoided, as they check sweating. The older writers explained the occasional beneficial effects of sudorifics by supposing that some peculiar morbific matter was expelled from the system, the retention of which had produced the disease; and hence sudorifics were enumerated among the Alexipharmaca and Alexiteria. But though cold, applied to the skin, may occasion disorder in some internal organ, it is more consonant with sound physiology to ascribe the internal affection to a metastasis of vital action, than to the retention of any supposititious morbific matter; for although cold diminishes the vital or organic action of the skin (*transudation*) yet it does not prevent the physical action (*evaporation*).

Sudorifics are employed in a great variety of cases,—as catarrhal and rheumatic affections, febrile disorders, chronic diseases of the skin, &c. They are mostly indicated when the cutaneous transpiration has been suddenly checked, and some internal part (as the bronchial membrane) has become affected; also in diseases which usually or frequently terminate by sweating, as fevers.

2. *Errhines* (*errhina*, from ἐν, *in*, and ῥὶν, *the nose*) are medicines

which produce an increased discharge of nasal mucus. When they excite sneezing they are called *sternutatories* (*sternutatoria*) or *ptarmics* (from πταίρω, *I sneeze*).

Most foreign matters applied to the pituitary membrane promote the secretion of nasal mucus. Sugar and the labiate plants operate mildly; euphorbium and white hellebore with great violence. Some kinds of snuff will, in persons unaccustomed to their use, affect the general system, giving rise to nausea, giddiness, great depression of muscular power, and slight disorder of the mental functions—effects which I have personally experienced on two or three occasions. The continued employment of snuff injures the sense of smell and alters the tone of the voice. In syphilitic affections of the nose, and where there is a disposition to nasal polypus, the continued use of errhines may perhaps be injurious. Errhines have been principally employed to relieve chronic affections of the eyes, face, and brain; for example, chronic ophthalmia, amaurosis, headache, &c. They can only be useful on the principle of counter-irritation.

Schwilgué enumerates the following purposes for which sneezing is excited: to excite respiration when this function is suspended; to promote the expulsion of foreign bodies accidentally introduced into the air-passages; to occasion a general shock at the commencement of dangerous diseases which we wish at once to suppress; to augment the secretion of nasal mucus, and of tears; to favour the excretion of mucus collected in the nasal sinuses; to rouse the action of the encephalon, of the senses, of the uterus, &c., and to stop a convulsive or spasmodic state of the respiratory apparatus. We should not, however, forget that the concussion occasioned by sneezing is not always free from dangerous results, especially in plethoric habits, and persons disposed to apoplexy, or affected with hernia, prolapsus of the uterus, &c.

3. *Sialogogues* (*sialogoga*, or *sialagoga*, from σίαλον, *the saliva*, and ἄγω, *to convey* or *drive out*) are medicines which excite the salivary discharge. They are of two kinds, local and remote.

a. *Local sialogogues.*—These are sialogogues which are applied to the mouth. When used in a soft or solid state they are called *masticatories* (*masticatoria*, from *mastico*, to *eat* or *chew*). They act on the mucous follicles of the mouth and the salivary glands. Most solid or soft bodies, when chewed, increase the flow of saliva; thus wax and mastic produce this effect. Acrids, however, as horse-radish, mezereon, pellitory of Spain, and ginger, possess this property in an eminent degree.

In almost all parts of the world masticatories are more or less used. In the East Indies betel-nuts (the seeds of Areca Catechu) are chewed, with quick lime and the betel-leaf (the leaf of Piper Betel). The Indians have a notion that these substances fasten the teeth, clean the gums, and cool the mouth (*Ainslie's Materia Indica*). In this country the masticatory commonly employed by sailors is tobacco.

As the saliva is generally swallowed, masticatories do not confine their action to the mouth, but excite likewise the stomach. Peron (*Voyage aux Terres Australes*) was convinced that he preserved his health, during a long and difficult voyage, by the habitual use of the betel; while his companions, who did not use it, died mostly of dysentery. For habitual use, and as mere sialogogues, mucilaginous and emollient

masticatories might be resorted to, but we find that acrids of various kinds have always been preferred. Masticatories, as therapeutic agents, have been principally used either as topical applications, in affections of the gums, tongue, tonsils, salivary glands, &c., or as counter-irritants in complaints of neighbouring organs, as in ear-ache, rheumatism of the pericranium, affections of the nose, &c. The stronger masticatories, as mustard and horse-radish, excite an increased discharge of nasal mucus and tears, as well as of saliva and mucus of the mouth.

β. *Remote sialogogues.*—Several substances have had the reputation of p oducing salivation or ptyalism by internal use. Of these, the preparations of mercury are the only ones on which much reliance can be placed, and even they sometimes disappoint us. The preparations of gold, of antimony, and of iodine, occasionally have this effect. The continued use of the hydrocyanic or nitric acid has, in several instances, produced salivation. In poisoning by foxglove this has been observed. Lastly, nauseants increase the secretion of saliva.

Mercurials are given in certain diseases to excite ptyalism, and in some cases it is necessary to keep up this effect for several weeks. It is not supposed that the salivation is the cause of the benefit derived, but it is produced in order that we may be satisfied that the constitution is sufficiently influenced by the medicine.

4. *Expectorants* (*expectorantia*) are agents which promote the expulsion of mucus and other secreted or exhaled fluids from the bronchia, trachea, and larynx In the healthy state, the liquids secreted or exhaled by the aerian membrane are got rid of by evaporation and absorption. But when from any circumstance the balance between the two processes of production and removal is destroyed, and an accumulation of mucus takes place, nature endeavours to get rid of it by coughing. Hence some have applied the term expectorant to irritating substances (as chlorine gas, the vapour of acetic or of benzoic acid, &c.), which, when inhaled, produce coughing. "We provoke cough," says Schwilgué (*Traité de Matière Médicale*, tom. ii. p. 296), "to favour the expulsion of foreign bodies introduced from without into the aerian tube, and especially of liquids; we have recourse to it to favour the expectoration of mucus, of mucosities, of membraniform concretions, and of pus, which have accumulated in the aerian passages, whenever the local irritation is not sufficiently great."

It has been thought by some that the mucus secreted may be too tough and viscid to admit of its being easily brought up by coughing, and the term expectorant has been applied to those medicines which have been supposed to render it thinner and less viscid. But as Mr. Moore (*An Essay on the Materia Medica*, 1792) has justly observed, thick phlegm is sometimes more easily expectorated than thin: and if this were not the case, we have no specific means of rendering the phlegm either thicker or thinner. Frequently the term expectorant is applied to substances supposed to increase or promote the secretion of bronchial mucus, and in pharmacological works a long list of medicines, thought to have this effect, is usually given. Most of the agents employed with this view act relatively,—that is, they obviate the causes which checked the healthy secretion. Some are topical agents, as various gases and vapours. There are others, however, which, when taken internally, are supposed to affect the aerian membrane in a specific manner, and are

beneficially employed in chronic catarrhs. Such are the balsams, the oleo-resins, the fœtid gums, squills, &c. Many of the substances which give relief in chronic pulmonary complaints do not promote, but check, the secretion of bronchial mucus: as the sulphate of zinc,—to which Begin (*Traité de Thérap.* t. ii. p. 561) adds the balsams. Yet these agents are usually classed with expectorants. Dr. Paris (*Pharmacologia*) makes one class of expectorants to consist of "medicines which diminish the inordinate flow of fluid into the lungs, and render the expectoration of the remainder more easy."

Most of the substances usually denominated expectorants possess stimulant properties. Some of them become absorbed and act on the bronchial membrane by local contact. They are principally employed in chronic catarrhs.

5. *Emetics* (*emetica*, from ἐμέω, *I vomit*,) are medicinal agents used for the purpose of provoking vomiting. They are sometimes called *vomits* (*vomitoria*.)

Usually within twenty or thirty minutes after taking an emetic, a general feeling of uneasiness and of nausea comes on. The pulse becomes small, feeble, and irregular; the face and lips grow pale, a sensation of relaxation and coldness of the whole system is experienced, the saliva flows copiously from the mouth, the eyes lose their lustre, and the whole countenance appears dejected. These symptoms, which constitute the first stage of vomiting, continue for a variable period, and are followed by the ejection of the contents of the stomach. As soon as actual vomiting commences, the general phenomena are altered: the pulse becomes frequent and full, the temperature of the body increases, and a sweat breaks out on the face and other parts of the body. During the act of vomiting, in consequence of the pressure made on the abdominal aorta, and the interruption to the circulation through the lungs, from the impeded respiration, the blood returns with difficulty from the head, the face swells and becomes coloured, the conjunctiva is turgid and red, the jugular veins are gorged, and tears burst from the eyes. The violent straining is often attended with pain in the head and eyes, and with the involuntary expulsion of the urine and fæces. The matters vomited vary according to circumstances; they may consist of the alimentary and other substances contained in the stomach previous to the exhibition of the emetic; of the fluids collected by the action of the emetic; and, lastly, of the emetic itself. Sometimes striæ of blood are observed, which usually come from the pharynx. The number of vomitings, and the ease with which they are effected, are liable to considerable variation, arising from the state of the digestive organs, the temperament of the patient, the state of the cerebral functions, &c. When the vomiting has entirely ceased, the patient feels languid, oppressed, and drowsy, and the pulse becomes weak and slow: the exhaustion is sometimes so great as to be attended with fatal consequences. A case of this kind is alluded to by Dr. Paris (*Pharmacologia*) in which an emetic was imprudently given to a patient in the last stage of phthisis, with the intention of dislodging the pus with which the lungs were embarrassed: syncope was produced, from which the patient never recovered. Among other occasional ill consequences of vomiting may be mentioned comatose affections, uterine or pulmonary hæmorrhages, hernia, abortion, suffocation, prolapsus of the uterus, rupture of the abdominal muscles, &c.

The intensity and duration of the different stages of vomiting have no necessary relation to each other. Thus the sulphates of zinc and copper excite speedy vomiting, with but little nausea;—and are, therefore, preferred as emetics in narcotic poisoning. Tobacco and tartarized antimony, on the other hand, produce great nausea and depression of system.

The causes of vomiting are various. One is, suddenly distending the stomach with warm water or demulcent liquids. In cases of corrosive or irritant poisoning, we adopt this method of exciting or promoting vomiting in preference to the use of acrid substances. Another method of provoking vomiting is tickling the fauces with the finger or a feather: this has been shewn by Dr. M. Hall to be a beautiful instance of reflex action. We adopt this plan in cases of poisoning until the ordinary emetics can be procured,—also in dyspepsia and cardialgia, arising from the presence of undigested food in the stomach. Acrids and irritants of all kinds likewise excite vomiting when swallowed. Thus gamboge, mustard, common salt, euphorbium, the mineral acids, &c., have this effect when taken in large or poisonous doses. Most of these, however, are dangerous agents, and, with the exception of mustard and common salt, are not given as emetics. The last-mentioned substances are administered to excite vomiting in cases of narcotic poisoning, in malignant cholera, &c. But there are certain irritants (such as tartar-emetic and ipecacuanha) which seem to have some specific power of provoking vomiting, since they produce this effect when applied to any part of the body, or when injected into the veins. These are the agents to which the term emetic is more usually applied.

Besides the above, there are many other causes of vomiting, such as acute pain, injuries of the brain, calculi in the kidneys, disagreeable odours, the sight of disgusting objects, whirling, sailing, or swinging, &c.

The irritation produced by the exhibition of emetics gives rise to an increased secretion from the mucous follicles of the stomach and duodenum; as is apparently shewn by the thick, filamentous, and viscid matters frequently ejected. We infer, also, that the action of the exhaling vessels must be increased, inasmuch as persons who have taken only a few spoonfuls of emetic liquids sometimes bring up a very considerable quantity of water. Darwin mentions a man who vomited six pints of liquid, although he had only swallowed one. Bile is frequently thrown up, either alone or mixed with other fluids; but we must not infer from this that it had existed in the stomach previous to the exhibition of the emetic, for bile is not ordinarily rejected in the first efforts, but only in the subsequent vomitings; and the quantity increases in proportion to the length of time the vomiting continues. It is generally supposed that emetics promote the secretion of bile and of pancreatic juice.

6. *Carthartics or Purgatives.*—These are medicinal agents which excite alvine evacuations. They do so by increasing the peristaltic motion of the alimentary canal, and by promoting secretion and exhalation from the mucous lining. It has been supposed that some of them stimulate the muscular coat of the intestine, without increasing the secretions,—and, *vice versâ*, that others stimulate the mucous follicles and exhaling

vessels, thereby occasioning a copious evacuation by stool, without much increase of peristaltic motion. But all purgatives act in both ways, though sometimes very unequally so:—some affecting the peristaltic motion principally,—others, the secretions and exhalations. Those that excite watery discharges are called *hydragogues;* as elaterium, gamboge, and jalap. Certain purgatives do not equally affect all portions of the canal. Thus colocynth, gamboge, black hellebore, and aloes, principally influence the large intestine. The acrid purgatives promote the secretion of bile and of pancreatic fluid, by the irritation they produce at the termination of the ductus choledochus.

Most if not all cathartics are local irritants, and, in some instances, the purgative operation seems to depend solely on this, as in the case of gamboge. But several others have, in addition, a specific influence over the alimentary canal, shewn by the fact that they purge even when applied to wounds or injected into the veins; as in the case of castor oil, senna, hellebore, &c.

Several purgatives become absorbed. Thus the particles of gamboge, rhubarb, sulphate of potash, and oil of turpentine, have been detected in the blood:—senna, rhubarb, and jalap, have communicated purgative qualities to the milk:—lastly, cassia pulp, rhubarb, senna, and gamboge, have been recognised in the urine.

Cathartics may be arranged in groups, as follow:—

a. The first group contains the mild cathartics, denominated *laxatives* or *lenitives;* viz. manna, cassia pulp, tamarinds, prunes, honey, bitartrate of potash, and the fixed oils (as castor, almond, and olive oils). These very gently evacuate the contents of the intestinal canal, and usually without causing any obvious irritation, or affecting the general system. Manna, however, is apt to occasion flatulence and griping. Laxatives are employed in any cases where we wish to evacuate the bowels with the least possible irritation, as in children and pregnant women, in persons afflicted with inflammation of any of the abdominal or pelvic viscera, with hernia, prolapsus of the womb or rectum, piles, or stricture of the rectum; and after surgical operations about the abdomen and pelvis.

b. The *second group* is composed of the *saline* or *antiphlogistic* purgatives, such as the sulphates of soda, potash, and magnesia. They increase the peristaltic motion of the alimentary canal, and augment the effusion of fluids by the exhalents of the mucous surface, thereby giving rise to watery stools. They do not appear to possess the power of inflaming the intestinal tube, nor of heating the general system. They are adapted for febrile disorders, inflammatory affections, plethoric conditions, &c.

c. The *third group* includes the *milder acrid purgatives*, such as senna, rhubarb, and aloes. These are more active substances than any of those mentioned in the preceding groups. They are acrids and stimulants, but their local action is not sufficiently violent to cause inflammation. Senna is employed where we want an active though not very acrid or irritant purgative. Rhubarb is administered in relaxed and debilitated conditions of the alimentary canal. Aloes is used in torpid conditions of the large intestines, and in affections of the head. It is objectionable in piles and diseases of the rectum.

d. The *fourth group* comprehends the *strong acrid* or *drastic purgatives;* such as jalap, scammony, black hellebore, gamboge, croton oil,

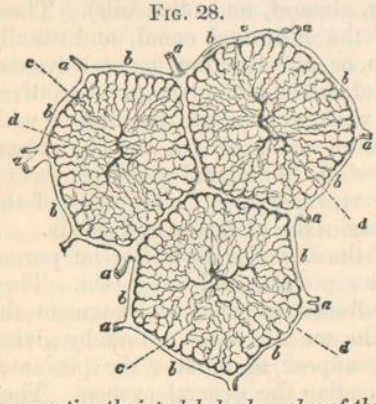
colocynth, and elaterium. These, when swallowed in large doses, act as acrid poisons. They are employed as purgatives in torpid conditions of the bowels; as hydragogues in dropsical affections, and as counter-irritants in affections of the brain. They are objectionable remedies in inflammatory and irritable conditions of the alimentary canal.

e. The *fifth group* contains the *mercurial purgatives;* as the hydrargyrum cum cretâ, the pilula hydrargyri, and calomel. We employ these as alterative purgatives, and to promote the hepatic functions. As they are uncertain in their operation, they are usually combined with, or followed by, other purgatives.

7. *Cholagogues.*—These are medicines which increase the evacuation of bile. It is probable that most, if not all, drastic purgatives increase the secretion and excretion both of bile and pancreatic juice, by irritating the opening of the ductus choledochus in the duodenum, just as certain substances taken into the mouth provoke an increased discharge of saliva by irritating the mouths of the salivary ducts. Graaf (quoted by Barbier, *Traité Elément. de Mat. Méd.* tom. iii. p. 125, ed. 2nde) says, that if a purgative be administered to a dog, and when it is beginning to operate the abdomen be laid open, the bile and pancreatic juice will be observed flowing into the duodenum.

When we consider the peculiarities attending the hepatic circulation, and that all the remedial agents whose particles are absorbed have to pass through the portal vein,—the vein by whose branches the bile is secreted,—our astonishment is great that this secretion is not more frequently affected by the various medicinal agents put into the stomach. I have already mentioned (p. 15) the different substances which have been detected in the blood of either the portal vein, or of veins (splenic and mesenteric) opening into it. The branches of this vein which ramify between the lobules of which the liver is principally made up, are denominated by Mr. Kiernan (*Philos. Trans.* for 1833) *interlobular* veins: their minuter ramifications within the lobules are called *lobular venous plexuses*, and these last inosculate towards the centre with the *intralobular* ramules of the hepatic veins.

FIG. 28.



Representing the interlobular branches of the portal vein, the lobular venous plexuses, and the intralobular branches of the hepatic veins of three lobules.

a a a. The interlobular veins contained in the spaces.

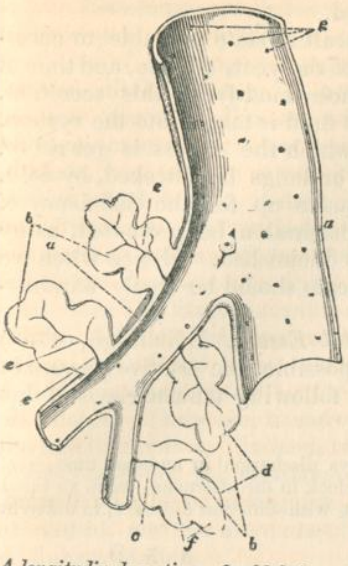
b b b. The interlobular veins which occupy the fissures, and which, with the veins in the spaces, form venous circles around the lobules. This is the appearance which the venous circles present when examined with a common magnifying glass; they are, however, formed by numerous, and not by single, branches, as represented in the figure.

c c c. The lobular venous plexuses, the branches of which, communicating with each other by intermediate vessels, terminate in the intralobular veins. The circular and ovoid spaces, seen between the branches of the plexuses, are occupied by portions of the biliary plexuses, constituting the acini of Malpighi.

d d d. The intralobular branches of the hepatic veins, in which the vessels of the plexuses terminate.

The intralobular veins open into the *sublobular* veins around which the lobules are arranged, and when a longitudinal section is made, these lobules present a foliated appearance. The *sublobular* veins unite into larger branches, called *hepatico-venous trunks.*

Fig. 29.



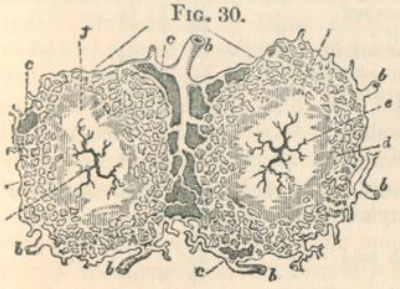
A longitudinal section of sublobular-hepatic veins, with lobules arranged around them.

Fig. 29.

a a. Sublobular hepatic veins.
b b. Longitudinal section of lobules.
c c. Basis of the lobules resting on the sublobular veins.
d. External or capsular surfaces of the lobules.
e e. Intralobular veins.
f. Projecting processes of the lobules.
g. Mouths of intralobular veins opening into the sublobular vein.

Such, then, is the course taken by medicinal agents in order to reach the hepatic vein, and by this the vena cava. Now the lobular plexuses of the portal vein are accompanied by ducts to carry away the bile as it is secreted.

Fig. 30.



Represents the intralobular ducts entering the lobules, and forming the lobular biliary plexuses.

Fig. 30.

a. Two lobules.
b b b. Interlobular ducts.
c c c. The interlobular cellular tissue.
d d. The external portions of the lobular biliary plexuses injected.
e e. The intralobular branches of the hepatic vein.
f f. The uninjected central portions of the lobules.

But notwithstanding the many substances which must ramify through the veins of the liver, only three or four have, in modern times, been supposed to exercise any specific influence in promoting the biliary secretion: these are mercurials, aloes, and rhubarb. How far these deserve the appellation of cholagogues will be better examined when we notice them individually.

8. *Diuretics.*—These are medicines which promote the secretion of urine. They have derived their name from διά, *through;* οὖρον, *the urine;* and ῥεω, *I flow.*

There are two principal modes of promoting the secretion of urine; the one direct, the other indirect. The *indirect* method consists in augmenting the quantity of fluids taken into the stomach, or in removing any cause which checks the secretion. The *direct* mode is to stimulate the kidneys by means which specifically affect these organs. These means are the diuretics, properly so called. But almost all the sub-

stances thus denominated are most inconstant in their effects; so much so, indeed, that some persons have doubted whether there are any agents which ought to be so designated.

The quantity of urine secreted in the healthy state is liable to considerable variation. Temperature, season of the year, climate, and time of day, are among the common circumstances modifying this secretion. Whenever an unusual quantity of aqueous fluid is taken into the system, the kidneys are the organs by means of which the excess is got rid of. If the customary discharge from the skin or lungs be checked, by cold, for instance, the kidneys endeavour to make up for the deficiency of action in the other organs. Again, if transpiration be promoted, as by external warmth, the secretion of urine is diminished. Hence when we wish to augment the renal secretion, diluents should be freely administered, and the skin kept cool.

Mr. William Alexander (*Experimental Essays*, Edinburgh, 1768) endeavoured to determine, as nearly as possible, the relative powers of different diuretics, and he has given the following tabular views of his results:—

A Table of the different quantities of urine always discharged in an equal time; viz. from nine o'clock in the morning till two o'clock in the afternoon, when an equal quantity of the same liquid was drunk, but with different diuretics, in different quantities, dissolved in it.

		℥	ʒ	ϑ
By lbj. ʒvijss.	simple infusion of bohea tea, standard,	15	4	0
By do.	with ʒij. of salt of tartar - - -	22	7	2
By do.	.. ʒij. of nitre - - - -	22	0	0
By do.	.. 4 drops oil of juniper - - -	30	3	0
By do.	.. ʒj. salt of wormwood - -	19	7	1½
By do.	.. ʒij. Castile soap - - - -	19	1	1
By do.	.. a teaspoonful of spt. nitr. dulc. -	17	6	1½
By do.	.. 15 drops of tinct. cantharides -	16	4	0
By do.	.. ʒij. of sal. polychrest - - -	16	3	0
By do.	.. ʒss. of uva ursi - - - -	16	1	0½
By do.	.. ʒj. of magnesia alba - - -	15	5	0
By do.	.. ʒij. of cream of tartar - -	10	2	0½

A Table of the different quantities of urine evacuated in the same space of time, after drinking the same quantity of different liquors.

		℥	ʒ	ϑ
By lbj. ʒvijss.	of weak punch, with acid - - -	21	2	3
By do.	.. new cow whey - - - -	18	6	0
By do.	.. decoct. diuret. Pharm. Edin. - -	17	5	0
By do.	.. London porter - - - -	16	7	0
By do.	.. decoct. bardan. Pharm. Edin. -	14	7	0
By do.	.. warm water gruel - - - -	14	6	2
By do.	.. small beer - - - - -	13	7	1
By do.	.. warm new milk - - - -	11	7	0

These tables are to a certain extent useful, but as diuretics act very unequally at different times, and cannot, therefore, be relied on, the value of Mr. Alexander's experiments is considerably diminished.

At pages 14 and 15 of this volume I have given a list of the substances which pass off by the urine. Many of these, especially the salts, stimulate the kidneys:—they do this probably by a local action in their passage through the renal vessels. Several of the vegetable diuretics owe their activity to volatile oil: such are, copaiva, the turpentines, juniper, and oil of cajuput. The oil probably acts on the kidneys by local contact, after its absorption. The modus operandi of squills and colchicum may, perhaps, be similar: that is, their active principles may

pass into the blood, and act on the kidneys in their passage through these organs.

9. *Emmenagogues* (*emmenagoga*, from ἔμμηνα, the *menstrual discharge*, and ἄγω, to *lead* or *convey*), are agents supposed to have the property of exciting the catamenia. As the suppression or retention of this discharge may be occasioned by very different circumstances, no one agent can be expected to prove emmenagogue in all or even in many cases. Deficient menstruation is rarely, perhaps, an idiopathic disease, but usually a morbid symptom merely; and, therefore, those agents which remove it must be relative,—that is, must have reference to the disease which produces it. Thus when deficient menstruation is connected with a deficiency of power in the system, tonics and stimulants are the best remedies. Again, in plethoric habits blood-letting and other debilitating agents are those most likely to be serviceable.

But the term emmenagogue is usually employed in a more limited sense, to indicate those substances which are supposed to possess a specific power of affecting the uterus and of promoting the catamenial discharge. There are, however, few bodies to which this definition can be strictly applied. Indeed, two reasons have led some pharmacological writers to doubt the existence of any medicines which can be properly termed specific emmenagoges, namely, the uncertainty of all the means so named, and the uterus not being an organ intended for the excretion of foreign matters.

The substances usually regarded as specific emmenagogues are, for the most part, medicines which, when taken in large doses, act as drastic purgatives, or which stimulate the urinary organs in a very marked manner. Such are savin, black hellebore, aloes, gamboge, cantharides, &c. They excite the pelvic circulation, give rise to a sensation of bearing down of the womb, especially in females disposed to procidentia uteri, increase uterine hæmorrhage, or the menstrual discharge, when given during these conditions,—and when administered in chlorosis or amenorrhœa, sometimes bring on the catamenia.

The only agent possessing an unequivocal specific influence over the uterus is the ergot of rye. But this agent seems rather to promote uterine contractions than the menstrual function,—though it has on many occasions been successfully employed in amenorrhœa.

Class 7. Abortiva seu Acceleratores Partus.—These are agents which increase the parturient efforts of the womb. At present, however, only one substance is known which possesses this property, and that is the *ergot of rye*, which will be spoken of hereafter.

Class 8. Caustics (*caustica*, from καίω, *I burn*).—These bodies disorganise by a chemical action. They are sometimes termed *potential cauteries* (*cauteria potentialia*), to distinguish them from fire or the actual cautery. The stronger caustics, as potassa fusa, have been termed *escharotics* or *erodents;* while the milder ones, as sulphate of copper, have been denominated *catheretics* or *cauterants*.

The following substances are those usually employed as caustics:—the strong acids (sulphuric, nitric, hydrochloric, phosphoric, and acetic), the alkaline substances (potash, soda, ammonia, and lime), and various metallic preparations (as the nitrate of silver, chloride of antimony, sulphate and acetate of copper, chloruret of zinc, binoxide and bichloruret of mercury, and arsenious acid.) Some of these become absorbed, and

thereby affect remote parts; such are arsenious acid, and the bichloruret of mercury.

Caustics are employed for various purposes, the principal of which are the following:—to remove excrescences or morbid growths of various kinds, such as warts, condylomata, some kinds of polypi, and spongy growths or granulations; to decompose the virus of rabid animals and the venom of the viper, and other poisonous serpents; to form artificial ulcers, as issues; to open abscesses; for the cure of hydrocele they have been applied to the scrotum, so as to penetrate through the tunica vaginalis; to change the condition of ulcerated and other surfaces; lastly, caustics are applied to strictures of the urethra.

Class 9. Rubefacients, Vesicants, and Suppurants.—These are agents which, when applied to the skin, cause redness, and sometimes vesication and suppuration. The milder ones, such as friction and warm fomentations, stimulate the skin temporarily, without producing actual inflammation. The stronger ones, such as mustard and cantharides, excite active inflammation. Those that cause the exhalation of a thin serous fluid beneath the cuticle are called *vesicants* or *epispastics:* mustard, euphorbium, mezereon, acetic acid, ammonia, and cantharides, are of this kind; while tartar emetic, and some other substances which produce a secretion of pus, are denominated *suppurants.* The medicines of this class are employed as counter-irritants in various diseases. Their general mode of operation has been before investigated (p. 45, *et seq.*)

Class 10. Acids.—The mineral acids, in a concentrated state, are powerful caustics; and, when swallowed, act as corrosive poisons; somewhat diluted and applied to the skin, they produce rubefaction. Administered internally, in moderate doses, they act as tonics, refrigerants, and diuretics; but by long-continued use they disorder digestion, and produce emaciation. When, from any cause—such as disordered digestion, particular kinds of food, or improper medicines—white sand (either phosphate of lime or phosphate of ammonia and magnesia,) appears in the urine, the internal use of acids will, in most cases, diminish or remove it. They are improper, however, when there is much irritation in the urinary organs.—[For further observations on the *modus operandi* of the acids, see page 9.]

Class 11. Alkalies.—Applied in a concentrated form, the alkaline substances act as powerful caustics, and, when swallowed, become corrosive poisons. Somewhat diluted and applied to the skin, they are rubefacients. Taken internally they neutralize any acid which may be found in the stomach, and hence have been termed antacids (*antacida*), or absorbents (*absorbentia*), and usually operate, when exhibited in moderate doses, as diuretics. By continued use they disorder digestion, render the urine alkaline, produce general debility, and give rise to symptoms similar to scorbutus. In such cases it is said that the blood drawn from a vein does not coagulate on cooling, but remains in a liquid state; and that if the use of the medicine be suspended, the blood again acquires its power of coagulation. By the continued administration of alkaline medicines the urine loses its acid properties, and occasionally becomes decidedly alkaline; and, in such cases, white sand (the phosphates) is usually deposited: hence, where a phosphatic diathesis already exists, these substances are highly improper. On the contrary, when the urine contains a larger portion than usual of uric acid, the use of alkalies is highly beneficial.