ELEMENTS

OF

MATERIA MEDICA.

PROLEGOMENA.

1. *Definitions.*

THERAPEUTICS (*Therapeia*, *Therapeutice*, *Therapeutica*, from Θεραπεύω, *I cure*) is that branch of medicine which has for its object the treatment of diseases.

ACOLOGY (*Acologia*, from Ἄκος, *a remedy*, and Λόγος, *a discourse*) is that department of therapeutics devoted to the consideration of remedies.

REMEDIES (*Remedia*, from *re* and *medeor*, I heal; *Auxilia medica*) are agents used in palliating or curing diseases. They are of two kinds—those acting directly, and those indirectly, on the body.

1. The remedies which act on the body *directly* are—
   a. Physical but imponderable agents, as light, heat, and electricity.
   b. Mechanical and surgical remedies.
   c. Hygienic means, as diet and exercise.
   d. Pharmacological agents or medicines.

2. The remedies which act on the body *indirectly* are those which operate primarily, by the agency of the mind. Certain affections of the mental faculties produce alterations in the condition of the body, and are, therefore, occasionally employed in the treatment of disease. These affections are of two kinds, agreeable or disagreeable.
   a. The *agreeable* mental affections are pleasure, joy, and ecstacy.
   b. The *disagreeable* mental affections are pain, grief, and misery.

PHARMACOLOGY (*Pharmacology*, from Φάρμακον, *a medicine*, and Λόγος, *a discourse*), or *Materia Medica*, is a branch of acology devoted to the consideration of medicines. It is subdivided into *Pharmacognosia*, which treats of simples, or unprepared medicines; *Pharmacy*, which teaches the modes of collecting, preparing, and preserving medicines; and lastly, *Pharmaco-dynamics*, which is devoted to the consideration of the effects and uses of medicines.

2. *Means of ascertaining the Operation of Medicines.*

In order to ascertain the kind of influence which a medicine exerts over the system, we may—
   a. Examine its physical and chemical properties.
   b. Observe the phenomena caused by its contact with the animal body.

a. *Examination of the physical and chemical properties of a medicine.*—The *sensible qualities* (odour, taste, and colour) give very little insight into the action of medicines; since some substances (as strychnia and

quinia), which agree in these properties, disagree in the effects which they produce on the organism.

The *natural-historical properties* (external form and structure) are of little value in ascertaining the operation of either mineral or animal substances. It is well known that two dissimilar bodies may assume the same crystalline shape, and they are said, therefore, to be *isomorphous*. Identity of form in the mineral kingdom depends not on the quality, but on the number, of the constituent molecules.

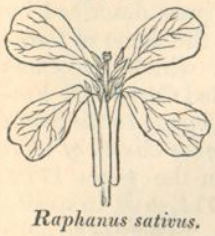
No attempts have been made to trace any relation between the toxicological or edible properties and the anatomical structure of animals. This has probably arisen from the comparatively small number of these beings which possess medicinal or poisonous properties; for we are enabled to employ, as food, animals of every class, from the highest to the lowest. Among quadrupeds and birds no species is poisonous, unless, indeed, the Arctic bear be an exception, whose liver is stated by Captain Scoresby to be deleterious.—(*Fleming's Philosophy of Zoology*, vol. ii. p. 110.) Among fishes, molluscous animals, and insects, however, several species are hurtful; and it is frequently found that where one is deleterious, kindred species are likewise more or less so. Thus all the coleopterous insects belonging to the tribe *Cantharidiæ* (*Latreille*) possess blistering properties.

The relations existing between natural-historical qualities and medicinal effects have been attentively examined with respect to vegetables. It has long been supposed that those plants which resemble each other in their external appearances are endowed with analogous medicinal properties. Cæsalpinus was, according to Dierbach, the founder of this doctrine; though Decandolle regards Camerarius as the first who clearly announced it. Linnæus says, "Plantæ quæ *genere* conveniunt, etiam virtute conveniunt; quæ *ordine* naturali continentur, etiam virtute propius accedunt; quæque *classe* naturali congruunt, etiam viribus quodammodo congruunt."—(*Philosophia Botanica*, ed. 4ta. p. 278.) I may also refer to Isenflamm, Wilcke, Gmelin, Jussieu, and Barton, as other supporters of this opinion. But the most important writer in favour of it is Decandolle, who, in 1804, published his *Essai sur les Propriétés Médicales des Plantes;* a second edition of which appeared in 1816. In the year 1831, we had another interesting treatise on the same subject by Dierbach. (*Abhandlung über die Arzneikräfte des Planzen, vergleichen mit ihrer Structur und ihren chemischen Bestandtheilen.)* There are other writers, however, who deny altogether the possibility of judging of the virtues of plants by their exterior forms and botanical characters. Of these I shall refer to one only, namely, Gleditsch *(De Methodo botanicâ dubio et fallaci virtutum in plantis indice*, 1742.)

It must be admitted that vegetable substances owe their peculiar qualities to the structure and consequent action of the organs producing them; and, therefore, that alterations in the structure of an organ, are attended with corresponding alterations in the qualities of its products. It consequently follows that the medicinal qualities of plants should accord with their classification in natural families. That they do so to a certain extent is fully ascertained by numerous facts. If one vegetable species serve as nutriment for either animal or plant, we frequently observe that other species of the same genus, or even of a different genus but of the same family, are also adapted for a like use; while, on the other hand, if

any particular species be injurious, neighbouring species are likewise more or less so. Experience has fully proved that in a very large number of instances there exists an analogy between the exterior forms and the medicinal properties of plants, so that we can sometimes predict the active principle and mode of operation of a vegetable, merely by knowing to what part of a natural arrangement it properly belongs. *Cruciferæ* (fig. 1), for example, present the greatest uniformity in their botanical, chemical, and medicinal characters. They contain a volatile acrid principle, which renders them stimulant; and having been employed successfully in scurvy, are frequently termed anti-scorbutics. The *Labiatæ* (fig. 2), which constitute, perhaps, the most natural family of the whole vegetable kingdom, contain a bitter resinous, or extractive matter, and an etherial, aromatic, or volatile oil; which two principles, mixed in different proportions, are found in all the species, to which they communicate tonic and carminative properties. Neither *Cruciferæ* nor *Labiatæ* contain a single unwholesome or even suspicious species. In *Coniferæ* (fig. 3) we find the different species pervaded with an oleo-resinous juice, in consequence of which they possess stimulant properties.—Many other families might be quoted to the same effect, and, therefore, we admit as a general rule, that plants of similar structure possess similar medicinal qualities.

Fig. 1.



Raphanus sativus.

Fig. 2.

Glechoma hederacea.

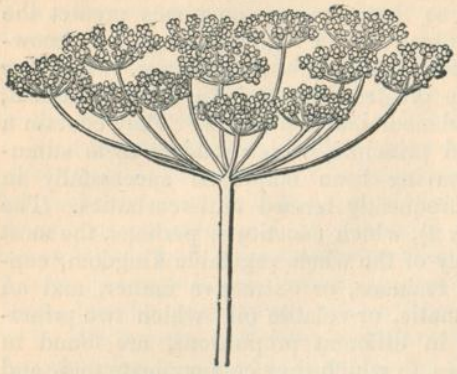
We are obliged, nevertheless, to admit the existence of numerous exceptions. There are many families, the plants of which appear to possess the greatest botanical affinity for each other, but which are endowed with very dissimilar remedial properties. *Umbelliferæ* (fig. 4) is an example of this. The root and leaves of *Daucus Carota* are wholesome and nutritive, but the analogous parts of *Conium maculatum* are highly poisonous. In some cases we even find plants of the same genus differing considerably in their medicinal properties. I need only mention in proof, *Cucumis Melo* and *Cucumis Colocynthis*. If we are to believe the statements of credible writers, even *Gramineæ*, which Decandolle declares to be "la famille la plus naturelle," contains more than one exception to the general statement in question. For the most part the plants of this family are farinaceous and nutritive. "None," says Dr. Lindley (*Natural System*), "are unwholesome in their natural state, with the single exception of *Lolium temulentum* (fig. 5), a common weed in many parts of England, the effects of which are undoubtedly deleterious, although perhaps much exaggerated." I may remark, however, that several other grasses have been asserted to be unwholesome. Loudon (*Encyclopædia of Plants*, p. 64) tells us that the seeds of *Bromus mollis* bring on giddiness in the human species and quadrupeds, and are fatal to poultry. The root of *Bromus purgans* is said to be used in Canada as an

Fig. 3.

Picea vulgaris (Nees ab Esenbeck.)

emetic, in doses of forty grains. *Bromus catharticus*, a Chilian plant, has a thick root, which is said to act as a purgative.—(*Dictionn. de Matière Médic. par F. V. Merat et A. J. De Lens*, tom. i. p. 672.) Humboldt (*Voyage*, t. i.) tells us that *Festuca quadridentata* (fig. 6) is very poisonous, and even fatal to animals. Perhaps this may be the grass described by some under the name of *Carapoucha*, and which by others has been called *Carapullo*. Frezier, in his *Voyage to the South Sea and along the Coasts of Chili and Peru*, in the years 1712, 1713, and 1714, says, in speaking of Lima, "There is an herb called *Carapullo*, which grows like a tuft of grass, and yields an ear, the decoction of which makes such as drink it delirious for some days. The Indians make use of it to discover the natural disposition of their children. All the time when it has its operation, they place by them the tools of all such trades as they may follow,—as by a maiden, a spindle, wool, scissars, cloth, kitchen furniture, &c.; and by a youth, accoutrements for a horse, awls, hammers, &c.: and that tool they take most fancy to in their delirium, is a certain indication of the trade they are fittest for,—as I was assured by a French surgeon, who was an eye-witness of this verity."

Fig. 4.



Fœniculum vulgare.

In the family *Solaneæ* we meet with other exceptions. Compare the fruit of *Capsicum annuum* with that of *Atropa Belladona*. I might select many other instances (as from the family *Leguminosæ*), to the same effect, but shall content myself with the examples already adduced, as sufficiently warranting the assertion that, in the present state of science, botanical affinities cannot be confidently relied on by the medical practitioner for determining the effects of remedial agents. I do not, therefore, agree with Dr. Lindley (*Natural System*, 2nd edit. p. viii.), that "a knowledge of one plant is a guide to the practitioner, which enables him to substitute *with confidence* some other plant that is naturally allied to it." As a *general rule* we may admit, that plants of the same family agree in the *nature* of their medicinal operation, but to this there are many remarkable exceptions, which diminish, though they do not absolutely destroy, its utility in practice. Furthermore, it deserves especial notice that certain vegetable families whose structure is most dissimilar, possess analogous properties: as *Melanthaceæ* and *Ranunculaceæ*.

In some instances the exceptions are perhaps only apparent, and arise from our imperfect acquaintance with the affinities or structure of plants. We can readily imagine, that a slight and almost imperceptible difference in the structure of the nutritive organs of two plants, may be the cause of a trivial difference in the chemical composition of their products. But organic analysis has shown us that a very inconsiderable difference in the combining proportions of the elements of organic substances is sometimes attended with important differences of medicinal activity.

The *chemical properties* of medicines may occasionally assist us in

Fig. 5.

Lolium temulentum, or Bearded Darnel.

determining the influence which these bodies have over the organism. For we sometimes find that substances possessed of similar chemical qualities operate in an analogous manner on the system. Thus sulphuric, nitric, and hydrochloric acids, act very much alike; so also do potash and soda. But these analogies are not common, and we frequently meet with substances whose chemical properties are similar, but whose medicinal qualities are most incongruous, as in the case of baryta and strontia; and of quinia and morphia: while, on the other hand, bodies whose chemical properties are exceedingly unlike, sometimes act in a very analogous manner; for example, manna and bitartrate of potash.

The properties of bodies are so completely altered by chemical combination, that it is in most cases difficult to form a correct opinion as to the action of a compound medicine, merely by knowing the nature and proportion of its constituent parts. Many metals, however, offer exceptions to this statement: thus all compounds into which arsenicum enters as a constituent are poisonous, and act alike on the organism.

b. Observation of the effects caused by the application of medicines to the animal body. On animals generally.—Some have examined the action of medicines on *dead* animal tissues, and drawn inferences therefrom as to the operation on the living organism. This mode of proceeding was adopted by Dr. Adair Crawford—(*An Experimental Inquiry into the effects of Tonics and other Medicinal Substances*, 1816.) But it is admissible only for those remedies whose action is either mechanical or chemical; and, therefore, with respect to the greater number of our remedial means, it is useless.

The examination of the effects of medicines on *living* animals is a much more valuable and important mode of investigation; for it may be asserted, as a general rule, that a substance which is poisonous to one species is more or less so to all classes of animals; and, in a considerable number of instances, its action is of the same nature or quality, though usually very different in degree, and modified by the variations in the developement of the several organs and functions. It has indeed been stated that many substances which are poisonous to man are innocuous to animals, and *vice versâ*. That this statement is wholly untrue, I will not venture to affirm, but I feel convinced it is an exaggerated one; and I

Fig. 6.

Festuca quadridentata (Kunth).

believe, with Dr. Christison (*Treatise on Poisons*, 3rd ed. p. 65,) that "if the subject be studied more deeply, the greater number of the alleged diversities will prove rather apparent than real."

The animals employed for the purpose of ascertaining the operation of medicines are, ordinarily, the dog and the rabbit, and, occasionally, the cat and the horse. The dog and cat are supposed to be "affected by almost all poisons exactly in the same way as ourselves," (*Christison*, p. 64;) yet they offer some peculiarities deserving of notice, especially in the case of narcotics. Their brains being much less developed than the cerebral organ in man, we naturally look for some diversity in the action of substances whose influence is principally directed to this viscus. Charvet, in describing the effects of opium (*De l'action comparée de l'Opium*,

p. 164,) observes, that from this inferior developement, the brain of the dog "is not so liable to sanguineous congestion, and when this condition is observed, it is not very intense—stupor is the only symptom of it; never coma, loss of consciousness, nor profound sleep." I have observed that the root of monkshood does not act precisely alike on rabbits and dogs. In the latter, one of the most remarkable symptoms of its operation is diminution of feeling; in the former, the function of feeling is much less obviously affected, but we observe more evident paralysis of the hind extremities. Differences of this kind are to be expected, since they are connected with unequal developement of the nervous system. As rabbits and horses cannot vomit, irritant poisons when administered to them cannot act as emetics. The skin of horses is more susceptible than the human integument of the action of turpentine. On the other hand, certain agents, whose operation on the human body is most energetic, have, comparatively, very little effect on the horse—as colocynth, briony, and jalap.—(*Moiroud, Pharmacologie Vétérinaire,* pp. 269 and 274.)

On man.—The action of medicines on the *dead* human body, or on parts separated from it, as the blood recently drawn from the veins, has been examined, with the view of learning the operation of these agents on the living body. It may be of assistance to us in ascertaining either the mechanical or chemical action of substances; but as the greater number of medicines act only on the living body, and quite independently of any known mechanical or chemical influences, this mode of investigation is of very limited value.

In ascertaining the action of remedial agents on the *living* body, it is necessary that we examine their influence both in healthy and diseased conditions. For, by the first we learn the positive or actual power of a medicine over the body; while by the second, we see how that power is modified by the presence of disease. Moreover, in the latter condition we sometimes discover remedial influences which our knowledge of the effects of medicines on the healthy body could not have led us to anticipate. The beneficial operation of arsenious acid in agues, or in lepra, could never have been inferred from any experiments made with this substance in health merely; nor could we have formed a correct estimate of the effects and proper dose of opium by employing it in tetanus, nor by using mercurials in fever. The homœopathists assert, and with truth, that the study of the effects of medicines in the healthy state is the only way of ascertaining the *pure* or *pathogenetic* effects of medicines—since when we administer our remedies to invalids "the symptoms of the natural disease, then existing, mingling with those which the medicinal agents are capable of producing, the latter can rarely be distinguished with any clearness or precision."—(*Hahnemann's Organon,* translated by *C. H. Devrient,* p. 190.)

3. *Mode of Action of Medicines.*

The production of effects by the application of medicines to the living body, depends on the existence of two classes of powers or forces; the one in the medicine, the other in the organism.

1. *Active forces of Medicines.*—Bodies act on each other in one or more of three ways, viz.: *mechanically,* by their weight, cohesion, external form, and motion; *chemically,* by their mutual affinities; and *dynami-*

cally, by agencies which are neither mechanical, nor chemical merely. Hence we may examine the actions of medicines under the three heads of mechanical, chemical, and dynamical.

a. Mechanical.—The alterations of cohesion, of form, of relative position, &c. caused by medicines, are denominated their mechanical effects. They are frequently attended or followed by organic changes; consequently, a medicine, whose action is simply mechanical, may produce two classes of effects—the one mechanical, the other vital; and the whole of its operation may be denominated *mechanico-vital.*

Müller *(Elements of Physiology*, translated by Baly, p. 59) considers that mechanical agents may give rise to chemical changes in the tissues. "Mechanical influence in frictions," he observes, "acts under certain circumstances as a vivifying stimulus; it has this effect, probably, by inducing in the composition of the tissues, slight chemical changes, as a consequence of which the affinity of the tissues for the general vital stimuli already in the organism is increased."

Formerly most of the articles of the Materia Medica were supposed to act on the organism mechanically merely. "I doubt not," says Locke, "but if we could discover the figure, size, texture, and motion of the minute constituent parts of any two bodies, we should know, without trial, several of their operations one upon another, as we do now the properties of the square or a triangle. Did we know the mechanical affections of the particles of rhubarb, hemlock, opium, and a man, as a watchmaker does those of a watch, whereby it performs its operations, and of a file, which, by rubbing on them, will alter the figure of any of the wheels, we should be able to tell before-hand that rhubarb will purge, hemlock kill, and opium make a man sleep."—(*Essay concerning Human Understanding*, book iv. chap. 3.) These mechanical notions of Locke harmonized well with those of the *iatromechanical* or *iatromathematical* sect of the age in which he lived; a sect which ranked amongst its supporters Borelli (its founder,) Bellini, and others, in Italy; Sauvages, in France; and Pitcairn, Keill, Mead, and Freind, in England. The functions of the body, the production of diseases, and the operation of medicines, were explained on mechanical principles. The action of stimulants, for example, was supposed to depend on the pointed and needle-like form of their particles, and the operation of emollients on their globular form.—(*Sprengel, Hist. Médec. by Jourdan*, t. 5, p. 131, *et seq.*) I need hardly say, the existence of particles with the peculiar shapes assumed, is quite imaginary; and, indeed, if, for the sake of argument, we assume their existence, the action of medicines is, notwithstanding, quite inexplicable. We can, indeed, easily believe that a ball of glass may be swallowed with impunity, and that the same substance, reduced to the form of a coarse powder, might cause irritation by the mechanical action of the angular particles on the tender alimentary tube; but we could not, on this hypothesis, explain why one medicine acts on one part of the body, and a second on another part.

There are very few medicinal agents now in use whose remedial efficacy can be solely referred to their mechanical influence. Indeed, several of the processes to which medicines are subjected before they are administered, have for their principal object the prevention or diminution of this influence. Among the medicines still employed, on account of their mechanical action, are the hairs of the pods of *Mucuna pruriens*, quick-

silver, and, perhaps, powdered tin; the first and the last are used as anthelmintics—the second, to overcome intus-susception, or intestinal invagination.

b. Chemical.—If substances, having powerful affinities for organic matter, be applied to the living tissues, they first destroy the life of the part, and then enter into combination with one or more constituents of the tissues: such substances are termed caustics. But the destruction of life in one part is attended with alterations in the vital actions, and the production of inflammation in surrounding parts; so that the chemical action of caustics is attended by both chemical and vital effects, and the whole of their operation may be denominated a *chemico-vital process.*

If the energy of the affinity of caustics for organic matter be diminished, as by diluting them, the vital powers are sometimes enabled to resist the production of any immediate chemical change, and the life of the part is consequently preserved. The caustic, then, operates at first as a mere irritant, and causes alterations of vital action only. In this case the active force is still supposed to be affinity; that is, the particles of the caustic are presumed to have a tendency to unite with those of the organised tissues; but the union being resisted by the vital powers, a new action is set up which constitutes the changes or effects before referred to. The long-continued application, however, of these weak chemical agents, will gradually effect slight changes in the composition of the tissues without producing the death of the altered parts. These organic alterations of a living part are of course attended by the production of morbid actions.

Chemical changes are sometimes produced in the secretions of distant parts by the internal use of certain agents. Thus the qualities of the urine are modified by the administration of acids or alkalis. Do these modifications or changes depend on the chemical influence of the substances swallowed? or on some other kind of influence which these agents exert, either directly or indirectly, over the secreting organs? Neither explanation is without difficulties; but I conceive the first to present the fewest. It cannot be denied that when either alkalis or acids are swallowed, they pass out of the system, in part at least, by the kidneys; and that in the urine they possess their usual chemical properties, modified by the presence of any substances with which they may have united. Moreover, the qualities which they impress on the urine are similar to those which they produce when added to this secretion after its evacuation from the bladder. Thus, by the internal use of alkalis, it has been found that the natural acidity of the urine may be destroyed, and an alkaline quality substituted for it: the same condition of urine is produced by the addition of alkalis to this fluid out of the body. Again, the internal use of soda or magnesia may give rise to the appearance of white sand (phosphates) in the urine: now the same kind of deposit may be produced in healthy urine by the addition of a few drops of an alkaline solution to it. Furthermore, by the administration of acids (sulphuric or hydrochloric), phosphatic deposits are diminished or entirely prevented, while the employment of alkalis promotes them. Now this influence of acids is probably, in part at least, chemical, since we find that a few drops added to urine which contains these deposits, dissolves them. In other words, as the modifications which acids and alkalis produce in the condition of the urine are precisely those which we might expect from the known

chemical properties of these bodies, it is more rational to refer these modifications to influences the nature of which we can understand, than to those which are incomprehensible.

Do substances (such as acids, alkalis, and metallic salts) which are known to possess affinities for the constituents of the blood and of the tissues, exercise those affinities in their passage through the system? and are the constitutional effects of those substances referrible to chemical influences? It is impossible to give satisfactory answers to either of these questions. We cannot deny the chemical influence of these agents; but we are hardly authorised to ascribe the whole of their effects to it. The truth is, that the facts on which we are required to form our opinion are too few to enable us to draw any accurate or precise conclusions. By the internal use of madder, the bones and some other parts become coloured; and the long continued employment of the nitrate of silver gives rise occasionally to a deposit of silver under the skin. But with two or three exceptions of this kind, no chemical changes in the living tissues or organs are obvious, and we have no right, therefore, to assume that any exist. For when external agents are taken into the system, they become subject to a superior power, and are no longer at full liberty to obey the ordinary laws of affinity. It must be some power superior to that recognized in chemical operations which prevents the action of the gastric juice on the stomach during life.

Müller, (*Elem. Phys.* p. 58, *et seq.*) however, ascribes the operation of most external agents to their chemical influence. Vital stimuli, (a certain degree of external heat, atmospheric air, water, and nutriment,) he observes, "do not merely produce a change in the composition of the organic structures, and stimulate by disturbing the balance in the system, but renovate the tissues by entering, in a manner indispensable to life, into their composition." On the other hand, all agents of this kind, as well medicinal substances as caloric, electricity, and mechanical influences, "may, when their action is excessive, have the very opposite of a vivifying effect, by producing such a violent change in the organic matter, that the combinations necessary to life cannot be maintained." "A great number of substances are important as medicaments, from producing a chemical change in the organic matter, of which the result is, not an immediate renovation of material and increase of vital force, but the removal of that state of combination of the elements which prevented healthy action, or excited diseased action; or the chemical change produced is such as to render the organ no longer sensible to a morbid stimulus; or it is such that certain apprehended destructive changes in its composition are no longer possible, as in the antiphlogistic plan of treatment; or, lastly, these substances produce a change in the nutritive fluids. Such substances are alteratives. By these remedies an organ morbidly changed in composition cannot be rendered sound by, as it were, a chemical process, but such a slight chemical change can be produced as shall render it possible for nature to restore the healthy constitution of the part by the process of nutrition. These remedies, again, may be divided into two principal kinds, according as they act chiefly on the nervous system, or on the other organs dependent on that system. Among those of the first kind, the most important are the so-called narcotics; those of the latter kind comprehend the numerous medicines which exercise their action on diseases in other organs. These remedies

also, by removing the obstacles to cure, become indirectly vivifying or renovating stimuli ; and they may themselves, by disturbing the balance in a part, produce symptoms of irritation. If used in excess, they either give rise to the injurious effects of the heterogeneous stimulants, or, by inducing a sudden change of composition, annihilate the vital force, as is the case with the narcotics. Since, however, such alterative medicines affect the composition of an organ each in its own way, one alterative may, after a time, lose its influence, as it were, by saturation, while the organ may still be susceptible of the influence of another. A great number of the instances of habituation are referrible to this cause."

Such are the statements, as to the operation of medicines, made by one of the first physiologists of the age. They deserve careful and attentive examination. But however plausible they may appear, the student is not to be unmindful that, for the most part, they are opinions merely, and that the chemical changes in the tissues, so frequently referred to, have not been as yet demonstrated by chemical analysis. Furthermore, I would refer those who are desirous of becoming acquainted with the arguments which have been adduced against the chemical action of medicines on the system, to Vogt's *Pharmakodynamik*, bd. i. p. 9, *et seq.* The only chemical change which this author will admit medicines to be capable of producing, is that which takes place in the parts to which they are applied.

c. Dynamical.—The above-mentioned mechanical and chemical influences are considered by many writers insufficient to explain the effects caused by the greater number of the articles composing our Materia Medica; principally on the ground that substances which exercise a most potent influence over the organism, frequently do so without producing any obviously mechanical or chemical changes in the condition of the body. A third mode of operation has, therefore, been admitted, which is unattended with any recognizable changes of form or of composition.

In the inorganic kingdom we have also evidence of an influence which cannot be denominated either mechanical or chemical. The communication of magnetical and electrical properties to iron by mere contact with another body, without the production of any change of form or of composition, either of the iron itself or of the imparting body, is an example of this. Now to influences of this kind the term *dynamical* has been applied; and in several pharmacological works, (among which are Burdach's *System der Arzneymittellehre*, C. H. E. Bischoff's *Handbuch der Arzneimittellehre*, and Vogt's *Lehrbuch der Pharmakodynamik*), it is employed to indicate those influences of medicines over the organism which are ascribable to neither mechanical nor chemical causes.

Some have attempted to account for the action of medicines on electrical principles. All bodies, says Bischoff, (*op. cit.* bd. i. p. 158,) by contact with each other, act as electrics, without, however, necessarily undergoing any chemical changes. Therefore, when a medicine is applied to the organism, its action is electrical (p. 162.) But though, says this writer, a medicine may produce electrical without chemical changes, yet the reverse of this does not hold good, for no chemical changes can occur without the production of alterations in the electrical condition of bodies (p. 163) ; and, consequently, the operation of caustics is an electro-chemical process.

In some few instances the effects of medicines are analogous to those of electricity. Thus the instantaneous death caused by hydrocyanic acid is something like an electrical phenomenon. "A drop of acid, mixed with a few drops of alcohol," says Magendie, "when injected into the jugular vein, kills the animal instantly, as if he had been struck by lightning."—(*Formulaire*, 8me ed. p. 174.) The same physiologist has compared the convulsive shock, caused by the Upas Tieuté, "to that which takes place when a current of galvanic fluid is directed along the spinal marrow of an animal recently killed."—(See *Orfila's Toxicologie Générale.*) Again, "If an animal be touched whilst under the action of this substance [extract of nux vomica,] it experiences a commotion similar to that of a strong electrical shock; and this takes place every time the contact is renewed."—(*Formul.* p. 5.) These phenomena deserve especial notice in relation to the suggestion of Dr. Faraday, (*British Annals of Medicine*, for Feb. 24, 1837,) that the agent or source of the animal portion of the nervous system may be electricity.

2. *Vital force of the Organism.*—The peculiar properties possessed by living beings are two in number; namely, a capability of receiving impressions, and a capability of contracting—that is, of executing certain motions when the requisite impression has been made. The first has been denominated *latent* or *organic sensibility;* while the second has been termed *insensible* or *organic contractility.* These two properties, observes Adelon (*Physiologie de l'Homme*, 2e ed. t. iv. p. 565,) are reducible to one (*sensibility;*) for to feel is to change the mode of existence, in consequence of an impression—that is, it is to move in a way that is neither physical nor chemical. But as Mr. Grainger (*Observations on the Structure and Functions of the Spinal Cord*, p. 105,) has justly observed, "Organic sensibility is not sensibility of any kind; but a capability possessed by certain nerves (the incident) of receiving and transmitting the impressions of physical agents to the true spinal cord; which organ, by its peculiar power, excites muscular contraction through the medium of the reflex nerves." He proposes, therefore, to call it *excitability* (p. 127;) and suggests "that the contraction required for the nourishment and support of plants is the result of an excited action, effected by a structure analogous in its office, though differing in its physical character, to the true spinal (and, I believe, sympathetic) system of the animal kingdom."—(P. 131.)

Vital properties have by some been ascribed to organic structure, by others to a distinct internal principle called *Life* or the *Vital Force.* For an account of the opinions of writers on this subject I must refer to *Barclay's "Inquiry concerning Life and Organization,"*—as the subject hardly falls within the scope of a work on Pharmacology.

4. *Physiological Effects of Medicines.*

The *primary* or *physiological effects* of medicines may for convenience be divided into such as are *local*, or those that occur in the part to which the agent is applied;—and into those that take place in distant organs, and which by way of distinction we denominate *remote effects.*

1. Topical or Local Effects.—These are of three kinds:—

a. Mechanical or Mechanico-vital effects, as those caused by the hairs of the pods of Mucuna pruriens,—by demulcents,—by adhesive plaster, &c.

b. Chemical or Chemico-vital effects, as those produced by the agents denominated caustics. The constituents of the tissues on which the caustics expend the energy of their affinities are principally water, albumen, fibrin, and gelatine. Water constitutes four-fifths of the weight of the animal tissues and without it, they are wholly insusceptible of vitality, except in the case of some of the lower animals.—(*Müller's Elem. of Physiol.* p. 7.) Hence, therefore, agents like sulphuric acid, which powerfully attract water, act as caustics. Substances which either coagulate liquid albumen, as the mineral acids and alcohol, or which dissolve solid albumen, fibrin, and gelatine, as the alkalis, are also powerful caustics. Many salts, as bichloruret of mercury, sulphate of copper, acetate of lead, and chloruret of zinc, form new compounds when placed in contact with the organic principles just referred to: they also are caustics. As a preliminary to the production of the chemical changes here mentioned, the caustic must destroy the life of the part. Lastly, around the cauterized parts inflammation is set up.

c. Vital Effects.—The effects placed under this head are those which are unaccompanied by any obvious mechanical or chemical changes. As examples we may select two kinds—the vascular and nervous.

The *vascular effects* are those caused by the agents termed *irritants* or *acrids*, as cantharides, savine, gamboge, croton oil, &c. They are, pain, heat, redness, and the other phenomena of inflammation.

The *nervous effects* are numbness, tingling, pricking, and sometimes paralysis, without necessarily any redness or other obvious change in the vascular conditions of the part. When a few drops of the tincture of the root of aconite are applied to a delicate part of the skin, as the inner surface of the lips, numbness and tingling are speedily experienced. The most powerful effects are produced by the *Aconitum ferox*, a native of Nepal, and used as a poison under the name of *Bish* or *Bikh*. Some years ago, at the request of Dr. Wallich, I undertook a series of experiments to determine its effects, (see his *Plantæ Asiaticæ rariores*). I found that one drop of the alcoholic tincture of the root applied to the tongue, caused, within ten minutes, intense numbness in the tip of that organ, and also in the lips, with a sensation as though the soft palate and uvula were relaxed and rested on the tongue. The latter symptom continued for about 15 minutes only, but the numbness and tingling endured for 18 hours.

2. Remote Effects.—These are of two kinds, chemical and vital.

a. Chemical effects.—Vogt (*Pharmakodynamik*, bd. i. p. 15) denies that any remote chemical effects can be produced. But for the reasons before detailed, I regard the alteration in the qualities of the urine, by the internal use of acids or alkalis, as the effect of chemical influence. Moreover, the deposition of silver under the skin by the exhibition of the nitrate, and the colour communicated to bones by the use of madder, seem to show that even solids may undergo chemical changes by the internal employment of medicines.

b. Vital effects.—The functions of remote parts are affected by medicines, as when narcotics or diuretics are exhibited:—The former act on the brain, the latter on the kidneys. Inflammation even may be set up in a distant organ,—as of the bladder, by the use of cantharides.

5. *Absorption of Medicines.*

Proofs.—The particles of most medicinal substances, when applied to the living body, become absorbed and pass into the circulation. Two facts prove this, viz., the disappearance of certain substances from a shut cavity into which they had been introduced,—and the detection of medicinal particles in the blood, secretions, or solids of the body.

a. Disappearance from a shut cavity.—Drs. Christison and Coindet found that four ounces of a solution of oxalic acid injected into the peritoneal sac of a cat, killed the animal in fourteen minutes. On a post-mortem examination, although none of the fluid had escaped by the wound, they found scarcely a drachm remaining.—(*Edin. Med. and Surg. Journ.* xix. 335).

b. Detection in other parts of the body.—Tiedemann and Gmelin (*Versuche über d. Wege auf welchen Substanzen aus dem Magen u. Darmkanal ins Blut gelangen.* 1820) have detected the following substances in the *blood* of animals to whom those agents had been administered: camphor, Dippel's oil, musk, indigo, rhubarb, lead, cyanuret of potassium, sulphocyanuret of potassium, iron, mercury, baryta, and alcohol. By other experimenters, asafœtida, sal ammoniac, iodine, hydrocyanic, and sulphocyanic acids, &c. have been found. (For authorities consult Magendie's *Elementary Compendium of Physiology*, and Christison's *Treatise on Poisons*).

In the *solids* of the body several substances have been recognized: for example, madder in the bones, silver in the skin, copper in the liver, lead in the liver, spinal cord, and muscles, mercury in various parts, &c.

In the *secretions* various medicinal agents have been recognized.—Thus, *in the cutaneous secretions*, mercury, iodine, sulphur, the odorous matter of musk, of garlic, and of onions, and other substances, have been detected;—*in the breath*, several substances have been recognized by their odour; for example, camphor, alcohol, ether, phosphorus, asafœtida, sulphur, the odorous matter of garlic, and of onions, &c. The *milk* sometimes acquires purgative properties, in consequence of the employment of purgatives (senna, for example) by the nurse. Bitters, indigo, iodine, and madder, have also been distinctly recognized in it. *In the urine* so many substances have been discovered, that it will be most convenient to exhibit them in a tabular form. The following is taken principally from the experiments of Drs. Wöhler and Stehberger, as mentioned by the late Dr. Duncan (*Supplement to Edinburgh Dispensatory*, 1829.)

SUBSTANCES WHICH PASS OFF BY THE URINE.

(A) Unchanged, or nearly so.

Salts.

Carbonate of potash.	Sulphuret of potassium.	Tartrate of nickel and potash.
Nitrate of potash.	Ferro-cyanuret of potassium (in 66 minutes.)	Borax.
Chlorate of potash.	Silicate of potash.	Chloruret of barium.
Sulpho-cyanuret of potassium.		

Colouring Principles.

Indigo, Madder (in 15 minutes.)	Red radishes.
Rhubarb (in 20 minutes.)	Mulberry.
Gamboge.	Black cherry (in 45 minutes.)
Logwood (in 25 minutes)	Cassia Fistula (in 55 minutes.)
	Elder rob (in 75 minutes.)

Odorous Principles somewhat altered.

Oil of turpentine.	Asafœtida.	Narcotic principle of Amanita muscaria
—— juniper.	Garlic.	Asparagus (*Cullen.*)
Valerian.	Castoreum.	
Saffron.	Opium.	

Other Matters.

Astringency of Uva ursi (in 45 minutes.) Oil of almonds (*Bachetoni.*)

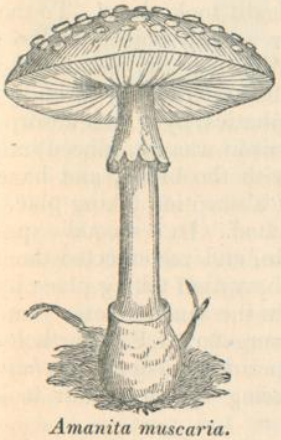
(B) In a state of combination.

Sulphur, as sulphuric acid and sulphuretted hydrogen.
Iodine, as hydriodic acid or ioduret.
Oxalic, Tartaric, Gallic (in 20 minutes), Succinic, Benzoic } Acids, appear in combination

(C) In a Decomposed state.

Tartrate, Citrate, Malate, Acetate } of potash, or soda, are changed into the carbonate of the same alkali.
Sulphuret of potassium changed, in a great measure, into the sulphate of potash.

Fig. 7.



Amanita muscaria.

If the accounts published respecting the *Amanita muscaria* (fig. 7) be correct, its effects are most extraordinary. A variety of this fungus has a powerful narcotic or rather inebriating effect; and that the active molecules get into the blood is proved by the fact of the urinary secretion being impregnated with them, and thus possessing an intoxicating property; and we are told that the inhabitants of the north-eastern parts of Asia use it for this property. A man, for example, may have intoxicated himself to-day by eating some of the fungus; by the next morning he will have slept himself sober; but by drinking a tea-cupful of his urine he will become as powerfully intoxicated as on the preceding day. "Thus," says Dr. Greville, on the authority of Dr. Langsdorf, "with a very few *Amanitæ*, a party of drunkards may keep up their debauch for a week;" and "by means of a second person taking the urine of the first, a third of the second, and so on, the intoxication may be propagated through five individuals."

Vessels effecting absorption.—The particles of medicinal and poisonous substances are absorbed by the veins principally, but also by the lymphatics and lacteals.

1. *Absorption by the Veins.*—The circumstances which seem to prove venous absorption are the following:—

a. Detection of substances in the venous blood.—Tiedemann and Gmelin (*op. cit.*) administered a variety of colouring, odorous, and saline substances to animals, mixed with their food, and afterwards examined the state of the chyle, and of the blood of the (splenic, mesenteric, and portal) veins. The *colouring* substances employed were—indigo, madder, rhubarb, cochineal, litmus, alkanet, gamboge, and sap-green; none of them could

be detected in the chyle, but some were found in the blood and urine. The *odorous* substances used were—camphor, musk, spirits of wine, oil of turpentine, Dippel's oil, asafœtida, and garlic: they were for the most part detected in the blood and urine, but none were found in the chyle. The *saline* substances tried were—acetate of lead, acetate and cyanuret of mercury, chloruret and sulphate of iron, chloruret of barium, and ferrocyanuret and sulpho-cyanuret of potassium. A few of these were detected in the chyle, and most of them in the venous blood and urine. From these experiments we may conclude, that although saline substances occasionally pass into the chyle, odorous and colouring matters do not; all the three classes of substances, however, are found in the venous blood. These results, observe Tiedemann and Gmelin, are opposed to those of Lister, Musgrave, J. Hunter, Haller, Viridet, and Mattei, but agree with those of Hallé, Dumas, Magendie, and Flandrin.

b. Magendie's experiment.—Magendie and Delille *(Elem. Comp. Physiol.)* performed a striking experiment, with the view of settling, if possible, the question of venous or lymphatic absorption of medicines and poisons. They divided all the parts of one of the posterior extremities of a dog, except the artery and vein, the former being left entire, for the purpose of preserving the life of the limb. A portion of the *Upas Tieuté* was then applied to a wound in the foot: in the short space of four minutes the effects of the poison were evident, and in ten minutes death took place. To the inferences drawn from this experiment, however, several objections have been stated: first, the exhibition of opium, to diminish the pain of the operation, has been said to vitiate the whole of the experiment; secondly, the coats of the arteries and veins contain lymphatics, by which absorption might be carried on; and thirdly, as the poison was introduced into a wound, the poison might have combined with the blood, and have rendered it deleterious, without the process of absorption taking place. The first two of these objections have been obviated. In a second experiment, Magendie severed the artery and the vein, and reconnected them by quills, so as to preclude the possibility of absorption taking place by the lymphatics of these vessels: the effects were the same. Some years since I assisted my friend Mr. Lloyd, assistant-surgeon of St. Bartholomew's Hospital, in performing an analogous experiment, using *Strychnia* instead of *Upas Tieuté*, and without administering opium: death took place in twelve minutes.

c. Lacteals tied: effects of poisons still produced.—Magendie says that symptoms of poisoning were observed in six minutes, when nux vomica was applied to the intestine, though the lacteals had been tied.

d. Blood-vessels tied: poisons do not act.—Segalas tied the veins of a portion of intestine, and applied poison, but no effects were produced. Emmert observed, that when the abdominal aorta was tied, hydrocyanic acid was applied to the foot without producing any effect, but when the ligature was removed, symptoms of poisoning came on. *(Müller.)*

e. Rapidity of absorption.—Mayer found that ferrocyanuret of potassium could be detected in the blood, in from two to five minutes after its injection into the lungs. The rapidity with which this salt enters the blood, says Müller, is too great for it to be explained by means of the slow circulation of the lymph.

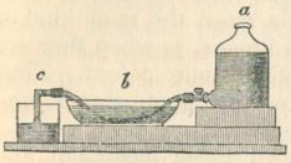
These circumstances appear to me to establish the fact of venous absorption.

2. *Absorption by the lacteals and lymphatics.*—The particles of medicinal and poisonous substances are probably absorbed by the lacteal and lymphatic vessels, as well as by the veins. But the process seems to be slow, and, moreover, is confined to certain agents. Tiedemann and Gmelin, whose experiments I have above referred to, were unable to recognize either colouring or odorous substances in the chyle, but occasionally detected certain salts. The absorption of saline, and non-absorption of colouring matters, have likewise been noticed by others *(Müller's Physiology.)*

Mechanism of Absorption.—The facts connected with absorption are best explained by assuming the existence of two powers or agencies by which this process is effected;—the one physical, and the other vital.

1. *Absorption by physical agency (Imbibition*, Magendie; *Exosmose* and *Endosmose*, Dutrochet.)—Two fluids separated by an interposed dead membrane, mutually, though not equally, permeate the membrane, so as to become intermixed with each other. If a current of water, coloured by litmus, be allowed to pass from a bottle (*fig.* 8, *a*), through a vein immersed in diluted sulphuric acid contained in a glass dish (*b*), into a reservoir (*c*), the litmus liquor is soon observed to become reddened by its passage through the vein, in consequence of the acid permeating the venous coats. If the relative position of the fluids be altered,—that is, the litmus put in the dish (*b*) and the acid passed from the bottle (*a*) through the vein, the litmus will still become reddened, shewing that the acid has passed in this case from within outwards.

Fig. 8.



But it may be said this effect is cadaveric only; that is, it occurs in the dead but not in the living vessels:—and in support of this view may be urged, the transudation of blood within the blood-vessels, and of bile within the gall-bladder, both of which phenomena are observed after death. Magendie has endeavoured to meet this difficulty with respect to the imbibition of poisons. He exposed and isolated the jugular vein of a dog, placed it on a card, and dropped some aqueous solution of the extract of nux vomica on its surface, taking care that the poison touched nothing but the vein and the card. In four minutes the effects of the substance became manifest, and the dog died.—*(Magendie's Lectures* in the *Lancet*, Oct. 4, 1834.) It must be admitted, however, that the result of this experiment does not absolutely prove, though it strongly supports, the opinion of the imbibing power of the living vessels; for it might be objected, that the nerves of the venous coats propagated the impression of the poison, and that death took place without absorption; or, that the small veins of the venous coat had taken up the poison. The proof, therefore, should consist in the detection of the poison within the vessel. Now this has been obtained by Magendie: a solution of nux vomica was placed on the carotid artery of a rabbit; but as the tissue of arteries is firmer and less spongy, and their parietes thicker than those of veins, a longer time elapsed before the poison traversed the vessel. In fifteen minutes, however, it had passed, and on dividing the vessel the blood adherent to its inner wall was found to possess the bitter taste of the poison.

With these results before us, we can hardly refuse to admit the imbi-

bition of living tissues, though I think we may fairly question whether this process can be effected so readily in the living as in the dead tissue.

2. *Absorption by a vital agency.*—The physical and chemical agencies with which we are at present acquainted are totally inadequate to explain all the phenomena of absorption. We are constrained, therefore, to admit another agency, which we may denominate vital or organic.

IS THE ABSORPTION OF A MEDICINE, OR POISON, ESSENTIAL TO THE PRODUCTION OF ITS REMOTE EFFECTS?—Magendie and Müller (*Physiol.* p. 246, *et seq.*) seem to consider the passage of poisons into the circulation essential to their operation on the system: while Messrs. Morgan and Addison (*Essay on the Operation of Poisonous Agents*, 1829,) deny that in any case absorption is absolutely necessary for the operation of a poison. "We are not opposed," observe the latter gentlemen, "to the theory of venous absorption, but to that theory which would associate with it the *absolute necessity* for the admission of a poison into a vein." The following facts will be of considerable assistance to us in forming an opinion on this controverted point:—

1. *Activity of substances injected into the blood-vessels.*—Medicinal or poisonous agents injected into the blood-vessels, exert the same kind of specific influence over the functions of certain organs, as when they are administered in the usual way; but that influence is more potent. Thus tartar emetic causes vomiting, castor oil purging, opium stupor, and strychnia convulsions, when thrown into the veins.

2. *Detection of substances in the blood.*—All those medicinal and poisonous agents whose sensible or chemical properties enable them to be readily recognised, have been detected in the blood, or in the secretions which are formed from the blood, after their ordinary modes of administration; as by the stomach.

3. *Activity of medicines promoted by the means which promote absorption, and vice versâ.*—The remote effects of many medicinal and poisonous agents are influenced by the same circumstances that influence absorption; and we are therefore naturally led to presume a mutual relation. Now these circumstances are principally three in number, viz. the nature of the tissue to which the agent is applied—the properties, (physical or chemical) of the medicine itself—and the condition of the system.

a. Nature of the tissue.—Nux vomica acts with the greatest energy when applied to the pulmonary surface,—with less when introduced into the stomach,—and with the least of all, when applied to the skin. The same order of gradation is observed with respect to opium. Now the faculty of absorption, or of imbibition, as Magendie calls it, does not take place with equal intensity in all tissues. Certain physical conditions, (viz., a fine and delicate structure, and great vascularity) enable the pulmonary surface to absorb or imbibe with extreme rapidity: in this respect, indeed, it is not equalled by any tissue of the body. Hence, then, if we assume that nux vomica and opium act by becoming absorbed, we can easily comprehend why they are so energetic when applied to this part. The membrane lining the alimentary canal absorbs with less facility than the pulmonary membrane, which may be accounted for by its less vascularity, and by its being covered, in some parts at least, by an epidermoid layer, and in all its parts by mucus, which, to a certain extent, checks absorption. The cutaneous surface, lastly, being covered by an inorganic

membrane (the epidermis,) does not possess the same physical faculties for absorption met with in either of the foregoing tissues; and hence the comparative inertness of medicines when applied to it. In fact, it is only by the long-continued application of these agents to the skin, that we are enabled to affect the general system; and that the obstructing cause is the epidermis, is shewn by the facility with which the system may be influenced when this layer is removed, as has been proposed and practised by Lembert and Lesieur, constituting what has been denominated the *endermic* or *emplastro-endermic* method of treating diseases; of which method I shall have occasion to speak hereafter.

b. The physical and chemical properties of the medicine.—Another circumstance, tending to prove some connexion between the activity of a medicine and its absorption is, that the effect of many medicines is in proportion to their solubility. Arsenic and morphia are both more energetic in solution than in the solid state. Now liquids, (particularly those miscible with the blood,) are much more readily absorbed than solids. In the treatment of many cases of poisoning, we endeavour to take advantage of this principle, and by rendering substances insoluble, diminish their activity, or render them quite inert. Thus the antidote for the salts of lead, or of baryta, is a sulphate, the acid of which forms an insoluble salt with either of the bases (lead or baryta.) Tannic acid (or astringent infusions which contain it,) is for the same reason found useful in cases of poisoning by vegetable substances whose active principle is an alkaloid; and we employ carbonate of lime as an antidote for oxalic acid, to render this substance incapable of being absorbed.

c. Condition of System.—Magendie asserts, as the result of experiments, that plethora uniformly retards, and depletion as constantly promotes, absorption. If, therefore, we wish to promote this function, we have a ready means of doing so, in blood-letting. Now every surgeon knows that one powerful means of promoting the action of mercurials on the mouth, is to abstract blood; and, therefore, we should be cautious about bleeding a patient, while a poisonous dose of some narcotic, as opium, is in the stomach. Nay, in theory, the best means of preventing the operation of poisons which act by becoming absorbed, would be to throw a quantity of warm water into the veins. Magendie tried this on animals, and found it successful.

4. *Magendie's experiment.*—The experiment of Magendie, already related, of applying the *Upas Tieuté* to the leg of a dog, connected to the body only by two quills, is another argument in favour of the operation of medicines by absorption: for in this case the action of the poison could have taken place only after it had passed into the blood.

5. *Division of the spinal cord.*—Some poisons, as hydrocyanic acid, are equally active when applied to the legs of an animal in whom the spinal marrow has been divided. In this case, the effect of the poison could not be the result of its action on the nerves of sensation and voluntary motion. But it may be said the division of the lumbar spine does not prevent the action of poisons by the nervous system, because it does not destroy the action of the excito-motory or sympathetic systems, the nervous branches of which are distributed to the lining membrane of the blood-vessels. I am aware that it is an experiment liable to objection; but, on the whole, it is certainly favourable to the opinion of the operation of poisons by absorption; more particularly when we bear in mind that the motion of the blood is

necessary to the action of the poison; for if the circulation of a part be obstructed, the poison will no longer act. These reasons are, to my mind, conclusive, that in a large number of instances at least, if not in all, the operation of a medicine on remote parts of the system depends on its absorption. Nor can I admit that this opinion is at all invalidated by the arguments and experiments of Messrs. Morgan and Addison.

The principal objections which have been raised to the theory of the operation of medicines by absorption, are the following:—

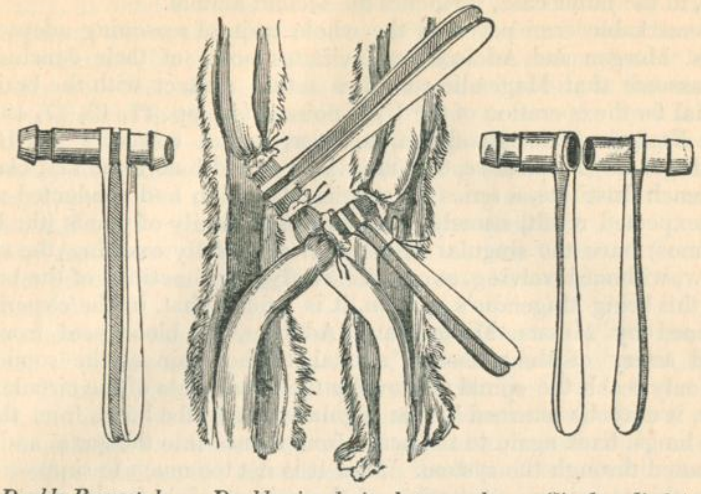
a. The experiments of Magendie and others, it has been observed, only show that a poison may get into the veins, and do not prove that absorption is essential to the effect. "We must strongly protest," say Messrs. Morgan and Addison, "against the assumption that, because a poison has been found to enter and pass through a vein, it is thence to be inferred that such a process is, under all circumstances, absolutely necessary to its operation." But it has been proved that the more absorption is facilitated the more energetic do poisons act, and *vice versâ*.

b. Mr. Travers, in his *Further Inquiry concerning Constitutional Irritation*, points out very forcibly the analogy to be observed between the effects of severe injuries and of poisons which operate rapidly on the system. Thus both strychnia and punctured wounds cause tetanus, and he, therefore, concludes their *modus operandi* must be identical: consequently, as there is nothing to absorb in the one case, so absorption cannot be essential in the other. But although the symptoms caused by the above poison are very analogous to those of traumatic tetanus, yet we are not to conclude that the effects of strychnia and of a puncture are precisely alike. "The fact of two substances producing similar symptoms in one organ," observes Müller (*op. cit.* p. 56) "does not prove that these substances produce exactly the same effects, but merely that they act on the same organ, while the essential actions of the two may be very different." And I confess I see nothing unphilosophical in supposing that the same morbid condition of a part may be induced in more than one way: for as every part of the organism depends for the performance of its proper functions on the receipt of arterial blood and of nervous influence, so alterations in the supply of either of these essentials may modify or even suspend the functions of a part.

c. Messrs. Morgan and Addison tell us that the blood circulating in the carotid artery of a dog poisoned by strychnia is not poisonous to a second dog, and they therefore infer that this poison does not act on the brain by absorption, but by an impression upon the sentient extremities of the nerves.

By the aid of a double brass tube, (fig. 9,) consisting of two short brass cylindrical tubes to each of which a long handle is attached (fig. 11), they established a complete circulation between the carotids of a poisoned and of a sound dog, by connecting the lower and upper ends of the divided arteries in both animals, so that each supplied the brain of the other with the portion of blood which had previously passed through the carotid artery to his own, and, consequently, the poisoned dog in this case received from the unpoisoned animal a supply of arterial blood equal to that with which he was parting. (Fig. 10.) One of the dogs was then inoculated with a concentrated preparation of strychnia, which had been found upon other occasions to produce death in these animals in about three minutes and a half. In three minutes and a half the inoculated

Fig. 9. Fig. 10. Fig. 11.



Double Brass tube. *Double circulation between the Carotids of a poisoned and a sound dog.* *Single cylindrical Brass tubes.*

animal exhibited the usual tetanic symptoms which result from the action of this poison, and died in little less than four minutes afterwards, viz. about seven minutes from the time at which the poison was inserted, during the whole of which period a free and mutual interchange of blood between the two was clearly indicated by the strong pulsation of the denuded vessels throughout their whole course. The arteries were next secured by ligature, and the living was separated from the dead animal; but neither during the operation, nor subsequently, did the survivor shew the slightest symptom of the action of the poison upon the system.

The inference which has been drawn from this experiment is, that the arterial blood of an animal under the influence of poison is not poisonous. But it appears to me that this is not a necessary inference, and as it is opposed to the result of other experiments, it requires careful investigation ere we admit it. Vernière has proved that if the extract of nux vomica "be thrust into the paw of an animal after a ligature has been tightened round the leg, so as to stop the venous, but not the arterial circulation of the limb, blood drawn from an orifice in a vein between the wound and ligature, and transfused into the vein of another animal, will excite in the latter the usual effects of the poison, so as even to cause death; while, on the contrary, the animal from which the blood has been taken will not be affected at all, if a sufficient quantity is withdrawn before the removal of the ligature."—(*Christison's Treatise on Poisons*, 3d ed. p. 10.)

Mr. Travers, (*op. cit.*) in noticing the different results obtained by Vernière and Messrs. Morgan and Addison, observes, that "if it be inquired why the poisoned blood concentrated below a ligature, and transferred into the vein of a healthy animal, proves destructive, while the blood of their common circulation affects only the one of the two animals which is the subject of the inoculation, the answer is obvious—that either

the mechanical impulse fails, or the activity of the poison is exhausted before, in the latter case, it reaches the second animal."

A remarkable error pervades the whole train of reasoning adopted by Messrs. Morgan and Addison, and vitiates some of their conclusions. They assume that Magendie considers actual contact with the brain as essential for the operation of the Upas poison, (see pp. 42, 43, 47, 49, &c. of the *Essay.)* This assumption, however, is not correct. "In 1809," says Magendie (*Formulaire*, 8me éd. p. i.) "I laid before the first class of the French Institute, a series of experiments which had conducted me to an unexpected result, namely, that an entire family of plants (the bitter Strychnos) have the singular property of powerfully exciting the spinal marrow, without involving, except indirectly, the functions of the brain." Now, this being Magendie's opinion, it is evident that, in the experiment performed by Messrs. Morgan and Addison, the blood sent from the carotid artery of the poisoned animal to the brain of the sound one could only reach the spinal marrow by the usual route of the circulation; that is, it must be returned by the jugular veins to the heart, from thence to the lungs, back again to the heart, from thence into the aorta, and then distributed through the system. Now it is not too much to suppose that, during this transit, some portion of the poison might be decomposed or thrown out of the system before it could arrive at the spinal marrow; and even if this were not the case, this organ could only receive a small quantity of the poison contained in the system, namely, that sent by the vertebral to the spinal arteries. Hence we ought to expect that a poison thrown into the arteries will operate less powerfully than when thrown into the veins, unless it be into the arteries supplying the parts on which the poison acts. Moreover, as an anonymous reviewer has observed (*Lond. Med. and Phys. Jour.* vol. lxiii.) it is to be recollected that as the carotid artery, in its healthy state, is little more than one-fourth of the calibre of the vessels carrying blood directly to the brain, consequently the dog not inoculated was subject to the influence of one-fourth only of the quantity of the poison which was conveyed to the *brain alone* of the inoculated animal. Furthermore I would add, that it is not too much to suppose that the circulation of the blood through the tube would not be so free as through the artery.

How do medicines and poisons which have entered the blood-vessels affect distant organs?—Viewing the question theoretically, we see three ways by one or more of which remote parts might be conceived to become affected after medicinal globules have passed into the blood.

1. *By modifying or altering the properties of the blood, and thereby unfitting it for carrying on the functions of the body.*—Although no facts are known which can be regarded as absolutely proving that the action of medicines or poisons is primarily on the blood, yet none I believe are inconsistent with such a notion in all cases, while several strongly favour it: and it has been justly observed by Andral (*Treatise on Pathological Anatomy*, translated by Drs. Townsend and West, vol. i. p. 642), that "as the blood nourishes the solids, and as without its presence they cannot support life, the state of the solids cannot but be influenced by the state of the blood."

In the first place, it must be admitted that in many diseases the properties of the blood are altered, and in some cases these alterations often

appear to be primary; that is, they precede alterations of the solids.—Secondly, in some diseases the blood acquires poisonous properties, and is capable of transmitting the affection of the individual from whom it was taken.—Thirdly, by the use of poisons, medicines, and particular kinds of diet, the properties of the blood become altered, while at the same time the condition of the solids is modified. Now as from the food is formed the chyle, from the chyle the blood, and from the blood the solids, a necessary connexion must exist between the quality of the ingesta and the condition of the solids. For facts and arguments relative to these positions, I must refer to Andral's work before quoted.

But if medicines or poisons introduced into the torrent of the circulation act primarily on the blood, what, it may be asked, are the effects produced?

In some cases the action is mechanical, as when air is introduced into a vein. "A very small quantity of air," says Magendie, (*Lancet*, Nov. 15, 1834) "passed slowly into a vein, mixes with the blood, traverses the lungs, and is exhaled with the pulmonary transpiration, without causing any remarkable accident; but when the quantity is increased, especially in a sudden manner, the air mixes with the blood contained in the heart, and forms with it a foamy kind of liquid, which does not pass readily through the capillary system of the pulmonary artery. In consequence of this obstacle to the passage of the blood through the lungs, the respiration and circulation become necessarily troubled, and the animal soon dies in a state of asphyxia,—not from any pernicious action of the air on nervous system." (For further information *On the Influence of Air in the Organs of Circulation*, see Dr. J. R. Cormack's *Prize Thesis* on this subject; Edin. 1837.) Water, when introduced into the circulation, probably acts merely as a diluent. For though when mixed with blood out of the body it dissolves the envelope of the red particles, we can hardly suspect that it produces a similar effect within the blood-vessels, from the circumstance that large quantities of water may be thrown into the veins without causing any remakable disorder of system; whereas if the globules were deprived of their envelope, or changed in their form, great disorder of the system might be expected. Solutions of various substances (as sal ammoniac, chloruret of sodium, carbonate of potash, sugar, &c.) produce no change in the globules out of the body; they therefore probably act mechanically on the blood.

Some substances exercise a chemical action on the blood; as the mineral acids, the alkalis, various metallic salts, alcohol, &c. The affinity of these agents is principally directed to the fibrin and albumen of the liquor sanguinis, and to the constituents of the globules. Hydrocyanic acid even would appear to be a chemical agent, since it makes the blood oily, fluid, and bluish in colour. Such substances, therefore, as exercise a chemical influence, cause speedy death when they are thrown into the veins, unless, indeed, the quantity introduced be very small. It is possible that organic substances may, as Dr. Christison supposes, be decomposed in the blood, without that fluid undergoing any apparent change. "A very striking proof of this is furnished by oxalic acid. Dr. Coindet and I, in one of our experiments, injected into the femoral vein of a dog, eight grains and a half of oxalic acid, which caused death in thirty seconds. Here it was impossible that the poison could have passed off by any of the excretions; yet we could not detect even that

large proportion in the blood of the iliac vein, and vena cava, collected immediately after death. As the blood possessed all its usual properties, we must suppose that the poison underwent decomposition in consequence of a vital process carried on within the vessels."—(*Treatise on Poisons*, 3d ed. p. 16.)

It must not, however, be assumed, that agents which effect chemical changes in the blood out of the body, or when injected into the veins, necessarily produce the same phenomena when absorbed from the intestinal or other surfaces; for the quantity taken up at any one time by this process is small in proportion to the volume of the circulating fluid, and the affinities between these agents and the constituents of the blood seem to be kept in check by the vital properties.

As the blood is a vital fluid, medicines may effect changes in it which are neither mechanical nor chemical. Strychnia and morphia produce no obvious effect on the blood, yet it is not impossible that they may cause some changes in its vital condition; and that to these, part of the symptoms caused by their use are to be referred. Here, however, all our remarks are but conjectural.

2. *By pervading the structure of the organ acted on.*—The usual mode of explaining the action of medicines after their absorption, is, that when they have got into the blood, they are carried in the ordinary course of circulation to the heart, and from thence to the lungs. Here the blood undergoes certain chemical changes, and is probably deprived of part of the medicinal particles: at least this appears to be the case with respect to certain odorous substances. The blood still impregnated with medicinal particles being returned to the heart, is transmitted from thence to all parts of the system. In their passage through the tissues of the different organs, it is presumed that these particles act on one or more parts which are endowed with a peculiar susceptibility to their influence.

Thus the opiate particles are supposed to exert a specific influence on the cerebral tissue; strychnia is thought to act on the grey matter of the spinal marrow; mercury, on the salivary glands; diuretics, on the kidneys; and so on. Müller supposes that a change is effected on the composition of the organic matter of the part acted on. The molecules are ultimately got rid of by the excretory organs. On this supposition, then, the blood is merely the "vehicle of introduction."

It must be admitted, that this theory, plausible as it may appear, cannot be satisfactorily proved. We may adduce several arguments in favour of it, but absolute proof or demonstration cannot be offered: our facts merely show the passage of medicinal particles into the blood, and the affection of the remote organs; but the link which connects the two phenomena cannot be, or at least has not yet been, demonstrated. The strongest argument in favour of this mode of explanation is, that the molecules of certain medicines may be detected in some one or more of the excreted fluids; while, at the same time, the functions of the organs secreting or excreting these fluids, have become influenced by the medicine. Now the simplest, and therefore the most plausible explanation, is, that the molecules, in passing through the organ, acted on its tissue, and thus gave rise to a functional change. The diuretic effects of nitre, alkalis, turpentine, &c., are readily explained on this theory: but when the affected part is not a secreting organ, and especially when the medicinal agent is not readily detected by its phy-

sical or chemical properties, we have not the same evidence to offer in support of this view, which, notwithstanding, may be not the less true. Several objections present themselves to this explanation. Many medicinal substances may be detected in the secretion of an organ, though no evident influence has been exercised over the organ itself. Thus the colouring particles of rhubarb may be recognised in the urine, although the action of the kidneys does not appear to be altered; and therefore it may be said, that in those cases where the quality of the secretion is affected, we have no right to infer that it depends on the passage of medicinal particles through the secreting vessels. This objection, however, deserves but little attention, inasmuch as we know that the susceptibility of the same part is not the same to all medicines; for it is not every medicine which produces vomiting when applied to the stomach.

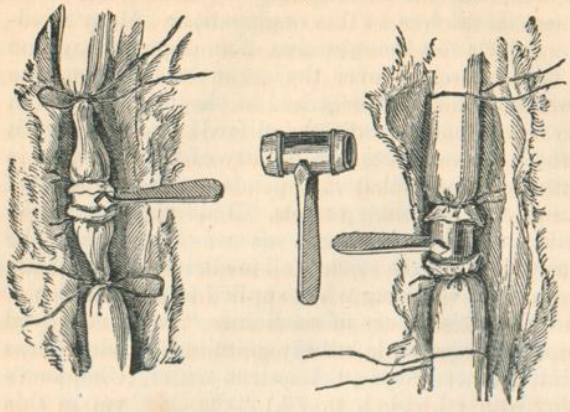
It has also been said that this theory of medicines "being conveyed by the circulation to particular parts, is utterly gratuitous, and no less improbable." "What intelligence," says an American writer, (Chapman's *Elements of Therapeutics*, 4th ed. vol. i. p. 73,) "directs them in this voyage of circumnavigation to the port of destination; and how, on their arrival (admitting it to happen,) are they separated from the great mass of fluids in which they are enveloped?" It is not supposed, on this theory, that medicines are *conveyed to particular parts*, but *to every part* of the body in which the blood circulates. How then, it may be replied, is it that particular parts only are affected, since medicinal molecules are in contact with every part? We do not pretend to account for this circumstance. Every one is familiar with the fact that carbonic acid may be applied to the stomach in large quantity with impunity; whereas, if taken into the lungs, it acts as a narcotic poison. The urine has very little effect on the bladder, but if introduced into the cellular tissue, gives rise to violent inflammation.

I have already alluded to another objection to this theory—namely, that injuries sometimes produce the same symptoms as poisons. But it must be recollected that in a large number of instances injuries do not produce the same symptoms; and in those cases where the effects of the two are analogous, I see no difficulty in assuming that there are two modes of affecting the nervous system.

The most important objections that have been advanced against the operation of medicines through the circulation, by local contact with the tissues, are those founded on the experiments of Messrs. Morgan and Addison. Of all their experiments, the following are, I conceive, the strongest against the theory under examination:—

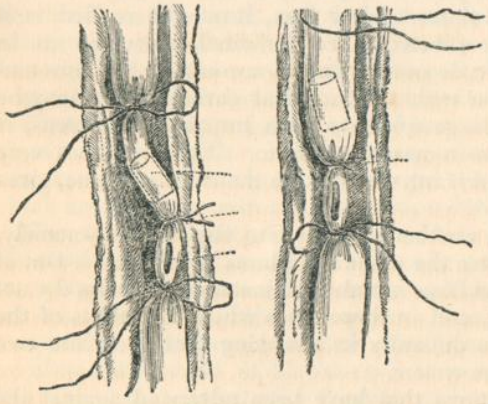
The jugular vein of a full-grown dog was secured by two temporary ligatures; one of which was tied round the upper, and the other round the lower part of the exposed vein. The vessel was then divided between these two ligatures, and the truncated extremities re-connected by means of a short brass cylinder or tube (fig. 13,) within which was placed a portion of woorara, of the size of a grain of canary-seed (fig. 12.) Both the temporary ligatures were then removed (fig. 14), the accustomed circulation through the vessels was re-established, and in forty-five minutes the animal dropped on the ground, completely deprived of all power over the muscles of voluntary motion: in two minutes, convulsions and respiration had entirely ceased. This result was to be expected, whatever theory be adopted.

Fig. 12. Fig. 13. Fig. 14.



In another experiment two temporary ligatures were applied to the jugular vein, as in the former case. A cylinder of quill, containing a little woorara, was then introduced into the vein between the two ligatures; another ligature was then applied (fig. 15), and the upper temporary ligature removed (fig. 16). In the space of 108 seconds after the removal of the ligature, the animal dropped in convulsions, as in the former case, and expired in 3¼ minutes. Now, in this experiment, the direct entrance of the poisoned blood into the heart, &c. was prevented by the lower ligature: hence, if this poison operated by contact with the brain, a greater length of time was necessary for its effects to be produced; inasmuch as the circulation was no longer going on through the trunk of the jugular itself, and, therefore, if the poison acted by actual contact, it must have got into the system by the vessels of the vein.

Fig. 15. Fig. 16.



This experiment, however, cannot be regarded as conclusive. For although the "result is certainly different from what might have been anticipated, on the supposition of the circulation of the poison in the blood being essential to its action, yet we cannot regard it as a conclusion against that supposition, unless it were shown that the poison, when the ligature above it is removed, and when it mingles itself with the stream of blood in the vein, does not taint this blood as far back as the next anastomosing branches, and so make its way forward to the heart. That this is not the effect of removing the farther ligature, is not shown by these authors; and their other experiments in favour of their peculiar doctrine of the mode of action of poisons, we have no difficulty in pronouncing to be inconclusive."—(See a criticism in *The British and Foreign Medical Review*, vol. v. for Jan. 1837.)

3. *By acting on the lining membrane of the blood-vessels.*—Messrs. Morgan and Addison contend, that when poisons are "introduced into the current of the circulation in any way, their effects result from the

impression made upon the sensible structure of the blood-vessels, and not from their direct application to the brain itself."—(*Essay*, p. 60.) The proofs adduced in support of this theory are, first, "the extreme susceptibility of the inner coat of a vein, when exposed to the action of a poison," as shown by the experiment related at page 26: secondly, that woorara acts on the brain as quickly when injected into the femoral, as when thrown into the carotid artery: thirdly, that woorara, applied to the cut surface of the cerebrum, caused no symptoms of poisoning: fourthly, that by establishing a complete double circulation between the carotids of a poisoned and of a sound dog, the latter does not become affected.

Of all these "proofs," however, the only important, though not unobjectionable one, is the first. The second and third are merely negative; their object being to show that poisons do not act by pervading the structure of the part, and to the fourth I have before offered some objections.

In conclusion, then, I would observe, that while Messrs. Morgan and Addison have thrown some doubt over our previously received notions on the operation of medicines, they cannot be admitted to have established their own hypothesis; and further experiments are still required to settle this doubtful question.

6. *Operation of Medicines by Nervous Agency.*

Messrs. Morgan and Addison contend, "that all poisons, and perhaps, indeed, all agents, influence the brain and general system, through an impression made upon the sentient extremities of the nerves, and not by absorption and direct application to the brain." Müller, on the other hand, asserts, "that before narcotic poisons can exert their general effects on the nervous system, they must enter the circulation."

Difficulties are met with by exclusively adopting either of these opinions. The operation of some medicines seems to be best explained by supposing the previous absorption of these agents, while that of other substances appears to be most satisfactorily accounted for by presuming they affect the nerves independently of absorption.

PROOFS THAT SOME SUBSTANCES ACT INDEPENDENTLY OF ABSORPTION.—Several circumstances lead us to infer that, in some instances, substances act on the general system without necessarily undergoing absorption.

a. The instantaneous operation of some Poisons.—One drop of pure hydrocyanic acid, says Magendie, placed in the throat of the most vigorous dog, causes it to fall dead after two or three hurried inspirations. If the nose of a rabbit be introduced into a receiver filled with hydrocyanic acid vapour, the animal drops dead instantly. Sir Benjamin Brodie once happened to touch his tongue with the end of a glass rod which had been dipped in the essential oil of bitter almonds; scarcely had he done so, before he felt an uneasy, indescribable sensation at the pit of the stomach, great feebleness of limbs, and loss of power to direct the muscles, so that he could hardly keep himself from falling. These sensations were quite momentary. In the cases now quoted the rapid action of the poisons seems almost incompatible with the idea of their absorption. Müller, however, thinks otherwise, and asserts they are explicable on the theory of absorption by imbibition. "The rapid effects of prussic acid," he observes, "can only be explained by its pos-

sessing great volatility and power of expansion, by which it is enabled to diffuse itself through the blood more rapidly than that fluid circulates, to permeate the animal tissues very quickly, and in a manner independent of its distribution by means of the blood, and thus to produce the peculiar material changes in the central organ of the nervous system more quickly in proportion as it is applied nearer to it."—(*Op. cit.* p. 247.)

b. The effects being disproportionate to the facility for absorption.—Orfila (*Toxicologie Générale*) says, that alcohol acts with much less energy when injected into the cellular texture, than when taken into the stomach; and as the power of absorption is greater in the former than in the latter part, he concludes that the remote action of alcohol must be produced by the agency of the nerves. Opium, on the contrary, is supposed to operate by absorption, because it is more active when injected into the cellular texture of the thigh than when taken into the stomach.

c. Dilution diminishing the remote effects.—The effect of dilution on the action of medicinal and poisonous agents oftentimes assists us in determining the mode by which the remote effects take place. Thus if we apply a strong mineral acid to the stomach, great disorder of the general system is produced; but if we dilute the acid previous to its exhibition, little disturbance in the system is observed. Now as dilution facilitates absorption, it is improbable that the constitutional disorder caused by swallowing strong mineral acids depends on their absorption. On the other hand, Dr. Christison (*op. cit.*) has shown that oxalic acid, considerably diluted, quickly enters the blood, and causes speedy death: hence it is presumed to kill in consequence of absorption.

d. Effect of Mechanical Injury.—Mechanical injuries sometimes give rise to effects on remote parts similar to those caused by the action of certain medicines or poisons. Laceration of the stomach produces similar constitutional disorder to that occasioned by the strong acids.

Agency of the Nervous System.—Between the individual parts of the organism there exist certain relations or connexions, which Adelon (*Physiologie de l'Homme*, t. 4me, p. 200,) has arranged in three classes,—the mechanical, the functional, and the sympathetic. It frequently happens that one organ in the performance of its functions exercises a mechanical influence over another. Thus the motions of the respiratory muscles have an important influence over the circulation of blood within the chest. By the contraction of the muscles of the fore-arm, pressure is made on the deep-seated veins, and the passage of blood through them thereby obstructed. These, then, are evident and clear cases of a *mechanical relation* between certain organs. We have also numerous instances of what have been called *functional relations;* but one example will suffice: the liver cannot secrete bile if the supply of arterial blood, or of nervous energy, be cut off: hence it is evident that the function of the liver depends for its performance on the proper execution of the functions of the arterial and nervous systems. But there is a class of relations which cannot be referred to either of the preceding heads, and which have been called the *true sympathies*, or the *sympathetic relations*. Thus if we titilate the mucous membrane of the nose, sneezing is produced; if the soft palate, vomiting.

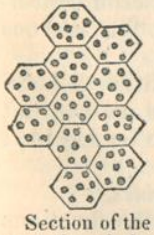
The phenomena hitherto called sympathetic have been denominated by Dr. Marshall Hall (*Memoirs on the Nervous System*, 1837,) *excito-motory*. They must not be confounded with those of sensation and

volition, from which they are quite distinct. They are effected by nervous fibres and a nervous centre. The fibres are of two kinds, one termed *incident excitor*, the other *reflex motor*. The centre is the grey matter of the true medulla oblongata and medulla spinalis, from which the nervous fibres arise.—(See *Grainger's Observations* on the *Structure* and *Functions* of the *Spinal Cord*, 1837.) The mode of action of these parts is this: when a physical agent is applied to any of the external or internal surfaces of the body, an impression is made on, and carried by, the incident excitor nerve to the grey matter, constituting the nervous centre of the system; and this part, by its peculiar power, excites contraction through the medium of its reflex motor nerves. Electricity has been suspected to be the secret agent effecting these communications.

When the nostrils are stimulated, the fauces irritated, or cold water dashed upon the face, filaments of the fifth pair of nerves are the incident excitors; when carbonic acid, or a drop of water, comes in contact with the larynx, and when the dust of ipecacuanha is inhaled into the bronchia, with the effect of inducing asthma, filaments of the pneumogastric nerve are the incident excitors. In all these instances filaments of the pneumogastric are the reflex motors, by means of which the actions of sneezing, vomiting, sobbing, closure of the larynx, and asthma, are produced. "It is singular," observes Dr. Hall, (*Lectures on the Nervous System*, p. 156, note,) "that ipecacuanha, taken into the stomach, should excite vomiting, and, inhaled into the bronchia, should excite spasmodic asthma, equally, as it would appear, through the pneumogastric nerve." Belladonna applied to the eyebrow causes dilatation of the pupil: the incident excitors concerned in this process are the fibres of the portio major of the fifth,—while the reflex motors are derived from the third or oculo-motor nerve. In cases of poisoning by this substance, difficulty or impossibility of deglutition has been observed,—another effect of its action on the excito-motory system.

Mr. Grainger is of opinion, that the ganglions of the sympathetic form a part, though to a certain degree an isolated one, of the excito-motory system; and that their action is excited like that of the spinal cord.—(*Op. cit.* p. 136, *et seq.*) He has also suggested (*op. cit.* pp. 131-2, 155-6-7,) that the motions displayed by plants and the lower animals are excited, and not voluntary; and that even in plants it may be effected by a structure analogous in its office, though differing in its physical characters, to the true spinal system of animals. Hitherto, however, no one has been able to demonstrate a nervous system in vegetables. Dutrochet (*Recherches anatomiques et physiologiques sur la structure intime des Animaux et des Végétaux*, 1824,) indeed asserts, that the small points, or spots, observed on the cells and vessels of plants (figs. 17 and 18,) are analogous to the nervous globules of animals; he calls them *nervous corpuscles*, and regards them as the scattered elements of a diffused nervous system. That globules are found in vegetables in the situation described by Dutrochet no one can deny; but the grounds on which he asserts them to be nervous are very slender. The researches of Leeuwenhoek, Prochaska, Fontana, Sir Everard Home, Bauer, the brothers Wenzel, and Dr. Milne

Fig. 17.

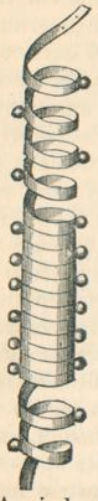


Section of the medulla of the *Mimosa pudica*, shewing the globular bodies adhering to the sides of the cells.

Edwards, he observes, have shewn that the nervous system of animals is composed essentially of agglomerated globular corpuscles.

If we examine, by the aid of a simple microscope, the pulpy matter of which the œsophageal ganglia of the great or vineyard snail *(Helix pomatia,)* or of the red slug *(Limax rufus,)* is made up, it is seen to be composed of agglomerated globular cells, on the sides of which are numerous globular or ovoid corpuscles (fig. 19.) In form and chemical properties, says Dutrochet, these corpuscles agree with those found in plants. Moreover, in the lower tribes of animals (the *Acrita*) we observe no nervous filaments; the nervous system consisting merely of the diffused or scattered corpuscles (as in the *Hydra* or fresh-water polype, fig. 20, and in *Vorticella Convallaria*, fig. 21; thus presenting another analogy between the nervous corpuscles of animals and the globular bodies of plants.

Fig. 18.

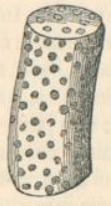


A spiral vessel, as found in the stems of *Solanum tuberosum*, and *Cucurbita Pepo*, with the adhering globules.

Fig. 19.

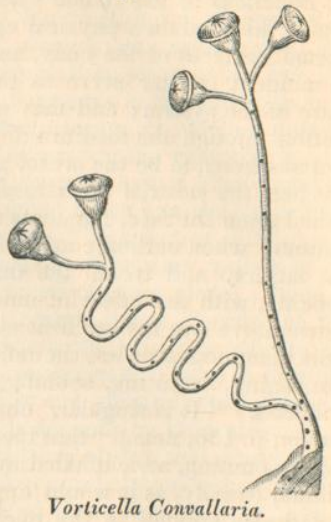
Globular cells of the œsophageal ganglia of *Helix pomatia* and *Limax rufus*.

Fig. 20.



Magnified view of the arm of a *Hydra*, (fresh-water polype) shewing the nervous corpuscles.

Fig. 21.



Vorticella Convallaria.

On these grounds, then, Dutrochet assumes that the little globules sticking to the cells and vessels of plants, and which are nothing but particles of amylaceous, ligneous, or resinous matter, are to be regarded as the scattered elements of a diffused nervous system.

7. *Parts affected by the remote action of Medicines.*

The remote effects of medicines consist of alterations in the functions of one or more organs more or less distant from the parts to which these agents were applied. Although an alteration of function presupposes an organic change, yet the latter is not always obvious.

A medicine may affect a distant organ directly or indirectly. The stupor caused by opium is presumed to arise from the direct influence exercised by this drug over the cerebrum, since it cannot be otherwise

accounted for. The convulsions produced by strychnia are best explained, not by ascribing them to any direct influence of this agent over the muscles, but to an influence exercised over the excito-motory system, which is functionally related to the muscles.

Some medicinal agents confine their remote influence principally to one organ, and affect the general system only through the relations existing between the affected organ and the other parts of the body. This is remarkably the case with the substance just referred to,—strychnia. Other agents affect several organs, as arsenic and mercury. We can readily believe that some may affect the whole system, by altering the qualities of the blood. "In fact, when all the tissues thus receive a vitiated blood, is it not consistent with sound physiology to admit that their regular modes of vitality, nutrition, and secretion, must be more or less deeply modified? We must either admit this conclusion, or deny the influence which, according to every physiologist, the blood exerts over each solid. It may, then, happen that one or more organs are affected in a more decided manner than the rest, and there may thus be produced in them various lesions that are only accidental and secondary; but it is not in these lesions the origin of the affection lay; it is not on them all the symptoms depend; nor, lastly, is it to them alone we are to have recourse, to throw a light upon the true nature of the disease, as well as upon the treatment proper to be pursued."—(*Andral's Pathol. Anat.* by Drs. Townshend and West, vol. i. p. 663.)

The intimate relations existing between the different organs and functions, make it exceedingly difficult, and, in many cases, even impossible, to distinguish between the direct and indirect influence of a medicine. In the following examples of organs and functions affected by medicines, this distinction has not been attempted :—

1. *Nervous System.*—Opium causes sleep and stupor,—alcohol inebriates and disturbs volition,—aconite diminishes feeling,—conia paralyses,—strychnia and brucia convulse.

2. *Circulating System.*—The frequency and force of the circulation is increased by the agents termed excitants, calefacients, or stimulants, but diminished by sedatives. Preternatural heat is reduced by refrigerants. (On the influence of asafœtida, digitalis, and senega, on the functions of the heart, see *Continental* and *British Medical Review*, Vol. I. p. 27.)

3. *Respiratory System.*—The frequency of respiration is diminished by narcotics. Emetic tartar and corrosive sublimate, used as poisons, inflame the lungs. Expectoration is promoted by the agents termed expectorants.

4. *Digestive System.*—Salivation is produced by mercury. The power of deglutition is diminished or destroyed by belladonna, when employed in poisonous quantities. Vomiting is caused by emetics. Digestion is promoted by condiments and the bitter tonics, but checked by opium. Purging is effected by cathartics,—constipation by opium and vegetable astringents. Mercury and aloes are believed to stimulate the liver.

5. *Secreting and exhaling organs.*—Mercurials and the alkalis increase the activity of all the secreting and exhaling organs. The oleo-resins and balsams stimulate the mucous surfaces. Opium diminishes the mucous secretions. Diuretics promote the secretion of urine,—diaphoretics the cutaneous exhalation,—sialogogues the flow of saliva,—emmenagogues the catamenial secretion,—expectorants the bronchial secretions, &c.

6. *Lymphatic System.*—Iodine, bromine, mercury, and the alkalis, are presumed to increase the activity of the lymphatic system.

7. *Muscular System.*—The tone of this system is promoted by cinchona. Strychnia convulses, conia paralyses the muscles.

8. *Sexual System.*—The sexual feelings are supposed to be excited by phosphorus. The catamenial discharge is promoted by emmenagogues. Parturition is assisted by ergot of rye.

9. *The Urinary organs.*—Diuretics increase the secretion of urine. Alkalis and acids alter the qualities of this fluid. Opium diminishes the contractility of the ureters and bladder. Cantharides irritate the bladder. The oleo-resins affect the urethra, and cure blennorrhagia.

8. *Of the nature or quality of the actions induced by Medicines.*

Medicinal agents may increase, diminish, or alter the vital actions, and, consequently, may be arranged in the three classes of stimulants, contra-stimulants or sedatives, and alteratives.

a. Stimulants.—In a therapeutic sense, says Müller, (*op. cit.* p. 62,) a stimulant is an agent which vivifies the organs, and renovates their composition. "Besides the vital stimuli before alluded to, there are other agents which, under certain conditions, exert a local, vivifying, and strengthening influence: they produce this effect by restoring the composition of the organ by their ponderable or imponderable influence, or by so changing its composition that the renovation by the general vital stimuli is facilitated. All this, however, depends on the state of the diseased organ; and the cases in which the so-called stimulant and tonic remedies have really their supposed effect, are very rare."

Many other agents are called stimulants, although they have no renovating influence, and do not vivify except by exciting re-action, and which, by long-continued operation, destroy, instead of restoring, the powers of the system.

b. Contra-stimulants, or sedatives.—These are agents whose action is the reverse of that of stimulants.

c. Alteratives.—These are neither stimulants nor contra-stimulants merely. They produce some unnatural or morbid change in the organic textures, and consequently occasion alteration of function. This class includes nearly the whole of the articles comprising our materia medica.

Brunonian theory.—The theory of Dr. John Brown supposes that all living beings possess a peculiar principle, termed *excitability*, and which distinguishes them from inanimate bodies. The agents which support life are termed *exciting powers;* and these acting upon the *excitability*, maintain life; in the language of Brown, produce *excitement*. Whatever can modify the excitability, and produce a greater or less degree of excitement, are termed *stimulant powers:* these are either universal or local. When the exciting powers act moderately, *health* is produced: when they act with too great energy, they cause *indirect debility:* when with too little, they produce *direct debility*. According to this doctrine, all medicines are stimulants, and differ from each other in little more than the degree in which they exert their stimulant power: moreover, they cannot cause exhaustion (of the excitability) except by an excessive action; in other words, by producing previous over-excitement.—(*The Works of Dr. John Brown*, by Dr. W. C. Brown, 1804.)

Considered in a therapeutical point of view merely, the following objections present themselves to this theory:—1. Many agents produce exhaustion without previously occasioning any obvious over-excitement (as the respiration of sulphuretted hydrogen or hydrocyanic acid gases):—2. Medicines differ from each other in something more than the degree of their power; compare together foxglove, ammonia, hydrocyanic acid, cinchona, mercury, alcohol, elaterium, and opium:—3. The great majority of our medicines act neither as stimulants nor sedatives merely; they alter the quality of the vital actions: and this alterative effect has been quite overlooked by the Brunonians.

Theory of Contra-stimulus—New Italian doctrine.—This theory may be considered as a modification of the preceding. It was founded about the commencement of the present century, principally by Rasori and Borda, and was subsequently adopted by Tommasini and other Italians.

It admits two classes of medicines, *stimulants* and *contra-stimulants*, thus obviating one of the objections to the doctrine of Brown. An agent that counteracts the effects of some well-known and well-characterized stimulant is denominated a contra-stimulant. The following is a list of remedies classified according to these principles:—

Stimulants.		*Contra-stimulants.*	
Caloric.	Carbonic acid.	Cold.	Nux vomica.
Opium.	The electric fluid.	Blood-letting.	Valerian.
Musk.	Aromatics.	Metallic medicines.	Coffee.
Camphor.	Cinchona (by some this is regarded as contra-stimulant.)	Emollients.	Mustard and pepper.
Phosphorus.		Tonics.	Cantharides.
Ether.		Ipecacuanha.	Turpentine.
Ammonia.	Red particles of the blood.	Purgatives.	Squills.
Wine.		Hydrocyanic acid.	Nitrate of potash.
Alcohol.	Animal food.	Digitalis, belladonna, stramonium, *Lactuca virosa*, &c.	Acids and oxygen.

It will be perceived that the founders of this doctrine have assembled, under the same head, agents causing the most opposite effects: for example, animal food and opium, aromatics and alcohol, cold and turpentine, hydrocyanic acid and cantharides. Moreover, they have separated others whose general operation is very analogous;—as musk and valerian; opium and *Lactuca virosa;* aromatics and pepper. In their anxiety to find stimulants and contra-stimulants, they have quite overlooked the large and important class of alteratives. They have taken no notice of the physiological effects of medicines, but have directed their whole attention to curative influences, which are accidental and uncertain: for the agents which they have collected under the head of contra-stimulants do not always, or even frequently, relieve excitement; on the contrary, they often have the reverse effect.

There is one part of the theory that deserves especial notice. It is asserted that the dose of a contra-stimulant should be proportioned to the degree of excitement; for when the inflammatory action runs high, the patient will bear enormous doses without any obvious evacuation from the skin, stomach, or bowels, and the disease will be subdued wholly by the contra-stimulant effect upon the fibres and other solids of the body. This capability of bearing large doses has been termed *tolerance* of medicines;—and, of course, if the theory be true, ought to decrease as the disease

declines; but this certainly does not generally hold good with respect to emetic tartar, as will be mentioned hereafter. Dr. Marshall Hall (*Researches relative to the Morbid and Curative Effects of Loss of Blood*, 1830, also, *Introductory Lecture*, 1834,) maintains, that while a man in health can lose a given quantity of blood (say ℥xv.) without fainting, the same individual, affected with congestion of the brain or inflammation, can bear a much larger quantity (as from ℥xxx. to ℥l.) before incipient syncope,—while in fever, intestinal irritation, dyspepsia, or cholera, a smaller quantity (as from ℥vi. to ℥xii.) will occasion fainting:—so that congestion and inflammation augment, while fever, cholera, &c. diminish the tolerance of blood-letting; he therefore makes use of this circumstance as a diagnostic to enable him to distinguish irritation from inflammation.

9. *Circumstances which modify the effects of Medicines.*

The circumstances which modify the effects of medicines may be arranged under two heads; those relating to the medicine, and those relating to the organism.

1. Relating to the Medicine.—Under this head are included,—

a. State of Aggregation.—The state of aggregation of a medicine modifies the effect. Thus morphia is more active in solution than in the solid state.

b. Chemical combination.—The soluble salts of the vegetable alkalis are more active than the uncombined alkalis, and *vice versâ*, the insoluble salts are less active. Lead and baryta are rendered inert by combination with sulphuric acid.

c. Pharmaceutical mixture.—The modifications produced by medicinal combinations have been very ably described by Dr. Paris.—(*Pharmacologia*, 6th ed. vol. i. p. 267.) The objects to be obtained, he observes, by mixing and combining medicinal substances, are the following:—

I. *To promote the action of the basis or principal medicine:*—

A. By combining together several forms or preparations of the same substance: as when we conjoin the tincture, decoction, and extract of cinchona in one formula.

B. By combining the basis with substances which are of the same nature, that is, which are individually capable of producing the same effect, but with less energy than when in combination with each other: as when we prescribe a compound of cassia pulp and manna.

C. By combining the basis with substances of a different value, and which do not exert any chemical influence upon it, but are found, by experience, to be capable of rendering the stomach, or system, or any particular organ, more susceptible of its action: as when we combine mercury with antimony and opium, to increase the activity of the former.

II. *To correct the operation of the basis, by obviating any unpleasant effects it might be likely to occasion, and which would pervert its intended action, and defeat the objects of its exhibition.*

A. By mechanically separating, or chemically neutralizing, the offending ingredient; as by digesting *Cetraria Islandica* in an alkaline solution, in order to remove the bitter principle, and to enable us to obtain a tasteless, but highly nutritious fecula.

B. By adding some substance capable of guarding the stomach or system against its deleterious effects; as when we combine aromatics with drastic purgatives, to correct the griping qualities of the latter;—or opium with mercurials, to prevent the latter affecting the bowels.

III. *To obtain the joint operation of two or more medicines.*

A. By uniting those substances which are calculated to produce the same ultimate results, although by totally different modes of operation: as when we combine

digitalis and potash to produce diuresis,—the first acting on the absorbents, the second on the secreting vessels of the kidneys.

B. By combining medicines which have entirely different powers, and which are required to obviate different symptoms, or to answer different indications: as when we combine opium and purgatives in painter's colic,—the first to relieve the spasm, the second to evacuate the contents of the intestinal canal.

IV. *To obtain a new and active remedy not afforded by any single substance.*

A. By combining medicines which excite different actions in the stomach and system, in consequence of which new or modified results are produced: as when we combine opium (a narcotic) with ipecacuanha (an emetic) to obtain a sudorific compound.

B. By combining substances which have the property of acting chemically upon each other; the result of which is, the formation of new compounds, or the decomposition of the original ingredients, and the developement of their more active elements: as when solutions of acetate of lead and sulphate of zinc are mixed to procure a solution of the acetate of zinc; and when the compound iron mixture of the Pharmacopœia is prepared.

C. By combining substances, between which no other chemical change is induced, than a diminution, or an increase, in the solubilities of the principles, which are the repositories of their medicinal virtues: as when we combine aloes with soap, or an alkaline salt, to quicken their operation, and remove their tendency to irritate the rectum.

V. *To afford an eligible form.*

A. By which the efficacy of the remedy is enhanced; as in the preparation of decoctions, infusions, tinctures, &c.

B. By which its aspect or flavour is rendered more agreeable; as when we exhibit medicines in a pilular form, or when we exhibit them in a state of effervescence.

C. By which it is preserved from the spontaneous decomposition to which it is liable; as when we add some spirituous tincture to an infusion.

d. Organic peculiarities.—Vegetables have their medicinal properties considerably modified by the nature of the soil in which they grow, by climate, by cultivation, by age, and by the season of the year when gathered.

e. Dose.—The modifications produced in the effects of medicines by differences of dose, are well seen in the case of opium, mercurials, and turpentine.

2. Relating to the Organism.—Under this head are included several circumstances, of which the most important are the following:—

a. Age.—One of the most distinctive characters of organised beings is that of undergoing perpetual mutation during the whole period of their existence; thus constituting the phenomena of age. In order the better to appreciate these changes, the life of man has been portioned out into certain periods or ages, as they have been termed, though as these pass imperceptibly into each other, there is no absolute or fixed distinction; and, consequently, the number of these periods has not been generally agreed on; some admitting only three, others four, five, six, seven, or even eight; the most popular number being seven.

Each period of life is characterised by certain conditions of the solids, by particular states of the functions, by a tendency to certain diseases, and by a different susceptibility to the influence of medicines.

The effects of medicines are modified both quantitatively and qualitatively, by the influence of age. Hufeland (*Lehrbuch der allgemeinen Heilkunde*, 2te Aufl. 1830, p. 84) has drawn up the following scale for different ages:—

Years.	25	20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Doses.	40	35	30	29	28	27	26	25	24	23	22	21	20	18	16	13	10

Months.	11	10	9	8	7	6	5	4	3	2	1	½
Doses.	9		8		7		6		5	4	2	1

Suppose the dose at the end of the first year to be 1, then at the fifth it will be 2, at the fifteenth 3, and at the twenty-fifth 4. In the above table the dose for an adult is supposed to be 40 grains. Dr. Young (*Introduction to Medical Literature*, 2nd ed. p. 453) gives the following rule for determining the doses for children under twelve years of age:— "The doses of most medicines must be diminished in the proportion of the age to the age increased by 12. For example, at two years old, to $\frac{1}{7} = \frac{2}{2+12}$. At twenty-one, the full dose may be given." But no rule is of much value, as the degree of developement is very unequal in different children of the same age. Moreover, the rule that applies to one medicine will not hold good with respect to others. This is particularly obvious in the cases of opium and calomel: the first must be given to children with the greatest caution, and in excessively small doses, whereas the second may be given to them almost as freely as to adults. Acetate of lead, nitrate of silver, arsenious acid, and some other metallic compounds, ought, perhaps, never to be prescribed for infants.

b. Sex.—The sex has an influence in the operation of medicines. Females differ from males in greater susceptibility of the nervous system, more excitability of the vascular system, and less energy or power in all parts. In these respects, indeed, they approach children. Women, therefore, require, for the most part, smaller doses of medicinal agents than men.

The periods of menstruation, pregnancy, and lactation, are attended with peculiarities in relation to the action of medicines. Drastic purgatives should be avoided during these states, especially the two first. Agents which become absorbed, and thereby communicate injurious qualities to the blood, are of course to be avoided during pregnancy, on account of the probable ill effects on the fœtus.

c. Mode of life: Occupation.—These circumstances affect the susceptibility of the whole organism, or of individual parts, to the influence of external agents.

d. Habit.—The habitual use of certain medicinal or poisonous agents, especially narcotics, diminishes the influence which they ordinarily possess over the body. Of the truth of this statement we have almost daily proofs in those who are confirmed drunkards, chewers and smokers of tobacco, and opium-eaters. Instances of the use of enormous doses of opium, with comparatively slight effects, will be found in every work on pharmacology. One of the most remarkable I have met with, is that related by G. V. Zeviani (*Sopra un vomito Urinoso*, in the "*Memorie di Matematica e Fisica della Societa italiana.*" Verona, t. vi. 1792-4, p. 93). A woman of the name of Galvani, during a period of thirty-four years, took more than *two cwt.* of solid opium!! When nineteen years old she fell down stairs, and divided her urethra by a knife. Although the wound healed, she was unable to pass her urine in the usual way, but vomited it up daily with excruciating pain, to relieve which, she resorted to the use of opium, the doses of which were gradually increased to 200 grains daily.

The influence of acrid or irritating substances is but little diminished by repetition,—a remark which applies especially to bodies derived from the mineral kingdom. There are, indeed, a few instances illustrative of the effect of habit in lessening the sensible influence of inorganic agents,

but their number is small. The most common is the tolerance obtained by the repeated use of tartar emetic in peripneumonia.

Several attempts have been made to account for the effect of habit. Some ascribe it to an increased power acquired by the stomach of decomposing the medicinal agent,—an explanation adopted, in the case of poisons, by Dr. Christison, and which he illustrates by reference to the increased facility acquired by the stomach of digesting substances which had at first resisted its assimilative powers. If this explanation were correct, we ought to observe the effect of habit principally when substances are swallowed, and little, or not at all, when they are applied to a wound, to the cutis vera, or other parts unendowed with digestive powers, and opium ought to have its usual effects in ordinary doses, on application to any part of the body of an opium-eater, except to his stomach. Müller (*op. cit.* p. 60), as I have before noticed (p. 11), ascribes a great number of the instances of habituation to the substance affecting the composition of an organ, and losing its influence by saturation, while the part may still be susceptible of the action of another agent. But a strong objection to this hypothesis is, that the effect of habit is observed principally in the case of narcotic vegetables, and is scarcely perceived in inorganic substances which evince the most powerful affinities for organic principles. The same physiologist ascribes part of the phenomena observed in the effects of habit to the excitability of the organ being deadened by the stimulus being too often repeated.

e. Diseased conditions of the body.—Diseases of various kinds sometimes have a remarkable influence in modifying the effects of medicines; a fact of considerable importance in practice. One of the most striking instances is that of opium in tetanus. A scruple of this substance has been given at one dose, and repeated every two or three hours for several days, without any remarkable effects being produced. The late Mr. Abernethy mentions in his lectures (*Lancet*, vol. v. 1824, p. 71) a patient who had tetanus from a wound which he received at the time of the riots in the year 1780, to whom a scruple of opium was given every day, besides a dose of a drachm at night: when his body was opened, thirty drachms of opium were found undissolved in his stomach. It might perhaps be inferred, that the diminished effect arose from the want of solution of the medicine; and that this was Mr. Abernethy's opinion seems presumable from his advice as to the mode of using it in this disease. "Give it," says he, "repeatedly in small doses, so that it may liquefy." However, that the want of liquefaction or solution is not the sole cause of this diminished influence, is proved from the fact that the tincture is also less effective in tetanus than in health.

Begin (*Traité de Thérapeutique*, t. ii. p. 701) tells us, that M. Blaise, in a case of tetanus, administered in ten days, four pounds, seven ounces, and six drachms of laudanum, and six ounces, four drachms, and forty-five grains of solid opium! Begin (*op. cit.* t. i. p. 113) endeavours to explain these facts by assuming that the stomach acquires an increase of assimilative power, so that it is capable of digesting these enormous quantities of opium, in consequence of which their usual narcotic effects do not take place. He supports this hypothesis by stating, that if, during tetanus, opium be injected into the veins in much smaller quantities, it produces its usual effects. But if this latter assertion be correct, it does not at all warrant Begin's assumption; and bearing in mind that opium

administered by clysters during tetanus is less powerful than usual, and also taking into consideration the case related by Mr. Abernethy, I think we have evidence sufficient to warrant our non-admission of this hypothesis. All, therefore, that can be said in the way of explanation, is, that in tetanus the nervous system has undergone some change by which its susceptibility to the influence of opium is considerably diminished.

Another example of the influence of disease in modifying the effects of medicines is seen in the difficulty of causing salivation in fever by the use of mercury. I have repeatedly seen large quantities of mercurials exhibited internally during this disease, and in some cases accompanied with mercurial frictions, without affecting the mouth, and in general such cases terminated fatally. I never saw a fatal case of fever in which salivation was established; but whether the recovery was the consequence of the mercurial action, or the salivation of the recovery, I will not pretend to decide, though the first is the more plausible view.

e. Climate —The well-known influence of climate in modifying the structure and functions of the animal economy, and in promoting or alleviating certain morbid conditions, necessarily induce us to ascribe to it a power of modifying the effects of medicines. But it is difficult to obtain pure and unequivocal examples of it, in consequence of the simultaneous presence and influence of other powerful agents.

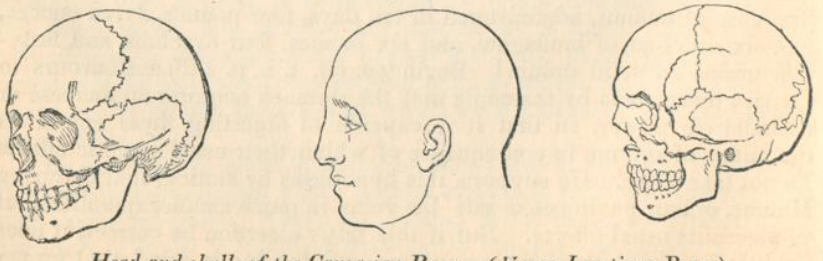
f. Mind.—The effects of medicines are very much modified by the influence of the mind. Hufeland (*op. cit.* p. 80,) knew a lady who, having conceived a violent aversion to clysters, was thrown into convulsions by the injection of a mixture of oil and milk. I have heard the most violent effects attributed to bread pills, which pills the patients had been previously informed exercised a powerful influence over the system. Much of the success obtained by empirical practitioners depends on the confidence which patients have in the medicines administered.

g. Race or *species.*—The effects of some medicines are not uniform on the different races or species of man.

The genus *Homo* is considered by most naturalists (among which may be mentioned the names of Blumenbach, Cuvier, Lawrence, and Pritchard,) to be made up of but one species: the differences which are observed between the inhabitants of certain regions of the world being regarded as sufficient to constitute varieties or races only, and not distinct species. Bory de St. Vincent, (*Essai Zoologique sur le Genre Humain*, 2nd edit. 1827,) however, admits no less than fifteen species.

The *races*, according to Cuvier, (*Le Règne Animal*, nouv. ed. 1824,) are three: the white, or *Caucasian;* the yellow, or *Mongolian;* the negro, or *Æthiopian.*

Fig. 22.



Head and skulls of the Caucasian Race —(Homo Japeticus, Bory.)

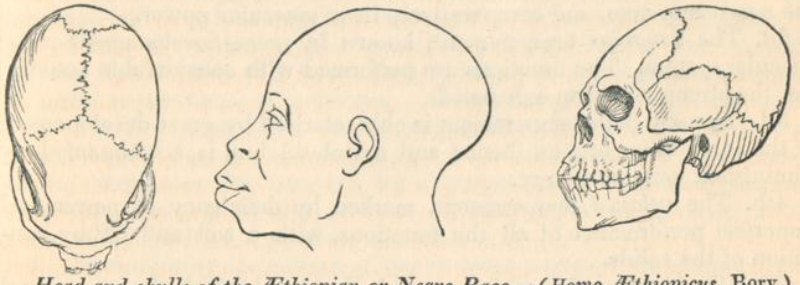
The *Caucasian race* is characterised "by a white skin; red cheeks; copious, soft, flowing hair, generally curled or waving; ample beard; small, oval, and straight face, with the features very distinct; expanded forehead; large and elevated cranium; narrow nose; and small mouth." It includes all the Europeans, the Laplanders excepted, the western Asiatics, and northern Africans.

Fig. 23.

Head and skulls of the Mongolian race.

The *Mongolian* race is characterised by "an olive yellow-coloured skin; hair thin, coarse, and straight; little or no beard; broad flattened face, with the features running together; small and low forehead; square-shaped cranium; wide and small nose; very oblique eyes; and thick lips. Stature inferior to the Caucasian." This race includes the eastern Asiatics, the Laplanders in Europe, and the Esquimaux in North America.

Fig. 24.



Head and skulls of the Æthiopian or Negro Race.—(Homo Æthiopicus, Bory.)

The *Æthiopian race* is characterised by "a black skin; hair short, black, woolly; skull compressed on the sides, and elongated towards the point; forehead low, narrow, and slanting; cheekbones very prominent; jaws projecting, so as to render the upper front teeth oblique; eyes prominent; nose broad and flat; lips (especially the upper one) particularly thick." It comprehends the Africans to the south of the Atlas chain.

Differences of race have been supposed to give rise, in some cases, to differences in the action of medicines on the body. Thus Charvet (*De l'Action comparée de l'Opium*, p. 59,) ascribes to this circumstance the different effects of opium on the Javanese and Malays (both belonging to the Mongolian race) as compared with those produced on Europeans, Turks, and Persians (the Caucasian race.) "The Javanese," says Lord Macartney, (*Embassy to China*, vol. i. p. 263-4,) "under the influence of an extraordinary dose of opium, becoming frantic as well as desperate, not only stab the objects of their hate, but sally forth to attack, in like man-

ner, every person they meet, till self-preservation renders it necessary to destroy them." A very similar account is given by Raynal (*Histoire Philosophique et Politique des Deux Indes*, t. 1er, p. 359,) of the effects of opium on the Malays.

h. Temperaments. — Under the denomination of temperaments are included peculiarities affecting certain individuals, independent of race, and which consist in disproportions in the developement or activity of certain organs, by which the whole animal economy is influenced. The term temperament is derived from the Latin verb *tempero, to mix together*, or *to temper*, and is applied to certain conditions of the body formerly supposed to arise from variations in the proportions of the fluids of the body. Thus, when the fluids were thought to be in proper relative proportions, they were said to temper each other, and by so doing, to produce a perfect temperament. When the yellow bile was supposed to be in excess it produced the choleric or bilious temperament; when black bile, the atrabilious or melancholic; when blood, the sanguineous; and lastly, when pituita or phlegm, the pituitous or phlegmatic. Although in modern times physiologists do not admit these notions, yet we cannot but acknowledge that individuals do present certain physical and functional peculiarities: and thus the existence of temperaments has been generally admitted, while the theory or explanation of them has varied with the prevailing medical doctrines of the day.

The number of temperaments has not been agreed on; Hippocrates admitted four, Boerhaave eight, others five. Under five heads, I think, we may include the leading varieties, which will then stand as follows:—

1st. The *nervous* temperament, characterised by great susceptibility of the nervous system, and comparatively little muscular power.

2d. The *sanguine* temperament, known by great developement of the vascular system. The functions are performed with considerable activity, but the strength is soon exhausted.

3d. The *muscular* temperament is characterised by great developement of the locomotive organs (bones and muscles;) but is accompanied by diminished nervous energy.

4th. The *relaxed* temperament, marked by deficiency of power and imperfect performance of all the functions, with a soft and flabby condition of the solids.

5th. The most *perfect* temperament is that in which all the organs and functions are properly balanced, and in which we have the greatest strength.

Each of these temperaments varies in regard to its susceptibility to the influence of medicinal agents. In the sanguine temperament stimulants are to be employed very cautiously: in the nervous and relaxed temperaments, evacuants are to be used with great care.

i. Idiosyncrasy.—Under this denomination are included these peculiarities which affect the functions of organs, without having any obvious relation to developement, and which are not common to a number of individuals. Its effect in modifying the effects of medicines and poisons is, in general, to increase their activity. Thus, some individuals are peculiarly susceptible of the action of opium, some of mercury, and others of alcohol. The odour of ipecacuanha will, in certain persons, produce short and difficult respiration, approaching almost to a paroxysm of asthma. The late Mr. Haden (*Dr. Dunglison's translation of Magendie's Formulary, with notes*

by C. T. Haden, Esq. 1825,) has related a case in which two drachms and a half of tincture of colchicum produced death: the mother of the patient was also exceedingly susceptible of the action of colchicum even in very small doses. In some instances the effect of idiosyncrasy is to diminish the activity of medicines. Thus some persons are exceedingly insusceptible of the action of mercury.

k. Tissue or *organ.*—The nature of the part to which a medicine is applied, has an important influence over the effect produced. The stomach, for example, is much more susceptible of medicinal impressions than the skin. Opium acts more powerfully on the system when applied to the serous than to the mucous tissues. Carbonic acid acts as a positive poison when taken into the lungs, but as a grateful stimulant when applied to the stomach. The modifications effected by the nature of the tissue will be more fully noticed hereafter.

8. *Therapeutical Effects of Medicines.*

The effects produced on diseases by the influence of medicines are denominated *therapeutical.* They are sometimes termed *secondary*, because, in a great majority of instances they are subordinate to those already described under the name of physiological.

Mode of production.—Therapeutical effects are produced in two ways:—

1. *By the influence of a medicine over the causes of diseases.*—This may be *direct* or *indirect.* Medicines which act directly are termed by Hufeland (*Lehrbuch*, p. 194) *specifica qualitativa.* As examples, the chemical antidotes may be referred to. Those anthelmintics (as oil of turpentine), which poison intestinal worms, also belong to this division. If the efficacy of sulphur in the cure of itch depend on its destroying the *Acarus Scabiei*, this will be another instance of the direct operation of an agent on the cause of a disease. As an example of a medicine acting *indirectly*, I may mention the dislodgement of a biliary calculus, contained in the ductus choledochus, by the administration of ipecacuanha as an emetic: or the removal, by a purgative, of a morbid condition of system, kept up by the presence of some depraved secretion in the bowels, the result of a previous disease.

2. *By modifying the actions of one or more parts of the system.*—In a large majority of instances the causes of disease are either not known, or they are not of a material nature. In all such cases we administer medicines with the view of producing certain changes in the actions of one or more parts of the system, and thereby of so altering the diseased action as to dispose it to terminate in health. Thus inflammation of the lungs frequently subsides under the employment of nauseating doses of tartarized antimony; and emetics will sometimes put a stop to the progress of hernia humoralis.

The medicines belonging to this division may be arranged in two classes; those which are applied to the diseased part, and, secondly, those which are applied to other parts.

a. Topical agents.—Under this head we include unguents or lotions used in cutaneous diseases, ulcers, &c.; gargles in affections of the mouth and throat; collyria in ophthalmic diseases; and injections into the vagina and uterus in affections of the urino-genital organs. In all such cases we can explain the therapeutic effect in no other way than by assuming

that the medicine sets up a new kind of action in the part affected, by which the previous morbid action is superseded; and that the new action subsides when the use of the medicine is suspended or desisted from. Sometimes it may be suspected that the influence which certain medicines exercise in diseases of remote organs, arises from their particles being absorbed, and, through the medium of the circulation, carried to the parts affected. Thus the beneficial influence which the turpentines occasionally exert in affections of the mucous membranes (as in gleet and leucorrhœa) may perhaps be owing to a topical influence of this kind; as also strychnia in affections of the spinal marrow.

b. Medicines which indirectly influence diseased action.—Under this head I include all those agents operating on some one or more parts of the body, which have a relation with the diseased part. Thus emetics may influence a disease by the mechanical effects of the vomiting which they induce. Alterations in the quality of the food relieve diseases depending on morbid changes of the blood,—as when we substitute fresh meat and vegetables, and the use of vegetables acids, for salt provisions in scurvy. Opium relieves spasm and pain, as in colic, or in the passage of calculi. Purgatives relieve cutaneous and cerebral affections; diuretics, dropsies; blisters, internal diseases, &c.

Fundamental methods of cure.—According to the homœopathists there are only three possible relations between the symptoms of diseases and the specific effects of medicines—namely, *opposition*, *resemblance*, and *heterogeneity*. It follows, therefore, that there are only three imaginable methods of employing medicines against disease; and these are denominated *antipathic*, *homœopathic*, and *allopathic*.

1. *Antipathia* (from Ἀντὶ, *opposite*, and Πάθος, *disease*).—The antipathic (called also by Hahnemann, *enantiopathic* or *palliative*) method consists in employing medicines which produce effects of an opposite nature to the symptoms of the disease, and the axiom adopted is "*contraria contrariis opponenda.*" Hippocrates may be regarded as the founder of this doctrine; for in his twenty-second Aphorism (*Aphorismi*, *Sectio* 2^{nda},) he observes—"All diseases which proceed from repletion are cured by evacuation; and those which proceed from evacuation are cured by repletion. And so in the rest; contraries are the remedies of contraries."

We adopt this practice when we employ purgatives to relieve constipation; depletives to counteract plethora; cold to alleviate the effects of scalds; narcotics to diminish preternatural sensibility or pain; and opium to check diarrhœa.

But purgatives are not to be invariably employed in constipation, nor opium in pain. Reference must be constantly had to the cause of these symptoms. If confinement of bowels depend on a torpid condition of the large intestines, powerful purgatives may be administered with great benefit; but if it arise from acute enteritis or strangulated hernia, they will probably increase both the danger and sufferings of the patient. Again, opium may be beneficially given to relieve the pain of colic, but it would be highly improper in all cases of acute pain, as in pleurisy.

The homœopathists object to antipathic remedies, on the ground that though the primary effects of these agents may be opposite to the phenomena of a disease, the secondary effects are similar to them. "Constipation excited by opium (primitive effect) is followed by diarrhœa (secondary effect); and evacuations produced by purgatives (primitive

effect) are succeeded by costiveness, which lasts several days (secondary effect)." (*Hahnemann, Organon*, § lxi). The only mode of meeting statements of this kind is to appeal to experience. Is opium ever beneficial in diarrhœa? Are purgatives useful in any instances of constipation? The homœopathists reply to both of these questions—No. We answer—Yes. Here, then, we are at issue with them on a matter of fact.

2. *Homœopathia* (from Ὅμοιος, *like* or *similar*, and Πάθος, *a disease*).—The homœopathic method of treating diseases consists in administering a medicine capable of producing an affection similar to the one to be removed, and the axiom adopted is "*similia similibus curantur*."

Hahnemann's first dissertation on homœopathy was published in 1796, in Hufeland's Journal (*Preface* to the English Translation of the "*Organon*.") In 1805 appeared his "*Fragmenta de viribus medicamentorum positivis*." But the first systematic account of this doctrine appeared in 1810, in a work entitled "*Organon der rationellen Heilkunde*."

The following, says Hahnemann, are examples of homœopathic cures performed unintentionally by physicians of the old school of medicine:

The author of the fifth book, Ἐπιδημιῶν, attributed to Hippocrates, speaks of a patient attacked by the most violent cholera, and who was cured solely by white hellebore; which, according to the observations of Forestus, Ledelius, Reimann, and many others, produces of itself a kind of cholera. The English sweating sickness of 1485, which was so fatal that it killed 99 out of 100 affected with it, could only be cured by the use of sudorifics. Dysentery is sometimes cured by purgatives. Tobacco, which causes giddiness, nausea, &c. has been found to relieve these affections. Colchicum cures dropsy, because it diminishes the secretion of urine, and causes asthma in consequence of exciting dyspnœa. Jalap creates gripes; therefore it allays the gripes which are so frequent in young children. Senna occasions colic; therefore it cures this disease. Ipecacuanha is effectual in dysentery and asthma, because it possesses the power of exciting hæmorrhage and asthma. Belladonna produces difficult respiration, burning thirst, a sense of choking, together with a horror of liquids when brought near the patient; a flushed countenance, eyes fixed and sparkling, and an eager desire to snap at the by-standers; in short, a perfect image of that sort of hydrophobia which Sir Theodore de Mayerne, Münch, Buchholz, and Neimicke, assert they have completely cured by the use of this plant. When, indeed, belladonna fails to cure canine madness, it is attributable, according to Hahnemann, either to the remedy having been given in too large doses, or to some variation in the symptoms of the particular case, which required a different specific—perhaps hyoscyamus, or stramonium. Drs. Hartlaub and Trinks have subsequently added another homœopathic remedy for hydrophobia—namely, cantharides. Opium cures lethargy and stupor, by converting it into a natural and healthy sleep. The same substance is a cure for constipation. Vaccination is a protection from small-pox, on homœopathic principles. The best application to frost-bitten parts is cold, either by the use of some freezing mixture or by rubbing the part with snow. In burns or scalds the best means of relief are the exposure of the part to heat, or the application of heated spirit of wine or oil of turpentine.

Hahnemann thinks that it is of little importance to endeavour to elucidate, in a scientific manner, how the homœopathic remedy effects a cure; but he offers the following as a probable explanation. The medi-

cine sets up, in the suffering part of the organism, an artificial but somewhat stronger disease, which, on account of its great similarity and preponderating influence, takes the place of the former; and the organism from that time forth is affected only by the artificial complaint. This, from the minute dose of the medicine used, soon subsides, and leaves the patient altogether free from disease; that is to say, permanently cured. As the secondary effects of medicines are always injurious, it is very necessary to use no larger doses than are absolutely requisite, more especially as the effects do not decrease in proportion to the diminution of the dose. Thus eight drops of a medicinal tincture do not produce four times the effect of two drops, but only twice: hence he uses exceedingly small doses of medicines. Proceeding gradually in his reductions, he has brought his doses down to an exiguity before unheard of, and seemingly incredible. The millionth part of a grain of many substances is an ordinary dose; but the reduction proceeds to a billionth, a trillionth, nay, to the decillionth of a grain, and the whole materia medica may be carried in the waistcoat pocket.

The following is the method of obtaining these small doses:—Suppose the substance to be a solid; reduce it to powder, and mix one grain of it with ninety-nine grains of sugar of milk: this constitutes the *first attenuation*. To obtain the *second attenuation*, mix one grain of the first attenuation with a hundred grains of sugar of milk. The *third attenuation* is procured by mixing one grain of the second attenuation with ninety-nine grains of sugar of milk. In this way he proceeds until he arrives at the *thirtieth attenuation*. The following table will shew the strength of the different attenuations, with the signs he employs to distinguish them:—

Signs.	Strength of one grain.	Signs.	Strength of one grain.
1. First attenuation	One hundredth part of a grain.	V. Fifteenth	One quintillionth.
2. Second	One thousandth.	VI. Eighteenth	One sextillionth.
I. Third	One millionth.	VII. Twenty-first	One septillionth.
II. Sixth	One billionth.	VIII. Twenty-fourth	One octillionth.
III. Ninth	One trillionth.	IX. Twenty-seventh	One nonillionth.
IV. Twelfth	One quadrillionth.	X. Thirtieth	One decillionth.

Here is a tabular view of the doses of some substances employed by the homœopaths:—

Charcoal, one or two decillionths of a grain.
Chamomile, two quadrillionths of a grain.
Nutmeg, two millionths of a grain.
Tartar emetic, two billionths of a grain.
Opium, two decillionths of a drop of a spirituous solution.
Arsenious acid, one or two decillionths of a grain.
Ipecacuanha, two or three millionths of a grain.

These doses are given in pills (*globuli*), each about the size of a poppy-seed.

Hahnemann gravely asserts, that the length of time a powder is rubbed, or the number of shakes we give to a mixture, influences the effect on the body. Rubbing or shaking is so energetic in developing the inherent virtues of medicines, that latterly, says Hahnemann, "I have been forced, by experience, to reduce the number of shakes to two, of which I formerly prescribed ten to each dilution" (*Organon*). In mixing a powder with sugar, the exact period we are to rub is, therefore, laid down: in dissolving a solid in water, we are told to move the phial "*circa axin*

suam," and at each attenuation to shake it *twice*—" *bis, brachio quidem bis moto, concute.*" (See Dr. Quin's " *Pharmacopœia Homœopathica.*")

The principal facts to be urged against this doctrine may be reduced to four heads:—

1st. Some of our best and most certain medicines cannot be regarded as homœopathic: thus sulphur is incapable of producing scabies, though Hahnemann asserts it produces an eruption analogous to it. Andral took quinia in the requisite quantity, but without acquiring intermittent fever; yet no person can doubt the fact of the great benefit frequently derived from the employment of this agent in ague; the paroxysms cease, and the patient seems cured. " But," says Hahnemann, " are the poor patients really cured in these cases?" All that can be said is, that they seem to be so; but it would appear, according to this homœopath, that our patients do not know when they are well. We are also told, that whenever an intermittent resembles the effects of cinchona, then, and not till then, can we expect a cure. I am afraid if this were true, very few agues could be cured. Acids and vegetable diet cure scurvy, but I never heard of these means causing a disease analogous to it.

2dly. In many cases homœopathic remedies would only increase the original disease. Only contemplate the evils likely to arise from the exhibition of acrid substances in gastritis, or of cantharides in inflammation of the bladder, or of mercury in spontaneous salivation.

3dly. The doses in which these agents are exhibited are so exceedingly small, that it is difficult to believe they can produce any effect on the system, and, therefore, we may infer that the supposed homœopathic cures are referrible to a natural and spontaneous cure. What effect can be expected from one or two decillionth parts of a drop of laudanum? Hahnemann says it is foolish to doubt the possibility of that which really occurs; and adds, that the sceptics do not consider the rubbing and shaking bestowed upon the homœopathic preparation, by which it acquires a wonderful developement of power!

4thly. Homœopathia has been fairly put to the test of experiment by some of the members of the *Académie de Médecine*, and the result was a failure. Andral tried the system on 130 or 140 patients, in the presence of the homœopaths themselves, adopting every requisite care and precaution, yet in not one instance was he successful. (See *Medical Gazette*, vol. xv. p. 922.)

3. *Allopathia* (from Ἄλλος, *another*, and Πάθος, *a disease*). The allopathic (called also by Hahnemann *heteropathic*) method consists in the employing medicines which give rise to phenomena altogether different or foreign (neither similar nor exactly opposite) to those of the disease.

Under this head is included that mode of cure effected by what is called *Counter-irritation;* that is, the production of an artificial or secondary disease, in order to relieve another or primary one. It is a method of treatment derived from observation of the influence which maladies mutually exert over each other. For example, it has been frequently noticed, if a diarrhœa come on during the progress of some internal diseases, the latter are often ameliorated, or perhaps they rapidly disappear, apparently in consequence of the secondary affection. The result of observations of this kind would naturally be the employment of alvine evacuants in other analogous cases where diarrhœa did not spontaneously take place: and this practice is frequently attended with beneficial

results. The appearance of a cutaneous eruption is sometimes a signal for the disappearance of an internal affection; and *vice versâ*, the disappearance of a cutaneous disease is sometimes followed by disorder of internal organs. Here, again, we have another remedy suggested, namely, the production of an artificial disease of the skin, as by blisters, by an ointment containing tartar emetic, or by other irritating applications; —a suggestion the advantage of which experience has frequently verified. I might bring forward numerous other examples to prove the fact (which, however, is so well known as to require little proof,) that action in one part will often cease in consequence of action taking place in another. Diseases, then, appear to have what Dr. Pring (*Principles of Pathology*, 1823, p. 352, *et seq.*) calls a *curative relation* with respect to each other; and we shall find that the greater part of our most valuable and certain remedies operate on the principle of counter-irritation; that is, they produce a secondary disease which is related to the primary one. Dr. Parry (*Elements of Pathology and Therapeutics*, 2nd edit. 1825,) calls this the "*cure of diseases by conversion.*" Let us offer a few examples:—vomiting is a powerful means of relief in bubo, and also in swelled testicle. John Hunter says, he has seen bubo cured by a vomit. I have frequently seen the progress of swelled testicle in gonorrhœa stopped by the exhibition of full doses of tartar emetic. Now it is very improbable that the benefit arises from the mere evacuation of the contents of the stomach. The only plausible explanation to be offered is, that the emetic sets up a new action in the system, which is incompatible with that going on in the groin or in the testicle. If this notion be correct, emetics act in these cases as counter-irritants. The efficacy of purgatives, in affections of the head, is best accounted for by supposing that they operate on the principle of counter-irritation. Blisters, cauteries, issues, moxa, and other remedies of this kind, are universally admitted to have a similar mode of operation.

Even the efficacy of blood-letting, in inflammatory affections, is better explained by assuming that this agent induces some new action incompatible with the morbid action, than that it is merely a debilitant. The immediate effect sometimes produced on disease, by this remedy, is so remarkable as hardly to admit of the supposition of its acting as a mere weakening agent. One full blood-letting will sometimes put an immediate stop to ophthalmia; and I have sometimes seen, even while the blood was flowing, the vascularity of the eye diminish, and from that time the disease progressively declined. When to this fact we add that the same disease is often successfully treated by other different, and even opposite remedies, such as mercury, and stimulant applications, we find a difficulty in explaining their beneficial agency, except by supposing that they influence disease by some relation common to all of them. This view of the counter-irritant operation of blood-letting is supported by Dr. Clutterbuck, (*Lectures on the Theory and Practice of Physic*, published in the *Lancet*, vol. x. 1826,) Dr. Pring, (*op. cit.* pp. 465-8,) and others. The term *counter-irritant* is, however, objectionable, since literally it expresses that the secondary disease should be a state of irritation,—a term hardly applicable to the condition caused by blood-letting. But this, as well as other remedial agents (mental impressions, for example,) agrees with the counter-irritants, commonly so called (blisters, &c.) in influencing diseases only by an indirect relation; it would

be better, therefore, either to extend the meaning of the term counter-irritant, or to employ some other, such as *counter-morbific*.

The older writers employed two terms, *Revulsion* and *Derivation;* the first was applied to those cases in which the secondary disease occurred in a part remote from the seat of the primary affection; the second was, on the contrary, confined to those instances in which the secondary was produced in the neighbourhood of the primary disease. For example, leeches or blisters applied to the feet in apoplexy were called revulsives, but the same applications to the head, in the same disease, would be derivatives. There is, however, no real distinction between them, their operation being similar; for revulsion was, even in their own sense of the word, only derivation at a distant part.

Topical applications are frequently counter-irritants. Thus we see stimulant washes, applied to the eye, cure ophthalmia; and they operate, apparently, by altering the morbid action, and substituting a milder and more easily cured disease for the one previously existing.

Using the term, therefore, in its most extended sense, we see our list of counter-irritants is a most extensive one. It comprehends emetics, purgatives, diffusible stimulants, mercury, blisters, cauteries, issues, setons, moxa, blood-letting, (including arteriotomy, venesection, cupping, and leeches,) irritating lavements, frictions, sinapisms, rubefacients, the hot and cold baths, and even mental impressions. That is, all these agents excite some action in the system which has a relation (oftentimes beneficial) with the morbid action: to use Dr. Parry's words, these agents cure disease by *conversion*.

The most unsatisfactory part of our subject is, the theory or hypothesis of the manner in which the mutual relations of diseased actions are effected. Dr. Parry presumes most diseases consist in local determinations of blood, and that it is a law of the human constitution that excessive morbid determination to two different parts shall not exist in the same person at the same time. Neither of these assumptions, however, is quite correct; but if both were true, they still leave untouched the question how determination of blood to one organ is cured by producing a determination to another. To account for it, some assume that the system can produce only a certain quantity of nervous energy, and that, as in every disease, there is an undue or preternatural distribution of nervous energy, so the production of an artificial disease in one part must, by consuming the nervous energy, diminish the disease in another. But the whole hypothesis is grounded on assumptions perfectly gratuitous and incapable of proof. As Dr. Pring justly observes, were this hypothesis true, it would lead us to employ not bleeding, purgatives, blisters, and all indirect remedies in hepatitis or consumption, but the exercise of the treadmill for a few hours; so that a patient labouring under phrenitis or pneumonia should be made to walk fifteen or twenty miles a day, by which it would be presumed so much nervous energy would be consumed in the arms and legs, that there could not possibly be any preponderance or excess in any other seat.

Let us, then, discard absurd hypotheses of this kind; and for the present be content with the knowledge of the fact that one disease, whether artificially or spontaneously generated, will often, but not invariably, supersede another.

9. *Parts to which medicines are applied.*

Medicines are applied to the skin, to mucous or serous membranes, to wounds, ulcers, or abscesses, or they are injected into the veins.

I. APPLICATIONS TO THE SKIN.—Medicinal applications are frequently made to the skin in order to produce local effects, as in the case of blisters, cataplasms, fomentations, lotions, embrocations, &c.; and occasionally to affect remote parts of the system, as when we use mercury. Most, if not all medicines, which influence distant organs by application to the skin, do so in consequence of their absorption; and as the cuticle offers a mechanical impediment to this process, we generally either remove it or make use of friction.

There are three methods of applying medicines to the skin; namely, the *enepidermic*, the *iatraleptic*, and the *endermic*.

1. The *Enepidermic method* consists in the application of medicines to the skin, unassisted by friction; as when we employ plasters, blisters, poultices, lotions, fomentations, baths, &c.

Baths are made of liquids (as simple water), soft substances (as hot dung, and saline mud), dry bodies (as sand), gases (as hot air), or vapours (as aqueous vapour). Gases or vapours are sometimes applied to the skin, either as local agents, or as means of affecting the constitution. Thus, baths of sulphurous acid gas are employed in itch; chlorine gas is recommended as an application to the skin in liver complaints; vapours of various mercurial preparations have been employed to excite salivation. The vapour of hot water, holding in solution the volatile matters of vegetables, has been employed in the treatment of many diseases, under the name of *medicated vapour baths;* though the greater part of their efficacy is to be ascribed to the influence of the vapour.

2. The *Iatraleptic method* (which has been so called from Ἰατρεύω, *to cure* or *heal*, and Ἀλείφω, *to anoint*), consists in the application of medicines to the skin, aided by friction. It has been termed the *epidermic method*—sometimes *anatripsologia* (from Ἀνατρίβω, *to rub in*, and Λόγος, *a discourse*), and also *espnoïc medicine*. It was employed by Hippocrates and other old writers, but fell into disuse until attention was again drawn to it by Brera, Chiarenti, Chrestien, and others. Among the substances which have been employed in this way, are camphor, digitalis, squills, cantharides, sulphate of quinia, veratria, colocynth, rhubarb, opium, belladonna, mercury, chloruret of gold, &c.

The mode of employing medicinal agents according to the iatraleptic method, is the following:—The substance to be applied being reduced to the finest possible state of division, is to be dissolved or suspended in some appropriate liquid, and in this state rubbed into the skin. The dose is always considerably larger than for the stomach—generally two or three, often as much as ten, and in some cases even twenty times the ordinary dose: but no absolute rule can be laid down on this head. The liquids employed to dissolve or suspend the medicine may be water, spirit, or oily or fatty matter. Iatraleptic writers, however, prefer the gastric juice, or saliva, or even bile; but I am not acquainted with any just grounds for this preference. Collard de Martigny (*Dict. de Médec. et de Chirurg. pratiq.* art. *Iatraleptie*) concludes from his experiments, that the palms of the hands, soles of the feet, neighbourhood of the

joints, the chest, the back, and the inner parts of the limbs, are to be preferred for the application of medicines.

The objections to this mode of employing medicines are the uncertainty of results, the time required to affect the system, the frequently unpleasant nature of the process (as when mercurial inunctions are employed), and the local irritation sometimes produced by the friction. Notwithstanding these, however, it may be resorted to occasionally with advantage, as where the patient cannot or will not swallow, or where the alimentary canal is very irritable, or insensible to the action of the medicine.

3. *The Endermic, or Emplastro-endermic method*, consists in the application of medicinal agents to the denuded dermis. For its introduction into practice we are indebted to M.M. Lembert and Lesieur.—(*Essai sur la Méthode Endermique*, par *A. Lembert*, 1828.)

The denudation of the dermis is usually effected by a blistering plaster. When the cuticle is elevated, an opening is to be made into it, in order to allow the serum to escape. The medicine is then to be applied to the dermis either with or without removing the cuticle. At the first dressing, the transparent pellicle formed by the dermis is to be carefully removed, as it very much impedes absorption. The medicine is applied to the denuded surface, either in its pure state, in the form of an impalpable powder,—or, if too irritating, it is to be incorporated with gelatine, lard, or cerate. Should any circumstances arise to lead us to fear that the quantity of the medicine applied has been too large, the mode of proceeding is the following:—Cleanse the surface immediately; make compression (as by a cupping-glass) around the denuded part, in order to prevent absorption, and apply any substance that will neutralize the effect of the medicine. Thus Lembert has found that two grains of the acetate of morphia will destroy the tetanic symptoms caused by the application of two grains of strychnia.

Instead of a blistering plaster, Trousseau recommends a vesicating ointment, composed of equal parts of a strong solution of ammonia and lard. Two applications, of five minutes each, are sufficient to raise the cuticle. Boiling water, which has been employed by some persons, is uncertain, painful, and dangerous: it may cause mortification of the dermis, and thus stop absorption.

The advantages of the endermic method are, that substances are not submitted to the influence of the digestive process, and their pure effects can be better ascertained;—their operation is in general very quick, and in some cases more rapid than when they are applied to the stomach. If the gastric membrane be inflamed, or if the patient cannot (or will not) swallow, more especially if the case be urgent, this is an admirable method of putting the system under the influence of a medicine.

The disadvantages of the endermic method are, the pain sometimes experienced by the application of medicinal agents to a denuded surface —some even may occasion mortification of the part; the possibility of the skin being permanently marked; lastly, some substances have no effect when used endermically.

The substances which have been used by this method are morphia and its acetate, muriate and sulphate, in doses of from a quarter of a grain to two grains; strychnia, from a quarter of a grain to a grain; aconitina, one-sixteenth to one-eighth of a grain; extract of belladonna, three or

four grains; sulphate of quinia, two to six grains; musk, six or eight grains; tincture of asafœtida, ten minims. Many other agents have also been employed endermically; as digitalis, extract of squills, aloes, saffron, bichloruret of mercury, tartar emetic, &c. For further information on the endermic method, consult, besides Lembert's Essay before quoted, the article "*Endermique Méthode*," by Bouillaud, in the *Dict. de Médec. et Chirurg. pratiques*; also some articles by Dr. Bureaud Riofrey, in the *Continental and British Medical Review*, vol. i. pp. 66, 321, and 385.

Method by inoculation.—In connexion with the endermic method may be mentioned another mode of employing medicines; namely, the method by inoculation proposed by M. Lasargue de St. Emilion. (See the *Continental and British Review*, vol. i. pp. 41 & 388.)

II. Applications to the mucous membranes. — We have two mucous membranes, to the different parts of each of which we apply medicines: the first is the gastro-pulmonary membrane, the second the urino-genital.

1. *Gastro-pulmonary membrane.*

a. Ocular mucous membrane (conjunctiva).
b. Nasal or pituitary membrane.
c. Bucco-guttural membrane.
d. Eustachian membrane.
e. Aërian or tracheo-bronchial membrane.
f. Gastro-intestinal membrane.
g. Recto-colic membrane.

2. *Urino-genital membrane.*

a. Urethro-vesical membrane.
b. Vagino-uterine membrane.

1. *Gastro-pulmonary membrane: a. Ocular mucous membrane* or *conjunctiva.*—Medicines are applied to the conjunctiva, to excite local effects only, though we might employ this part for other purposes, since remote organs may be affected by it. Thus a drop of hydrocyanic acid applied to the conjunctiva of a dog produces immediate death. The term *Collyrium* (Κολλύριον) was formerly employed to indicate solid substances applied to the eyes. It now usually means liquid washes for the eyes, and is equivalent to *eye-water*. Cottereau (*Traité Elémentaire de Pharmacologie*, 1835,) calls all medicines (solids, soft substances, liquids, and vapours or gases,) which are applied to the eyes, collyria.

b. Nasal or *pituitary membrane.*—We seldom apply medicines to the *pituitary* membrane except in affections of the nose or of parts adjacent. Sometimes they are employed to irritate and excite a discharge; they are then called *errhines;* but when used to produce sneezing, as when foreign bodies are in the nasal cavities, they are termed *sternutatories* or *ptarmics.*

c. Bucco-guttural mucous membrane.—Medicines are very rarely applied to the *mouth* and *throat*, except for local purposes. However, it has been proposed to excite salivation by rubbing calomel into the gums. Solids used in the mouth are termed *lozenges* (*trochisci*) or *masticatories*, according as they are allowed to dissolve slowly or are masticated; liquids are called *collutoria* or *gargarismata.*

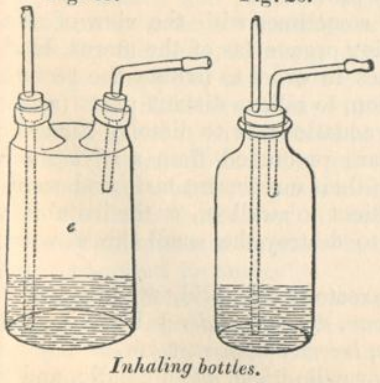
d. Eustachian membrane.—Aurists now and then apply washes to the *Eustachian tubes* in local affections; but the occasions for this practice are rare, and the operation difficult, except in practised hands.

e. Aërian or *tracheo-bronchial membrane.*—Accidental observation, as well as experiment, has shewn that medicines produce very powerful effects on the membrane lining the *trachea* and *bronchial tubes.* For the

most part, applications here are made use of for local purposes, as in asthma, chronic bronchitis, phthisis, &c. though occasionally to affect the brain, the blood, the heart, &c. Dr. Myddleton (*A Preliminary Dissertation illustrative of a new System of Pulmonary Pathology*, 1825,) has advocated, in pulmonary diseases, the inhalation of substances (as cinchona, sulphate of iron, myrrh, &c.) reduced to an impalpable powder. The fumes (*suffitus*) of tar, balsam, resins, and other burning bodies, have also been employed in these cases. Sir Alexander Crichton has strongly recommended tar vapour; the method of using which is the following:—The tar employed should be that used in the cordage of ships; to every pound of which half an ounce of carbonate of potash must be added, in order to neutralize the pyroligneous acid generally found mixed with the tar, the presence of which will necessarily excite coughing. The tar thus prepared is to be placed in a suitable vessel over a lamp, and to be kept slowly boiling in the chamber during the night as well as the day. The vessel, however, ought to be cleansed and replenished every twenty-four hours, otherwise the residuum may be burned and decomposed,—a circumstance which will occasion increased cough and oppression on the chest.

The inhalation of aqueous vapour (*halitus*,) either alone or with other substances, is oftentimes useful in various affections of the lungs and of the throat, &c. The apparatus for this purpose may be that proposed by Dr. Gairdner (*Edinburgh Medical and Surgical Journal*, vol. xix.;) or Dr. Mudge's inhaler, or in the absence of these, a teapot, or basin with an inverted funnel. In many asthmatic cases the difficulty of breathing is so great, that the patient cannot close the mouth around the tube, especially if the latter be small, without exciting a sense of impending suffocation. In such instances I have found the only easy and practicable method of enabling the patient to inhale is, by holding the mouth over hot water contained in a basin or tea-cup. Various narcotic and emollient herbs are sometimes added to the water, but I suspect without contributing in any way to its efficacy. The vapour of hot vinegar, of sulphuric ether, of iodine, of camphor, and of other volatile bodies, is occasionally employed in pulmonary diseases. The vapour of iodine may be conveniently inhaled by means of a double-necked glass bottle (fig. 25,) into which we introduce about an inch of water, to which a few drops of the tincture of iodine have been added. Through one of the necks a straight glass tube passes, and dips under the surface of the water. The other neck has a short curved glass tube passing through it, by which the patient inhales. In the absence of a double-necked bottle we may use a common wide-mouthed bottle (fig. 26,) the cork of which has two perforations, through which pass the glass tubes. Chlorine gas may be inhaled in a similar manner, using a solution of the gas, or of chloride of lime, instead of the tincture of iodine. If oxygen, or nitrous oxide, be inhaled, the most easy and con-

Fig. 25. Fig. 26.



Inhaling bottles.

venient mode of effecting it is from a bladder; but for other and more complete, though more costly methods, I must refer you to the works of the late Dr. Beddoes, and of the celebrated engineer, Mr. James Watt.—(*Considerations on the Medicinal Use, and on the Production of Factitious Airs*, 1796.)

f. Gastro-intestinal membrane.—We employ both extremities of the *alimentary canal* for the exhibition of medicines; the upper, however, more frequently than the lower. This mode of employing medicines is called the *method by ingestion.* Of all parts of the body the gastro-intestinal surface is the most useful for the application of medicines. This arises from the great susceptibility, the active absorbing power, and the numerous relations, which the stomach has with almost every part of the body. In many cases remote effects are more easily produced by this than by any other organ, as in the case of diffusible stimulants. Medicines which act by absorption are more energetic when applied to the serous membranes, the bronchial membrane, the cellular tissue, &c. In some cases it is not only possible, but probable, that the stomach may either partially or wholly digest a medicine.

g. Recto-colic membrane.—Sometimes, though less frequently than the stomach, the *rectum* is employed for the application of medicines. It has been asserted that the general susceptibility of the rectum is only one-fifth of that of the stomach, and that medicines take five times as long to operate by the former as by the latter: hence it has been said that both the dose, and the interval between the doses, should be five times as great as when applied to the stomach. But this assertion is far from being universally correct, though it may be so occasionally. Orfila asserts that those agents which operate by absorption, as opium and tobacco, are more active by the rectum than by the stomach; and he assigns as a reason the greater venous absorption of the rectum, and its less digestive power. But this statement is in direct opposition to the experience of almost every practitioner. Whenever I have had occasion to employ opium by way of enema, I always exhibit twice or three times the ordinary dose, without exciting any remarkable effects. Dr. Christison states that he has given two measured drachms of laudanum by injection, without producing more than usual somnolency, a quantity which, if Orfila's statement were correct, would probably prove fatal.

We apply medicines to the rectum sometimes with the view of alleviating disease of this or of neighbouring organs (as of the uterus, bladder, prostate gland, &c.); at other times in order to irritate the rectum, and, on the principle of counter-irritation, to relieve distant parts (as the head); sometimes to produce alvine evacuations, or to dissolve hardened fæces; occasionally, also, when we are precluded from applying our remedies to the stomach, on account of their unpleasant taste and smell, the inability or indisposition of the patient to swallow, or the irritability of the stomach; and, lastly, in order to destroy the small thread-worm (*Ascaris vermicularis.*)

When the substances applied to the rectum are solid, we name them *suppositories* (*suppositoria*, from *suppono, to put under*;) but when of a fluid nature, they are termed *clysters, lavements*, or *enemata.*

Formerly *suppositories* were conical, or cylindrical, like a candle, and of variable size,—sometimes one or two inches long. They are now usually made globular, and of small size. They are employed to evacuate the

bowels; to irritate the rectum, and thereby to relieve affections of distant organs; but more commonly to act as local agents in affections of the rectum, bladder, uterus, prostate gland, urethra, &c. I have frequently employed with great advantage a mixture of opium and soap, to prevent the pain of priapism during the night, in gonorrhœa.

Clysters or *lavements* require to be considered under several points of view: *first*, in reference to the material of which they are made, and which must vary with the object for which these remedies are employed; *secondly*, with respect to the quantity of liquid used, and which will depend on the age of the patient. The average quantity for an adult is about twelve or sixteen ounces; and I believe that it is rarely proper to use more than this. I am quite sure that the practice of introducing several pints of fluid into the large intestines, with the view of exciting alvine evacuations, is bad. In the first place it often provokes the contraction of the gut, by which the injection is immediately returned; and, secondly, repeated distension diminishes the susceptibility of the part, so that the ordinary accumulation of fæcal matter no longer acts as a sufficient stimulus. Mr. Salmon (*Practical Essay on Prolapsus of the Rectum*, 1831, p. 24,) has related a case of this kind, where the patient had nearly lost all power of relieving the bowels, except by enemata or purgatives, and had produced dilatation of the rectum, in consequence of having been in the habit of introducing into the intestine two quarts of gruel twice every day. A newly-born infant requires about one fluid ounce; a child of one to five years, from three to four ounces; and a youth from ten to fifteen, from six to eight fluid ounces. *Thirdly*, the impulse with which the fluid ought to be thrown up deserves attention. If too much force be used, the sudden dilatation of the gut may bring on spasmodic action of its lower part, by which the clyster will be returned. *Fourthly*, the instruments by which the injection is effected require notice. The common pipe and bladder are too well known to require description. I am inclined to think that the most convenient, safe, and useful apparatus, is the elastic bottle and tube. Any quantity of liquid, however small, may be thrown up with the greatest ease, and without any danger of the impulse being too great. Its application is exceedingly convenient; a lusty person, by placing one foot on a stool or chair, may easily apply it without assistance; and its price is very moderate. Another form of enema apparatus is a narrow water-proof tube, holding about a pint of liquid, about four feet long, narrower at one end, which is furnished with a common injecting pipe, and about two and a half inches in diameter at the other. The fluid being placed in the tube, the pipe is introduced into the rectum, and the apparatus held in a perpendicular direction, by which the fluid is propelled into the gut by its own gravity. This apparatus, although very simple, appears to me to be less convenient for common use than the elastic bottle, and not to be well adapted for the administration of small quantities of fluids. In the shops are sold syringes of various forms as enema apparatus.

Gaseous matters have been sometimes thrown into the rectum. Thus the injection of common air has been proposed in ileus (*Edinburgh Medical and Surgical Journal*, vol. xvi.) Tobacco smoke has sometimes been employed in hernia: it is injected by a peculiarly constructed pair of bellows. Carbonic acid gas has been used in ulceration of the rectum.

2. *Urino-genital membrane: a. Urethro-vesical membrane.*—Applica-

tions to the *urethra* are made only for local purposes; either in a solid form, as caustic or medicated bougies, or in that of a liquid, as an injection: the latter is easily applied by a common syringe. Syringes of various kinds, for this purpose, are sold by Messrs. Maw, of Aldersgate Street.

Injections are sometimes thrown into the *bladder*, but always for local purposes. The operation is easily performed by attaching a catheter to an elastic bottle.

b. Vagino-uterine membrane.—Medicines are applied to the *vagina* and *uterus* to produce local effects only. Thus injections are made to relieve vaginal discharges, to excite the catamenia, &c. They are usually liquids, but the following case, told me by my friend Dr. Clutterbuck, proves that gases are sometimes employed. A lady, who had suffered a considerable time from some uterine affection, and had derived no relief from the treatment adopted, was advised to consult a physician in Italy. After he had examined the condition of the uterus, he assured her there was no organic disease, but merely a considerable degree of irritation; for which he proposed to apply carbonic acid, as a sedative. This was done by means of a pipe and tube, communicating with a gasometer situated in another room. The patient obtained immediate relief, and although she had been obliged to be carried to the doctor's house, on account of the pain experienced in walking, she left it in perfect ease. On her return to England, she had a relapse of the complaint, and applied to Dr. Clutterbuck to know whether she could have the same remedy applied in London, in order to save her the necessity of returning to Italy.

III. Applications to the serous membranes: *a. Tunica vaginalis.*—Irritating injections, such as wine and water, solutions of metallic salts, &c. are thrown into the cavity of the serous membrane of the testicle in hydrocele, in order to excite inflammation and the subsequent adhesion of the sides of the sac.

b. Peritoneum.—Injections have also been made into the peritoneal sac in ascites, and in some cases with success.—(*Philosophical Transactions* for the year 1744.) The practice, however, is very dangerous. Mr. Cooper (*Dictionary of Practical Surgery*, art. *Paracentesis*,) has seen two fatal cases of it.

IV. Applications to ulcers, wounds, and abscesses.—These are employed principally to excite local effects, and sometimes, though rarely, to produce a constitutional affection. Thus it has been proposed to apply corrosive sublimate to wounds, with the view of causing salivation.

V. Injection of medicines into the veins, *(Chirurgia infusoria; Ars clysmatica nova; Infusion of medicines.)*—This history of this operation is inseparably connected with that of *Transfusion*. The first experiments on infusion are said to have been performed in Germany. (See Paul Scheel's work, entitled "*Die Transfusion des Bluts und Einsprützung der Arzneyen in die Adern*," Kopenhagen, 1802: Zweiter Band, 1803.) But the first scientific examination of the operation was made by Sir Christopher Wren.—(*Philosophical Transactions* for 1665, vol. i. p. 131.) His example was followed by Boyle, Clarke, Henshaw, Lower, and others. (For further information on the history of this operation, consult Scheel's work, before quoted; also Dieffenbach's essay, "*Ueber die Transfusion des Bluts und die Infusion der Arzneien*," 1833; or Marx's, "*Die Lehre von den Giften*," 1827 and 1829.)

The partisans of this method of treatment assert, that when medicines

are administered by the stomach, their properties are more or less altered by the digestive powers of this viscus; and that by injecting medicines at once into the veins, we avoid this influence. This statement, however, is not accurate, since Drs. Christison and Coindet have shown that some substances are decomposed even in the blood, or at least that they cannot be recognized in this fluid. Furthermore, it has been proved that the effects are of the same general nature as when medicines are applied to the skin or stomach; thus, tartar emetic vomits, senna purges, opium stupifies, and so on. So that some of the supposed advantages of this operation have no real existence, while several objections to it exist: such as the danger of introducing air into the veins, or of throwing in too large a dose of the remedy (for a slight excess in some cases may prove fatal), or of the occurrence of phlebitis. These, then, are sufficient reasons for not resorting to this practice, except on very urgent occasions; for example, to excite speedy vomiting when the patient is unable to swallow. Köhler (mentioned by Dieffenbach, who notices also several other analogous cases) preserved the life of a soldier, in whose throat a piece of beef tendon was sticking, by throwing a solution of six grains of tartar emetic into a vein of the arm: vomiting was induced, and the meat expelled. Meckel injected two grains of this salt, dissolved in water, into the veins of a woman, to restore suspended animation, from immersion in water.

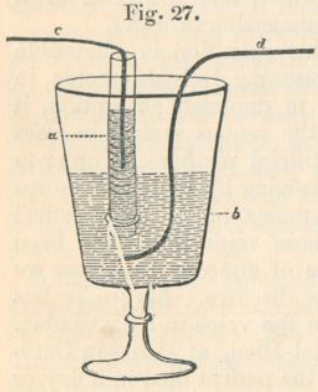
In some obstinate and dangerous diseases this operation is admissible as a last resource; for example, in cases of poisoning, in hydrophobia, in malignant cholera, &c. As plethora appears to diminish absorption, it has been proposed to throw tepid water into the venous system in cases of narcotic poisoning, and thus to cause artificial plethora, in order to prevent the occurrence of the symptoms of poisoning by stopping absorption. Vernière found three grains of nux vomica produced no effect when applied to a wound in a dog into whose veins water had been thrown; and he asserts, that by the early use of aqueous injections we may prevent the developement of contagious diseases. Magendie has tried the effects of injecting tepid water into the veins in hydrophobia. The operation was first performed at the Hôtel-Dieu, at Paris, in October, 1823: the convulsions were stopped, but the patient died in a day or two afterwards. This operation has been several times repeated, and with the same results. In June 1832, I tried it on a patient (afflicted with this terrible disease) under the care of the late Mr. Bennett, of the Commercial Road: the patient was a boy about nine years of age; he was nearly insensible at the time I performed the operation. I threw in about one quart of tepid water without any obvious effect on the pulse: no convulsions were subsequently observed, but the patient died in a few hours. Saline solutions were injected into the veins in malignant cholera, and often with apparent advantage. Purgatives, narcotics, &c. have been thrown into the veins by different physiologists, and in most cases the effects observed were similar to, though more powerful than, those produced when these agents were administered by the stomach. To this statement, however, the oils are an exception; for when injected into the veins in large quantities they interrupt the circulation, and produce a kind of asphyxia.

Agency of Galvanism.—It has been proposed to assist the introduction of certain medicinal particles into the blood by galvanism. This practice was first adopted with iodine in 1823, by Dr. Coster, (*Archives*

Générales de Médecine, t. ii. p. 432,) and in 1833 by M. Fabré-Palaprat, (*Arch. Gén.* 11me série, t. ii.; also, *Becquerel, Traité de Electricité*, t. iv. p. 321.) The principle on which galvanic electricity has been employed is, that the poles (electrodes) of a voltaic battery have attractive and repulsive powers for certain substances: thus the positive pole (anelectrode) attracts oxygen, chlorine, and iodine,—while the negative pole (cathelectrode) attracts hydrogen and the metals. M. Fabré-Palaprat asserts, that by the aid of galvanism he can cause certain chemical agents to traverse the body and appear at some distant part. He bound on one arm a compress, moistened with a solution of ioduret of potassium, and covered by a platinum disk, connected with the negative pole (cathelectrode) of a voltaic battery of thirty pairs of plates. On the other arm was placed a compress, moistened with a solution of starch, and covered by a platinum disk, connected with the positive pole (anelectrode) of the battery. In a few minutes the starch acquired a blue tinge, shewing that the iodine had been transported from one arm to the other.

But the idea entertained by Davy, that the poles (electrodes) possess attractive or repulsive powers, has been shown by Faraday to be incorrect. It is, indeed, true, that if we place a solution of ioduret of potassium in a glass tube (fig. 27, *a*.) closed at the lower extremity by a piece of bladder, and immerse the tube in a glass vessel containing a solution of common salt and starch, we may, by connecting the liquid in the tube with the negative pole (cathelectrode) (*c*,) and the outer or starch liquid with the positive pole (anelectrode) (*d*) obtain the blue iodide of starch in the outer liquid, shewing that the iodine must have transuded the bladder. But the transudation is effected by exosmosis or imbibition, and not by the action of the battery, since the iodine may be recognised in the external liquid by appropriate tests, when no voltaic apparatus has been employed. The positive pole (anelectrode) does not, therefore, attract the iodine through the bladder, but merely sets it free when the ioduret has transuded.

Fig. 27.



I have twice repeated M. Fabré-Palaprat's experiment,—once on my pupil, Mr. John Smith, and a second time on my assistant, Mr. Scoffern, but though I employed fifty pairs of plates during fifteen minutes, I was unable to obtain the least trace of the passage of iodine through the body.

It is not improbable, however, that electricity may promote absorption, either by increasing endosmosis, or by acting as a stimulus to the blood-vessels and lymphatics.

10. *Classification of Medicines.*

In some works on Medical Botany, which contain figures of the plants employed in medicine, the authors have not followed any arrangement; in consequence, I presume, of the impossibility of procuring specimens in regular order. This is the case in the following works:—

W. Woodville, M.D. Medical Botany, 3 vols. 4to. London, 1790. A Supplement to the Medical Botany, 4to. London, 1794.

J. Bigelow, M.D. American Medical Botany, 3 vols. 8vo. Boston, 1817-18-20.

W. P. C. Barton, M.D. Vegetable Materia Medica of the United States, 2 vols. 4to. Philadelphia, 1818.

J. Stephenson, M.D. and *J. M. Churchill*, Medical Botany, 4 vols. 8vo. London, 1827-31.

Flora Medica, 2 vols. 8vo. 1827.

The large number of substances employed in the treatment of diseases renders some arrangement of them almost absolutely necessary;—and I conceive any order of treating of them to be better than none.

Arrangements or classifications of medicines, like those of plants, (*Théorie Elémentaire de la Botanique*, par P. Decandolle, 1819,) may be divided into *empirical* and *rational* ones.

1. Empirical Arrangements.—These are independent of the nature of, and have no real relation or connexion with, the substances to be arranged. An *alphabetical* order, since it is founded on names which are arbitrary, and have no relation to the bodies they are intended to designate, is of this kind. Two advantages have been supposed to be gained by its employment;—firstly, a ready reference to any particular substance; and, secondly, the avoidance of errors committed by writers who adopt other methods. But the first is more imaginary than real; for an index gives to any mode of classification every advantage derived from an alphabetical arrangement; and, as each substance is known by a variety of names, an index becomes as necessary to an alphabetical, as to any other method. Like other classifications this has its disadvantages, the most important of which are, that it brings together substances of the most incongruous natures, and separates those which agree in most of their properties; and from its want of order, it distracts the attention of the student, and is, therefore, totally unfitted for an elementary work.

The following are some of the more important works in which medicines are described in an alphabetical order:—

M. de la Beyrie, and *M. Goulin*, Dictionnaire raisonné-universel de Matière Médicale, t. 8. Paris, 1773.

J. Rutty, Mat. Medica antiqua et nova, repurgata et illustrata. 4to. Roterodam, 1775.

W. Lewis, an Experimental History of the Materia Medica, 4to. 1761.—4th edit. by Dr. Aikin, 2 vols. 8vo. 1791.

Andrew Duncan, jun. M. D. The Edinburgh New Dispensatory, 11th ed. Edinburgh, 1826. Supplement to the above, 1829.

J. R. Coxe, M.D. The American Dispensatory. Philadelphia, 1806.

J. Thacher, M.D. The American New Dispensatory. Boston, 1810. 2d ed. 1813.

A. T. Thomson, M.D. The London Dispensatory. London, 1811. 9th ed. 1837.

J. A. Paris, M.D. Pharmacologia, 3rd ed. 1820. 8th edit. 1833.

W. Ainslie, M.D. Materia Indica. London, 1826.

W. T. Brande, A Manual of Pharmacy. London, 1825. 3rd ed. 1833.

A. Chevallier, *A. Richard*, and *J. A. Guillemin*, Dictionnaire des Drogues simples et composées; tom. 5, Paris, 1827-9.

F. P. Dulk, Die Preussische Pharmakopöe, übersetzt und erläutert; 2te Aufl. 2 Th. 8vo. Leipsig, 1830.

L. Martinet, Manuel de Thérapeutique et de Matière Médicale. Paris, 1828.

F. S. Ratier, Traité élémentaire de Matière Médicale; tom. 2, Paris, 1829.

F. V. Mérat et *A. J. De Lens*, Dictionnaire universel de Matière Médicale et de Thérapeutique Générale, t. 6, 1829-34.

L. W. Sachs and *F. P. Dulk*, Handwörterbuch der praktischen Arzneimittellehre, Königsberg, 1830-37. 19 Lief. A.—St.

G. B. Wood, M.D. and *F. Bache*, M. D. The Dispensatory of the United States of America, 1833. 3rd edit. 1836.

Bachmann, *W. L.* Handwörterbuch der praktischen Apothekerkunst, 2 Bde. Nürnberg, 1837.

A. Ure, M.D. A Practical Compendium of the Materia Medica, with numerous Formulæ for the Treatment of Diseases of Infancy and Childhood. London, 1838.

J. Steggall, M.D. A Text Book of Materia Medica and Therapeutics, 12mo. London, 1837.

2. Rational Arrangements.—These have an actual relation with the bodies for which they are used, and are the classifications properly so called. They are founded on the properties of the substances treated of; consequently, are as numerous as there are classes of properties. Thus medicines may be arranged according to their

a. Sensible properties (colour, taste, and smell.)
b. Natural-historical properties (external form and structure.)
c. Chemical properties.
d. Physiological effects.

a. Classifications founded on the sensible qualities (colour, taste, and odour.)—Classifications of this kind are necessarily very imperfect, owing to the impossibility of defining sensations. Moreover, their use is very limited, in consequence of the colour, taste, and odour of bodies having no necessary relation to their medicinal properties. In the best executed arrangements of this kind, the denominations of many of the classes or orders are objectionable;—dissimilar bodies are brought together;—and similar ones separated.

Mr. Greeve's classification.

Classes.	Families.	Orders.
I. Inodorous and insipid	1. *Liquid*	1.
	2. *Soft*	1. Pulverescent. 2. Unctuous.
	3. *Hard*	1. Tough. 2. Brittle.
II. Inodorous and sapid	1. *Sweets*	1. Saccharine. 2. Amylaceous. 3. Mucous or Unctuous. 4. Faint. 5. Frugous.
	2. *Bitters*	1. Mawkish. 2. Astringent. 3. Pure bitter. 4. Austere. 5. Styptic 6. Acrid. 7. Salino-amare.
	3. *Alkalines*	1.
	4. *Acids*	1. Pure acid. 2. Saccharo-acid.
	5. *Salines*	1. Pure salt.
III. Odorous and insipid	1. *Fragrant*	1. Sweet. 2. Aromatic.
IV. Odorous and sapid	1. *Sweets*	1. Saccharine. 2. Faint. 3. Sweet-spicy.
	2. *Bitters*	1. Mawkish. 2. Subastringent. 3. Bitter-spicy. 4. Sharp-bitter. 5. Austere. 6. Subacrid. 7. Acrid.
	3. *Acidous*	1.
	4. *Camphreous*	1. Camphreous aromatics. 2. Savoury. 3. Terebinthinate. 4. Camphreous.
	5. *Spirituous*	1. Vinous. 2.

The following writers have offered the best examples of this mode of classification:—

Jon. Osborne, M.D. On the Indications afforded by the Sensible Qualities of Plants with respect to their medical Properties. Contained in the Transactions of the Association of Fellows and Licentiates of the King and Queen's College of Physicians, vol. v. 1828.

A. F. A. Greeves, An Essay on the Varieties and Distinction of Tastes and Smells, and on the Arrangement of the Materia Medica. [Published by *Dr. Duncan* in his Supplement to the Edinburgh New Dispensatory, 1829.]

b. Classifications founded on natural-historical properties.—By natural-historical properties, I mean those made use of in natural history. They are principally external form and structure. In living beings we find that peculiar structure denominated *organized*. The structure called *crystalline* is peculiar to mineral and other inorganized bodies.

A. *Classifications of organized beings.*—In the following works the *vegetable* substances employed in medicine are arranged according to their natural-historical properties:—

J. A. Murray, Apparatus Medicaminum tam simplicium quam præparatorum et compositorum, vol. v. Göttingæ, 1776-89;—post mortem auctor. edid. *L. C. Althof*, vol. vi. Göttingæ, 1792.

A. P. De Candolle, Essai sur les Propriétés Médicales des Plantes, comparées avec leurs Formes Extérieurs et leur Classification Naturelle, 1804, 2d. éd. Paris, 1816.

A Richard, Botanique Médicale. Paris, 1823.

P. J. Smyttère, Phytologie-pharmaceutique et Medicale. Paris, 1829.

J. H. Dierbach, Abhandlung über die Arzneikräfte der Pflanzen verglichen mit ihrer structur und ihren chemischen Bestandtheilen. Lemgo, 1831.

T. F. L. Nees von Esenbeck und *C. N. Ebermaier*, Handbuch der medicinisch-pharmaceutischen Botanik. Düsseldorf, 3 Th. 1830-32.

The *animal* substances used in medicine are arranged in natural-historical order in the following works:—

J. F. Brandt und *J. T. C. Ratzeburg*, Medizinische Zoologie oder, getreue Darstellung und Beschreibung der Thiere die in der Arzneimittellehre in Betracht kommen in systematischer Folge herausgegeben. Berlin, 2 Bde. 1827-33.

P. L. Geiger, Handbuch der Pharmacie, 2ten Bd. 2te Hälfte. Heidelberg, 1829.

Both the *vegetable* and *animal* materia medica are arranged according to the natural system in the following works:—

J. J. Virey, Histoire Naturelle des Médicamens. Paris, 1820.

A. L. A. Fée, Cours d'Histoire Naturelle pharmaceutique. t. ii. Paris, 1828.

A. Richard, Elémens d'Histoire Naturelle Médicale, t. iii. Paris, 1831-35.

J. Johnstone, M.D. A Therapeutic Arrangement and Syllabus of Materia Medica. 12mo. London, 1835.

E. Soubeiran, Nouveau Traité de Pharmacie théorique et pratique, t. ii. Paris, 1836

As in the subsequent part of this work the vegetable and animal substances used in medicines will be arranged in natural-historical order, it will be unnecessary here to offer any examples illustrative of it. I have preferred this mode of arrangement principally on account of the great difficulties attending any other method, especially that founded on the effects of medicines.

Artificial method of Linneus.—This appears to me the best place for noticing those pharmacological works in which the Linnean artificial method of arranging plants is followed.

Car. A. Linné, Materia Medica, ed. 4a. curante *J. C. D. Schrebero*. Lipsiæ et Erlangæ, 1782

P. J. Bergius, Materia Medica e Regno vegetabili, 2 tom. ed. 2nda. Stockholmiæ, 1782.

P. L. Geiger, Handbuch der Pharmacie, 3tte. Aufl. 2 Bde. Heidelberg, 1830.

Methods founded on the parts of organized beings employed.—In some works the vegetable and animal substances employed in medicine are classified according to the parts used; as barks, roots, seeds, secretions, &c.

R. A. Vogel, Historia Materiæ Medicæ. Ludg. Batav. & Lipsiæ, 1758.
C. Alston, M.D. Lectures on the Materia Medica, 2 vol. London, 1770.
J. C. Ebermaier, M.D. Taschenbuch der Pharmacie. Leipzig, 1809.
N. J. B. G. Guibourt, Histoire abrégée des Drogues simples, 2de. éd. Paris, 1826. 3me. éd. 1836.

B. *Classification of inorganized substances.*—I am unacquainted with any natural-historical arrangement of the inorganized substances of the materia medica; that is, of an arrangement founded on the external forms and structure of these bodies. Most writers who have followed the natural system in their descriptions of vegetable and animal medicines, have adopted a chemical classification for the inorganized medicinal substances; a mode of proceeding which I shall follow in this work. As an example of a natural-historical classification of minerals, I may refer to the following work:—

F. Mohs, Treatise on Mineralogy, translated by W. Haidinger, 3 vols. Edinburgh, 1825.

It may perhaps be useful to present the student with a classification of all the crystallized substances employed as medicines; as far, at least, as their primary forms have been determined. And here I must explain, that the forms of crystals are *primary* or *secondary*. "A *primary* form is that parent or derivative form from which all the secondary forms of the mineral species to which it belongs may be conceived to be derived according to certain laws." (*Brooke's Familiar Introduction to Crystallography*, 1823.) The *secondary* forms consist of all those varieties belonging to each species of mineral which differ from the primary form.

All the known primary forms may be arranged in six groups, or systems, as follows:—

Group 1st. Regular or Cubic System: (*Octahedral System*: *Tessular System*, Mohs).—The primary forms belonging to this group, are the *Cube* (or *Hexahedron*), the *Tetrahedron*, the *Regular Octahedron*, the *Rhombic Dodocahedron*, and the *Trapezohedron*. Of these the Cube is usually regarded as the fundamental form or type. The following pharmacological agents belong to this group:—

Bismuth	Mercury	Ioduret Potassium
Carbon	Phosphorus	Muriate Ammonia
Copper	Silver	Arsenious Acid
Gold	Chloruret Sodium	Alum
Iron	Bromuret Potassium	Galena (sulphuret lead).

Group 2nd. Right Square Prismatic System: (*Square Prismatic System*: *Pyramidal System*, Mohs).—The primary forms included in this group are, the *Right Prism* with a *square base*) also called *Right Square Prism*, or simply *Square Prism*), and the *Octahedron* with a *square base*. The first is considered to be the fundamental form. The following medicinal substances belong to this group:—

Chloruret Mercury (Calomel)	Ferrocyanuret Potassium	Copper Pyrites
Bicyanuret Mercury	Red Antimony (oxisulphuret).—(*W. Phillips.*)	Peroxide Tin.

Group 3rd. Right Rectangular or Right Rhombic Prismatic System: (*Right Prismatic System*).—This group includes the following primary forms; the *Right Rectangular Prism*, the *Octahedron* with a *rectangular base* (*Right Rectangular Octahedron*), the *Right Rhombic Prism*, and the *Octahedron* with a *rhombic base* (*Right Rhombic Octa-*

hedron). The fundamental form is either the right rectangular or the right rhombic prism. The following are the pharmacological agents belonging to this group :—

Bichloruret Mercury	Sulphate Magnesia	Morphia
Sesquisulphide Antimony	Sulphate Zinc	Sulphur (native)
Sesquisulphide Arsenicum (Orpiment)	Nitrate Silver	Emetic Tartar
	Nitrate Potash	White Antimony (protoxide)
Carbonate Lead	Citric Acid	
Carbonate Baryta	Bitartrate Potash	
Sulphate Potash	Soda-Tartrate Potash	

Group 4th. Oblique Rectangular or Oblique Rhombic Prismatic System.—(*Oblique Prismatic System*).—The primary forms included in this system are, the *Oblique Rectangular Prism*, the *Oblique Octahedron* with a *rectangular base* (*Oblique Rectangular Octahedron*), the *Oblique Rhombic Prism*, and the *Oblique Octahedron* with a *rhombic base* (*Oblique Rhombic Octahedron*). Mr. Brooke (*Encyclopædia Metropolitana*, art. *Crystallography*) refers the *Right Oblique-angled Prism* to this group. The fundamental form of this system is the Oblique Prism (either rectangular or rhombic). The following pharmacological agents belong to this group :—

Sulphur (by slow cooling)	Sulphate Iron	Acetate Copper
Sulphide Arsenicum (Realgar)	Chlorate Potash	Acetate Zinc
	Phosphate Soda	Tartaric Acid
Carbonate Soda	Borax	Oxalic Acid
Sulphate Soda	Acetate Soda	Sugar.

Group 5th. Doubly Oblique Prismatic System.—This system includes the *Doubly Oblique Prism* (also called the *Oblique Prism* with an *oblique-angled parallelogram* for its base.) The following pharmacological agents belong to this system :—

Sulphate Copper	Sulphate Cinchonia	Nitrate Bismuth

Group 6th. Rhombohedric System (Mohs).—The primary forms of this group are, the *Rhombohedron* (also termed *Rhomboid*), the *Bipyramidal Dodecahedron*, and the *Regular Hexagonal Prism*. The fundamental form is the Rhombohedron. The following pharmacological agents belong to this group :—

Antimony	Carbonate Zinc	Nitrate Soda
Plumbago	Bisulphuret Mercury	Hydrate Magnesia
Carbonate Lime	Ice	Chloruret Calcium
Carbonate Iron		

c. Classifications founded on the Chemical Constituents.—The difficulties attending the analysis of organized substances form a great obstacle to the formation of a chemical classification. Most of the writers who have attempted an arrangement of this kind are German.

Donald Munro, A Treatise on Medical and Pharmaceutical Chymistry, and the Materia Medica. London, 1788.

C. H. Pfaff, System der Materia Medica nach chemischen Principien mit Rücksicht auf. d. sinnl. Merkmale und d. Heilverhältnisse der Arzneimittel. Leipzig, 7 Bde, 1808-24.

F. A. C. Gren: Handbuch der Pharmacologie, 3te Aufl. herausgegeben von *Bernhardi* und *Buchholz*, 2 Bde. Halle u. Berlin, 1813.

F. G. Voigtels, vollständ. System der Arzneymittellehre, herausgeg. von *Kühn*. 4 Bde. Leipzig, 1816-17.

C. W. Hufeland, Conspectus Materiæ Medicæ, Berolini, 1816, ed. 2, 1820; ed. 3, 1828.

G. W. Schwartze, Pharmacologische Tabellen, oder system. Arzneimittellehre in tabell. Form. Leipzig, 1819-25. 2 Aufl. fol. 1833.

G. A. Richter, ausführliche Arzneimittellehre, Handbuch für prakt. Aerzte. 5 Bde. u. 1. Suppl. 1826-32.

As an example of a chemical classification I shall select Schwartze's, and must refer the reader to the late Dr. Duncan's (jun.) *Edinburgh Dispensatory*, 11th ed. p. 172, for Pfaff's chemical classification of the vegetable materia medica.

Schwartze's Classification.

Div.	Div.	Div.
1. Aqua Communis	8. Extractiva amara	15. Alcalina
2. Gummosa, mucilaginosa	9. Adstringentia seu Tannica	16. Salina
3. Farinosa, amylacea	10. Ætherea--Oleosa	17. Metallica
4. Gelatinosa	11. Resinosa	18. Corpora simplicia, solida, non metallica
5. Albuminosa	12. Narcotica	19. Kalia sulphurata
6. Saccharina	13. Spirituosa	20. Sapones
7. Pinguia—Oleosa	14. Acida	

It will be observed that the author has not always founded his divisions on the chemical properties of medicines; some of them refer partly or wholly to the effects produced by these agents on the body. The nomenclature is not always perfect: thus, his seventeenth class is called "Metallica," as if it alone contained metallic substances; whereas divisions fifteen and sixteen also contain them. Again, some of the divisions, for example "Resinosa," contain substances whose effects are most dissimilar; while substances of analogous operation are placed in separate divisions.

d. Classifications founded on the Physiological Effects of Medicines.—As the ultimate object of all our inquiries into the materia medica is to obtain a knowledge of the mode of operation of medicinal substances, it follows, that the most desirable and useful, because the most practical, classification of these agents, would be that founded on the similarity of their effects. But so many difficulties exist in the way of producing such an arrangement—so much remains yet to be determined with respect to the nature of the modifications impressed on the organised tissues by the influence of medicines—that it must be evident to every one who attentively studies the subject, that in the present state of our knowledge no such classification can be satisfactorily effected.

Of the numerous arrangements of this kind which have been attempted, some are founded on the *nature*, *quality*, or *general character* of the effects; as in the following works:—

W. Cullen, M.D. Treatise of the Materia Medica. Edinburgh, 1789.

R. Pearson, M.D. A Practical Synopsis of the Materia Alimentaria and Materia Medica. London, 1808.

C. I. A. Schwilqué, Traité de Matière Médicale, 2 tom. Paris, 1818.

J. Arnemann, Chirurgische Arzneimittellehre, 6 Aufl. vind. A. Kraus. 1818.

J. Arnemann, praktische Arzneimittellehre, 6 Aufl. von L. A. Kraus. 1819.

T. Young, M.D. An Introduction to Medical Literature, art. Pharmacology, 2nd edit. 1823.

J. B. G. Barbier, Traité Elémentaire de Matière Médicale, 2nde éd. 3 tom. Paris, 1824.

N. Chapman, M.D. Elements of Therapeutics and Materia Medica, 4th ed. Philadelphia, 1825.

Dr. Nuttall, Lancet, 1825-6, vol. ix. p. 578.

H. M. Edwards, and *P. Vavasseur*, M.D. Manuel de Matière Médicale. Paris, 1826.

C. Sundelin, Handbuch der speciellen Heilmittellehre, 2 Bde. 3te Aufl. 1833.

John Murray, M.D. A System of Materia Medica and Pharmacy, 5th edit. Edinburgh, 1828.

A. Duncan, M.D. Physiological Classification of the Materia Medica. In the Supplement to the Edinburgh New Dispensatory, 11th ed. 1829.

J. Wendt, praktische Materia Medica. Breslau, 1830, 2 Aufl. 1833.

F. Foy, Cours de Pharmacologie, 2 tom. Paris, 1831.

A. T. Thomson, M.D. Elements of Materia and Therapeutics, 2 vols. 1832; 2nd ed. 1 vol. 1835.

E. S. and *K. D. Schroff*, Arzneimittellehre und Receptirkunde. Wien. 1833.

A. Trousseau et *H. Pidoux*, Traité de Thérapeutique. Paris, 1er tom. 1836. 2nd tom. re part. 1837.

C. G. Mitscherlich, Lehrbuch der Arzneimittellehre. 1re Bd. 1te Abl. Berlin, 1837.

The best arrangements of the authors just quoted are, in my opinion, those of Drs. Murray, Duncan, and A. T. Thomson. I subjoin that of Dr. Duncan:—

DR. DUNCAN'S PHYSIOLOGICAL CLASSIFICATION OF THE MATERIA MEDICA.

External Agents act,				
I. By nourishing the body -	ALIMENTA.			
(*a*) Drink - Potus.				
When they act medicinally - - - -				Diluentia.
(*b*) Food - - Cibi.				
When they act medicinally - - -				Demulcentia.
II. By evacuation - -	EVACUANTIA.			
(*a*) By the skin insensibly - -	- - -			Diaphoretica.
——— sensibly -	- - -			
(*b*) By the mucous membrane				
Of the nostrils - -	- - -			Errhina.
Of the lungs - -	- - -			Expectorantia.
Of the stomach - -	- - -			Emetica.
Of the intestines - -	- - -			Cathartica.
Of the uterus - - -	- - -			Emmenagoga.
(*a*) By glandular secretion				
The kidneys - -	- - -			Diuretica.
The salivary glands - -	- - -			Sialogoga.
III. By exciting the vital powers -	STIMULANTIA.			
(*a*) Chiefly of the parts to which they are applied - -	TOPICA.			
Applied externally				
Causing redness - -	- - -			Rubefacientia.
——— serous secretion -	- - -			Vesicantia.
——— purulent secretion -	- - -			Suppurantia.
Administered internally.				
Condimenta when alimentary.				
When acting medicinally	- - -			Carminativa.
(*b*) Of the system generally -	GENERALIA.			
(*a*) Obscurely, but more durably	PERMANENTIA.			
Producing no immediate obvious effect -				Tonica.
Constricting fibres and coagulating fluids -				Astringentia.
(*b*) More evidently, but less durably,	TRANSITORIA.			
Acting on the organic functions	- - -			Calefacientia.
Acting on the mental functions	- - -			Inebriantia.
IV. By depressing the vital powers	DEPRIMENTIA.			
Acting on the organic functions -	- - -			Refrigerantia.
Acting on the mental functions	- - -			Narcotica.
V. By chemical influence on the fluids,	CHEMICA			
Acidifying - - -	-			Acida.
Alkalizing - - -	- - -			Alkalina.

A very cursory examination of the substances placed by the author under each of the above classes will satisfy the most superficial observer that this classification does not, in a large number of instances, effect that which it proposes to do; namely, to arrange together "substances according to the effects which they produce in a state of health." For example, under the head of diaphoretics and sudorifics we have mustard, copaiva, opium, ipecacuanha, alcohol, antimony, ammonia, and mercury; among narcotics are opium, nux vomica, foxglove, saffron, and colchicum; in the class sialogogues we have, horseradish, tobacco, and mercury. Now no one will pretend to affirm that the substances thus grouped together operate in an analogous manner on the system, or that their effects are similar.

Some physicians have classified the articles of the materia medica in accordance with *Brunonian principles*. I have already mentioned that Brown regarded all medicines as stimulants; that is, as agents causing excitement. But he supposed some of them to produce less excitement than health requires, and, therefore, to be the remedies for sthenic diathesis: hence they were termed *Debilitating* or *Antisthenic*. On the other hand, some agents give more excitement than suits the healthy state, and are, therefore, the remedies for the asthenic diathesis. These he called *Stimulant* or *Sthenic*. (*The Works of Dr. John Brown*, vol. ii. p. 205, 1804.) The following pharmacological works are based on Brunonian principles: (*Encyclopädisches Wörterbuch der medicinischen Wissenshaften*, 3 Bd. art. *Arzneimittellehre*.)

Versuch einer einfachen practischen Arzneimittellehre. Wien. 1797.

Pharmacopœa Browniana, oder Handbuch der einfachsten und Wirksamsten Heilmittel, mit klinischen Bemerkungen im Geiste der geläuterten neuen Arzneilehre. Stuttgart, 1798.

J. S. Frank, Versuch einer theoretisch-praktischen Artzneimittellehre nach den Principien der Erregungstheorie. Erlangen, 1802.

C. F. Oberreich, Umriss einer Arzneimittellehre nach den Grundsätzen der Erregungstheorie. Leipzig, 1803.

J. J. Chortet, Traité de Pharmacologie, basée sur la theorie de Brown. Paris, 1806.

F. Wurzer, Grundriss der Arzneimittellehre. Leipzig, 1808.

J. H. Müller, Handbuch der Lebens-und Arzneimittellehre. Leipzig, 1809.

J. A. Neurohr, Versuch einer einfachen praktischen Arzneimittellehre, Zweite Aufl. Heidelberg, 1811.

K. Schöne, praktische Arzneimittellehre für Aerzte und Wundärze nach den Grundsätzen der Erregungstheorie. 2 Bde. Berlin, 1815.

The partizans of the *theory of contrastimulus* divide medicines into two great classes: one comprehending those agents which augment or depress the excitability—(stimulants and contra-stimulants)—and which on that account are termed *dynamics;* the other contains all mechanical and chemical agents, under the denomination of *irritants*. (*Dict. de Médecine et de Chirurg. pratiq.* art. *Contre-stimulant*, par Andral.) I have already given a list of stimulants and contra-stimulants, and have pointed out some objections to the arrangement.

The followers of Broussais, the founder of what the French denominate the *New Medical Doctrine*, or *Physiological Medicine*, consider all medicines to be either stimulants or debilitants. When a stimulant is applied to the organ affected, it is termed a direct stimulant, but when applied to a part more or less distant from that affected, it is termed a revulsive, or sometimes an indirect debilitant. Hence medicines are divided into *debilitants*, *direct stimulants*, and *revulsives*. This is the plan adopted in the following work:

L. J. Begin, Traité de Thérapeutique, rédigé d'après les principes de la nouvelle Doctrine Médicale, t. ii. Paris, 1825.

Another mode of classifying medicines is on *chemico-physiological principles;* or, to use the phrase of Dr. Osann (*Encyclop. Wörterb. d. med. Wissenschaften*) "on the chemico-therapeutical basis of natural philosophy." This method has been adopted in the following works:

K. F. Burdach, System der Arzneimettellehre. 1807-9. 3 Bde. 2te Aufl. 1817-19. Leipzig.

**C. H. C. Bischoff*, die Lehre von den chemischen Heilmitteln, oder Handbuch der Arzneimittellehre. 3 Bde. 1825-31. Bonn.

W. Grabau, M.D., chemisch-physiologisches Syst. der Pharmakodynamik. 1er Theil Kiel, 1837.

Another mode of classifying medicines is to arrange them according to the *particular structure or organ which they affect;* as into medicines acting specifically on the nervous system; medicines acting specifically on the vascular system; and so on. Some authors have formed their principal divisions, or classes of medicines, from the parts acted on, and their orders from the nature or quality of the effect. The following writers have founded their classifications on the particular organs affected by medicines:—

* *J. L. Alibert*, Nouveaux Elémens de Thérapeutique et de Matière Médicale. 5me. ed. 3 t. Paris, 1826.

Dr. Granville, Medical and Physical Journal for April, 1822, vol. xlvii.

J. Eberle, M.D., A Treatise on Materia Medica and Therapeutics. 2nd ed. Philadelphia, 1824. 3d ed. 1835.

* *Ph. F. W. Vogt*, Lehrbuch der Pharmakodynamik. 2 Bde. 2te Aufl. 1828.

Dr. Michaelis, Encyclopädisches Wörterbuch der Medicinischen Wissenschaften. Art. Arzneimittel. Berlin, 1829.

Eberle's Classification.

A.—Medicines that act specifically on the intestinal canal, or upon morbific matter lodged in it	I. Medicines that excite discharges from the alimentary canal	Emetics. Cathartics.
	II. Medicines calculated to destroy or counteract the influence of morbific substances lodged in the alimentary canal	Anthelmintics. Antacids.
B.—Medicines whose action is principally directed to the muscular system	I. Medicines calculated to correct certain morbid conditions of the system, by acting on the tonicity of the muscular fibre	Tonics.
	II. Medicines calculated to correct certain morbid states of the system, by acting on the contractility of the muscular fibre	Astringents.
C.—Medicines that act specifically on the uterine system	I. Medicines calculated to promote the menstrual discharge	Emmenagogues.
	II. Medicines calculated to increase the parturient efforts of the womb	Abortiva.
D.—Medicines that act specifically on the nervous system	I. Medicines that lessen the sensibility and irritability of the nervous system	Narcotics.
	II. Medicines that increase and equalize the nervous energy	Antispasmodics.
E.—Medicines whose action is principally manifested in the circulatory system	I. Medicines that increase the action of the heart and arteries	Stimulants.
F.—Medicines acting specifically upon the organs of secretion	I. Medicines that act on the cutaneous exhalents — General	Diaphoretics.
	I. Medicines that act on the cutaneous exhalents — Topical	Epispastics. Errhines. Emollients.
	II. Medicines that increase the action of the urinary organs	Diuretics.
	III. Medicines that alter the state of the urinary secretion	Antilithics.
	IV. Medicines that promote the secretory action of the salivary glands	Sialagogues.
G.—Medicines that act specifically upon the respiratory organs	I. Medicines calculated to increase the mucous secretion in the bronchia, and to promote its discharge	Expectorants. Inhalations.
	II. Medicines whose action is truly topical	Emollients. Escharotics.

* I have given a sketch of this classification in the *Medical Gazette*, vol. xvii. p. 164.

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.

e. 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,

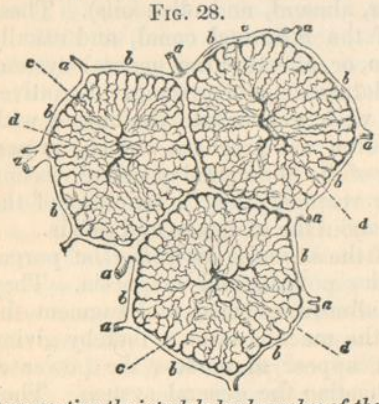
colocynth, and elaterium. These, when swallowed in large doses, act as acrid poisons. They are employed as purgatives in torpid conditions of the bowels; as hydragogues in dropsical affections, and as counter-irritants in affections of the brain. They are objectionable remedies in inflammatory and irritable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

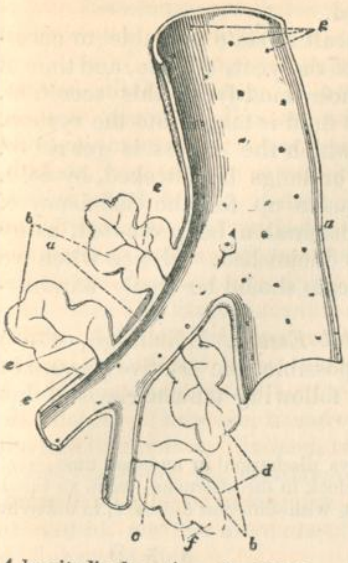
b b b. The interlobular veins which occupy the fissures, and which, with the veins in the spaces, form venous circles around the lobules. This is the appearance which the venous circles present when examined with a common magnifying glass; they are, however, formed by numerous, and not by single, branches,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



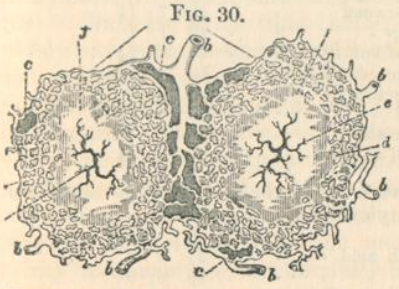
A longitudinal section of sublobular-hepatic veins, with lobules arranged around them.

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	℈
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	℈
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.