PHARMACOLOGIA.

ON THE

OPERATIONS OF MEDICINAL BODIES,

AND ON THE

CLASSIFICATIONS FOUNDED ON THEM.

"Medicos tandem tædet et pudet, diutius garrire de Remediis, Specificis, et Alexipharmicis, et cæteris, nisi eorum naturam et modum quo prosint, quodammodo ostendere et explanare possint."

CONSPECT. MED. THEOR.

PHARMACOLOGIA.

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Medicinal substances are those bodies, which, by due administration, are capable of producing certain changes in the condition of the living system, whereby its morbid actions may be entirely removed, or advantageously controlled.

In adopting this definition we intentionally exclude those alimentary substances which are more immediately subservient to the support of life, and to the repair of that diurnal waste, which the exercise of its functions so inevitably occasions.

It has been generally supposed, that substances whose application does not produce any sensible action upon the healthy system, cannot possess medicinal energy; and, on the contrary, that those bodies which occasion an apparent effect in health, must necessarily prove active in the cure or palliation of disease. Under certain limitations we may perhaps venture to assent to this general proposition; but it cannot be too forcibly or too frequently impressed upon the mind of the medical practitioner, that *Medicines are frequently but relative agents*, producing their effects in reference only to the state of the living frame; we must therefore concur with Sir Gilbert Blane in stating, that the virtues of medicines cannot be fairly essayed, or beneficially ascertained, by trying their effects on sound subjects, because that particular morbid condition does not exist which they may be exclusively calculated to remove;* thus in certain states of debility, *Tonics* may excite the system when languid, by their sympathetic influence upon the *primæ viæ*, while in a robust condition of the body, the effects of the same agents may be wholly inappreciable.

* Medical Logic. Edit. 2nd. p. 92.

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The Modus Operandi of remedies, or the general principle upon which they effect salutary changes in the morbid states of the body, is involved in considerable obscurity, and has given rise to much ingenious speculation and scientific controversy. It would seem that the immediate impression of a remedy may depend upon mechanical, chymical, or vital agencies; and that the sanative impulse thus occasioned may either be Absolute, or Relative;—Primary, or Secondary;—Local, or General;—Direct, or Sympathetic; Permanent, or Transient;—thus certain purgatives will occasion intestinal excretions in every condition of the body, and may therefore be justly considered as *absolute* agents; while diuretics, since they generally require for their success, a certain state of the living system, may with equal truth be denominated *relative* in their operation. That the obvious effect of a remedy may either depend upon its *primary*, or upon its *secondary* and incidental operation, will at once be apparent by inspecting the diagram which exhibits the classification of diuretic medicines; the same scheme will also show that remedies may be *local* or *general* in their effects, and may excite an action in distant organs, either by entering the circulating mass, and being thus brought into contact with their textures;—by occasioning an impulse conveyed through the nervous system,—or by exciting a local impression upon the stomach and *primæ viæ*, and thus arousing their energies through the mysterious medium of sympathetic* communication.

That certain bodies are capable of evading the assimilating functions, and of entering, unchanged, into the circulating current, either through the branches of the thoracic duct, or of the *vena portarum*, is a fact which admits of chymical demonstration; many of the alkaline salts are thus conveyed to the kidneys, and being excreted from the blood by its vessels, are to be easily detected in the urine by appropriate reagents; I have made many experiments upon this subject, and am prepared to state some results which may perhaps explain the occasional value of such bodies as medicines. Some essential oils, particular *bitter* principles,† and certain colouring matter,‡ seem also capable of passing the barriers of digestion, and of circulating to the remote parts of the body; mercury, and several of the other metals, would likewise appear, under certain circumstances, to possess a similar privilege, and the former to be able moreover to facilitate the absorption of other bodies with which it may be associated, as I shall hereafter more fully exemplify.§

* The term *sympathy* has often been objected to, as being too figurative; it is certainly a metaphor taken from an affection of the mind, but, as Sir Gilbert Blane very justly remarks, the import of words ought either to be assumed conventionally according to a definition, or to be adhered to in the sense affixed to it by established usage; "by *animal sympathy*," says he, "is not meant the intelligible principle of Stahl's hypothesis, but that mutual influence of distant parts, so subtle and rapid as in some instances to be compared to thought or lightning; while in other instances it is an action more tardy and habitual." *Medical Logic, Edit.* 2nd, p. 123. In the present work, I wish the reader to understand the term *sympathy*, wherever it may occur, in conformity with the above definition.

† *Colchicum*, *Squill*, and many other vegetable diuretics, are of this nature.

‡ The Indian Fig, (*Cactus Opuntia*,) when eaten, renders the urine of a bloody colour.

Rhubarb has likewise an effect upon the colour of this secretion.

§ That certain substances enter unchanged into the circulating fluid, is so clearly established by the facts related by our author, as well as by many others of a similar nature, that we should have supposed none but the most obtuse intellect could have

In some instances, the medicinal body undergoes a partial decomposition by the digestive organs, *in transitu*, by which some of its constituents escape into the circulation, while the others are completely digested, and converted into chyle; this occurs with saline compounds into which vegetable acids enter as constituents. See *Potassæ Acetas*. It is also stated in the history of Diluents, that there is reason to believe that *water* may under particular circumstances suffer decomposition, and transfer its elements for the formation of new compounds, furnishing *oxygen* to some, and *hydrogen* to others. There is likewise reason to suppose, that in particular conditions of the digestive functions, a remedy may be at once rendered inert by its entire decomposition.*

That an impression made upon the stomach by a medicinal agent, should be the means of exciting an action in the distant parts of the machine, will not appear extraordinary when we consider how universal a sympathy and control this central organ exercises over every function of the body; imbued with exquisite and diversified sensibilities,—subjected to the first and coarsest impressions of our various ingesta,—stretched occasionally to an enormous extent by the unrestricted indulgence of appetite,—disturbed by the passions,—exhausted by volition, and debilitated by intense thinking; in short, assailed by numerous foes from *without*, and harassed by various revolutions from *within*, can we feel surprised that the aberrations of this viscus should give origin to the greater number of maladies with which we are afflicted, or that those medicinal applications should be effective that are directed for their cure, through the medium of its sympathies?

A dose of *Ipecacuan*, by exciting the stomach, will abate both the force and velocity of the heart in its vital motion, and affect the whole series of blood-vessels, from their origin to their most minute ramifications, as is evinced by the pallor of the skin under its operation, as well as by its efficacy in arresting hemorrhage; so the brain, when disordered by vertigo, frequently derives instantaneous relief from the administration

resisted their force. Yet have we seen a popular writer on Materia Medica in our own country, without denying the facts themselves, attempt to explain them away by gravely informing his readers that all the substances alluded to are *completely decomposed* before they enter the circulation, "but when thrown into the secretions or excretions, being removed beyond the control of the vital energies, chymical affinities are sometimes again brought into play, by which these substances are in part or wholly regenerated!!" Such puerility as this does not deserve a refutation.—*Ed.*

* This is probably the reason of many bodies producing but little effect upon the inferior animals. The vegetable eaters are certainly less affected by vegetable poisons than those animals who exclusively live upon *animal* substances: it is thus, that a rabbit can take a very large dose of opium without any ill effects, while half the same quantity would poison a dog. It is a curious fact, that a sound horse can take a very considerable portion of opium with impunity, but if he be weakened by previous disease, by strong purgatives, or by excessive bleeding, he is speedily destroyed by a much less dose; (*See Bracy Clarke's Reformed Pharmacopœia for Horses.*) In this latter case, does it not appear that the fatal result depends upon the fact of the digestive organs having been disabled, by debility, from effecting that decomposition by which under ordinary circumstances, the drug is disarmed of its potency? What important lights might not be obtained by the institution of a series of well devised experiments upon the comparative effects of medicinal bodies upon man and other animals? The Physiologist has thus availed himself of the resources of the comparative anatomist, and I feel persuaded, that results equally beneficial to science would follow a similar inquiry in relation to the operation of medicines.

In the course of the present work, I hope to show the truth of this position by some appropriate illustrations.

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of a teaspoonful of æther in a glass of water. The stomach however is not in every case the medium of sympathy; a substance may excite a powerful impression upon a distant part, by the instrumentality of the nerves, without any concurrence of the stomach; thus, the *Belladonna*, by coming in contact with the *Tunica Conjunctiva* of the eye, will occasion immediate dilatation of the *Iris*, although no other part of the system is in the slightest degree affected.

But there is yet another mode by which remedies may be made to exert a sanative effect upon particular organs of the body, through the medium of what Mr. Hunter called *contiguous* sympathy, and whose existence appears to depend upon the mere proximity and contiguity of parts, without any relation to the distribution of the nerves; thus it is, that relief is afforded to a deep-seated inflammation, by scarifying the nearest external surface; while we know from long experience that the thoracic or abdominal viscera, when similarly affected, receive corresponding relief from the same topical use of bleeding, blistering,* or fomenting.

With respect to the *Modus Operandi* of medicines the following classification may be established.

THE PARTICULAR ORGANS OF THE BODY MAY BE EXCITED INTO ACTION, THROUGH FOUR DISTINCT AND DIFFERENT MODES OF COMMUNICATION.

I. *By the actual contact of the appropriate remedy.*

1. *Conveyed by absorption*, WITHOUT DECOMPOSITION.

Internally.
- *a. through the branches of the Thoracic duct.*
- *b. . . . . of the Vena Portarum.*†

Externally.
- *c. . . . . of divided blood-vessels.*
- *d. . . . . of Lymphatics.*‡

2. *Conveyed by absorption*, WITH DECOMPOSITION, *by which one or more of its constituents are developed, and pass into the circulating current.*

II. *By an impulse conveyed through the instrumentality of the nerves.*

III. *By the sympathetic control exerted by the stomach on distant parts.*

IV. *By the operation of contiguous sympathy, or of that which is excited by the mere proximity and continuity of parts.*

* So little does blistering appear to act upon the principle of *contiguous* sympathy, that it is frequently most efficacious when excited at a distance from the diseased organ.—*Ed.*

† That the Vena Portarum constitutes one of the avenues through which certain extraneous bodies enter the circulating current, there cannot exist a doubt; but a series of well devised experiments are greatly wanted for the elucidation of the subject. The Professors of Veterinary Medicine might on this occasion render us an important service by some comparative researches.

‡ See *Unguent. Hydrarg.*

And it is important to observe, that those are frequently antagonist operations, and consequently, that remedies, although they should occasion the same apparent effects, unless they act through the same medium, are not SIMILAR agents, but, on the contrary, are generally medicinally incompatible with each other; for an illustration of this truth, the practitioner may refer to the observations which I have offered under the history of diuretics.

The difficulty of justly appreciating these phenomena, in every instance, has furnished a powerful objection against the validity of any classification of medicinal substances which is founded on their supposed modes of operation; and it must be acknowledged that, if we are unable to assign to remedies their primary action, or to distinguish this from their more obvious, though perhaps secondary effects, we shall frequently be compelled to place similar medicines under opposite heads, and to include those of very dissimilar characters under the same artificial division; an error which has contributed more generally to embarrass and misguide our practice than any other therapeutical fallacy, and it was the conviction of this truth which induced me to introduce the present chapter, and to impress the importance of its subject upon the attention of my practical readers.

It is probable that, in philosophical strictness, no two medicines in our Materia Medica are perfectly similar, although they recede from each other by such insensible shades of gradation that we may with practical advantage admit their parallelism; at the same time, it must be ever kept in remembrance, that *those Medicines only are practically similar, whose operations have been found by experience to continue similar under every condition of the human body; and which, moreover, owe such similarity to modes of operation which are compatible with other, and consonant with the general indications of cure.*

The importance of admitting this proposition will be frequently illustrated in the sequel; and it may be observed in this place, that every classification in which it is not recognised as a leading principle, must be as imperfect in its execution, as it will be unjust and erroneous in its views.

Before I proceed to any farther discussion upon the present subject, it will be necessary to offer a synoptical view of an arrangement of medicinal bodies founded upon the basis of their operations, in order that I may be better enabled to illustrate the observations which it is my intention to introduce: for this purpose I shall present the reader with three different classifications of this kind; the first being that proposed by Dr. Cullen,* and which is now admitted to rest on principles nearly altogether false, but the investigation of which will afford many useful lessons of practical importance; the second classification is by Dr. Young;† and the third is that proposed by Dr. Murray,‡ which, from its simplicity and strict conformity with the views I intend to offer, will be adopted as being the most eligible for the occasion.

* Treatise on the Materia Medica, vol. 1. p. 191.
† Medical Literature Edit. 2. (*Pharmacology,*) p. 454.
‡ System of Mat. Med. vol. 1. p. 132.

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CULLEN'S ARRANGEMENT OF THE MATERIA MEDICA.

Medicamenta agunt in

- SOLIDA.
  - SIMPLICIA.
    - *Astringentia.*
    - *Tonica.*
    - *Emollientia.*
    - *Erodentia.*
  - Viva.
    - *Stimulantia.*
    - *Sedantia.*
      - *Narcotica.*
      - *Refrigerantia.*
    - *Antispasmodica.*
- FLUIDA.
  - IMMUTANTIA.
    - Fluiditatem.
      - *Attenuantia.*
      - *Inspissantia.*
    - Misturam.
      - Acrimoniam Corrigentia.
        - *In Genere.*
          - *Demulcentia.*
        - *In Specie.*
          - *Ant-acida.*
          - *Ant-alkalina*
          - *Antiseptica.*
  - EVACUANTIA.
    - *Errhina.*
    - *Sialogoga.*
    - *Expectorantia.*
    - *Emetica.*
    - *Cathartica.*
    - *Diuretica.*
    - *Diaphoretica.*
    - *Menagoga.*

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CLASSIFICATION OF THE MATERIA MEDICA BY Dr. YOUNG.

I. Chymical Agents.

1. *Caustics.*
2. *Antiseptics.*
3. *Antidotes.*
4. *Demulcents.*
5. *Diluents.*

II. Vital Agents.

A. Supporting Strength.

1. *Nutrients.*

B. Causing Action.

Partial & Transient.

1. *Expergefacients.*
2. *Excitants.*
3. *Calefacients.*
4. *Sudorifics.*
5. *Errhines.*
6. *Sialogogues.*
7. *Expectorants.*
8. *Stomachics.*
9. *Emetics.*
10. *Cathartics.*
11. *Chologogues.*
12. *Hydrogogues.*
13. *Simply Propellents.*
14. *Anthelmintics.*
15. *Diuretics.*
16. *Carminatives.*
17. *Emmenagogues.*
18. *Epispastics.*
19. *Suppuratories.*
20. *Sorbefacients.*
21. *Astringents.*

Permanent.

Tonics.

C. Diminishing Action or Sensation.

Primarily

1. *Narcotics.*
2. *Sedatives.*
3. *Nauseants.*
4. *Diaphoretics.*

Secondarily

Exhaurients.

III. Insensible Agents.

Specifics.

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CLASSIFICATION OF REMEDIES BY Dr. MURRAY.

A. General Stimulants.

a. *Diffusible.* { *Narcotics.* / *Antispasmodics.*

b. *Permanent.* { *Tonics.* / *Astringents.*

B. Local Stimulants.

Emetics.	*Expectorants.*
Cathartics.	*Sialogogues.*
Emmenagogues.	*Errhines.*
Diuretics.	*Epispastics.*
Diaphoretics.	

C. Chymical Remedies.

Refrigerants.	*Lithontriptics.*
Antacids.	*Escharotics.*

D. Mechanical Remedies.

Anthelmintics.	*Diluents.*
Demulcents.	*Emollients.*

With respect to the classification of Dr. Cullen, we may commence our objections by stating, that the very basis upon which it rests is a mere gratuitious assumption, viz. *that certain medicines act on the fluids of the body.* With the exception of a very few substances, it is now generally admitted that medicines produce their effects by acting on the living materials of which our organs are composed, and not by modifying the specific gravity, or chymical composition, of the fluids which they may happen to evacuate. The origin of this latter opinion is to be traced to the exploded notions of the humoral pathologists, and to the exclusive doctrine of the earlier chymists; for as the former recognised a depraved condition of the fluids as the source of every disease, so did the latter imagine that every remedy operated by producing a chymical change upon its composition; and the remedial value of a medicinal substance was estimated by its effects upon inert matter. Thus were experiments made with different substances upon the blood, and other fluids of the body, in order to deduce, from the results, the nature and extent of their powers as agents upon the living frame; for instance, the

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spirit and *salt of hartshorn*, as they were found to render the blood more fluid, when added to it, *out of the body*, were indiscriminately administered in almost every complaint, with a view to dissolve that "lentor of the fluids" which was regarded as the more general source of disease. For similar reasons, a tribe of medicines were introduced into practice under the title of *Antiseptics*, for the prevention of a process which very probably never takes place in the living body: the powers of these supposed agents were, as usual, inferred from their effects in resisting and preventing the putrefaction of dead matter.

Nor is the distinction assumed by Dr. Cullen, between the action of remedies on the *simple* and *living* solids less hypothetical. Tonics and astringents may certainly exert a beneficial effect upon the animal fibre, but not by any immediate action on its materials, but through the agency of its living principle.—"*Medicamentum non agit in cadaver.*"

The classification of Dr. Young, although it presents many points of interest and value, is not altogether free from objection; his classes in some instances are perhaps unnecessarily sub-divided, without a sufficient regard to the primary and secondary operations of the substances which they include. The arrangement of Murray has been adopted in the present inquiry, not as being less objectionable, in a general point of view, but as one which from its simplicity, is better calculated, as a framework, if I may so express myself, for the display of those particular facts, the knowledge of which I consider essential for the successful administration of medicinal agents, and for the full comprehension of those practical doctrines which it is the exclusive object of this work to inculcate.

Dr. Murray observes that, in this arrangement, he places in the first division those substances which exert a GENERAL STIMULANT operation on the system. Of this there are two sub-divisions, THE DIFFUSIBLE and the PERMANENT; the former including the class of *Narcotics*, with which may be associated, as not very remote in their operation, the class of *Anti-spasmodics;* the latter comprising two classes, viz. *Tonics* and *Astringents*. Through these there is a gradual transition from the highly diffusible stimulant, to those most slow and durable in their action.

A second division comprehends LOCAL STIMULANTS, those, the action of which is determined to particular parts of the system. Such are the classes of *Emetics*, *Cathartics*, *Emmenagogues*, *Diuretics*, *Diaphoretics*, *Expectorants*, *and Sialogogues;* with which may be associated the classes of *Errhines* and of *Epispastics*, founded on direct local application.

The remaining classes include substances which do not operate according to laws peculiar to the living system. To one division may be referred those, whose effects depend on the CHYMICAL changes they produce in the fluids or solids; the classes which may be established on this principle are *Refrigerants*, *Antacids*, *Lithontriptics*, and *Escharotics*. To another division belong those, the operation of which is purely MECHANICAL, as *Anthelmintics*, *Demulcents*, *Diluents*, *Emollients*, and certain *Laxatives*.

Under the above classes, says Dr. Murray,* may be comprehended all those substances which are capable of producing salutary changes in

* A system of Materia Medica and Pharmacy, vol. 1. p. 131.

the human system, and which are used as remedies. I have stated my reasons for adopting this as a general basis of classification, although I shall deviate very considerably in the subordinate divisions of the plan, in the hope of establishing some distinctions that may tend to practical utility.

I. GENERAL STIMULANTS.

The four classes comprehended under this first division, are NARCOTICS, ANTISPASMODICS, TONICS, and ASTRINGENTS.

Although these remedies differ very essentially in the degree and permanence of their action, as well as in the character of their apparent effects, yet, as it is conceived that their *primary* operation is stimulant, they are considered as possessing sufficient general similitude to sanction their arrangement under one comprehensive division.

NARCOTICS.

Synon: *Sedatives. Anodynes. Hypnotics. Soporifics.*

Substances which, in a moderate dose, occasion a temporary increase of the actions of the nervous and vascular systems, but which is followed by a greater depression of the vital powers than is commensurate with the degree of previous excitement, and which is generally followed by sleep.

The relative intensity of these primary and secondary effects varies in the different narcotics,* and even in the same narcotic in different doses; in some cases, especially if the quantity administered be considerable, the symptoms of diminished sense and action follow so immediately, that the previous stage of increased action is very obscure, or not in the least perceptible, while in other cases, the operation of the substance is more particularly directed towards the heart and arteries, and syncope succeeds its exhibition. These facts have led many physiologists to deny the stimulant nature of these bodies, and to consider their primary operation as one of a depressing kind, whence they have bestowed upon them the name of SEDATIVES; in referring to the classification of Cullen and Young, we shall find that the arrangement of these substances have been directed in strict conformity with such a view of the subject; but it may be asked, how the increased excitement and exhilaration which so obviously follow the use of these bodies, in small doses, can be reconciled with that theory which considers them as absolutely and primarily sedative? In order to combat an argument so fatal to his hypothesis, Dr. Cullen summons to his aid the potent intercession of his tutelar deity, the *Vis Medicatrix*, a power which he supposes to preside over our living body, and with anxious vigilance, to resist the invasion

* *Narcotics*, from νάρκη *Torpedo*; an animal which has the power of *stupefying* any thing that it touches.

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of every thing that is noxious, or hostile to its health and well being: with such assistance it was not difficult to explain any paradox in physiology, and the anomalies attending the agency of narcotic medicines were accordingly, in the school of Cullen, easily reconciled with the views of a favourite theory. He supposed that whenever a *sedative* was applied in a moderate dose, the *Vis Medicatrix* took the alarm, and excited all the powers of the system, in order to throw off the noxious application, and that thus *indirectly* arose those peculiar symptoms of increased action; but when the dose was more considerable, he contended that the preserving power of the system was silenced, and unable to offer any salutary resistance, and consequently that universal depression immediately followed; but there is no direct evidence in support of the existence of such a power, and still less of its influence upon such occasions; it is far more philosophical to refer the operation of narcotics to a peculiar stimulating power, remarkable for the extreme rapidity with which it exhausts the energy of the nervous system. No one will deny the stimulating powers of alcohol, and yet a very large draught of this liquor will occasion extreme exhaustion without the occurrence of any signs of previous excitement; nor will any one be disposed to question the depressing influence of opium, and yet small doses have enkindled excitement and sustained the powers of life, under circumstances of extreme and alarming exhaustion.*

From the celerity with which narcotics produce their effects, it is reasonable to suppose that they act upon the nervous system through the sympathetic relations of the stomach, although in some instances it is highly probable that these bodies are actually absorbed into the circulation; I am inclined to think that this occurs with opium, as death is accelerated in cases of persons poisoned by it, by the adoption of those measures which are best calculated to promote its absorption: (*see Opium.*) A still more striking proof is furnished by the fact of opium, when externally applied to ulcers, producing all its constitutional effects, such as costiveness, head-ach, nausea, &c. Whether the effects of spirituous potations are to be attributed to the introduction of alcohol into the blood, or to the sympathies existing between the stomach and brain, is still a question of doubt. Dr. Cooke† relates a case, on the authority of Sir A. Carlisle, of a person who was brought dead into the Westminster Hospital, in consequence of having drank a quart of gin for a wager, and that upon examination, a considerable quantity of a limpid fluid was found within the lateral ventricles of the brain, *distinctly impregnated with gin.* I very well remember the case, for it occurred during the period that I held the situation of physician to that hospital, but it is very doubtful whether such an absorption occurs under ordinary circumstances. We well know the facility with which certain odorous bodies enter the circulation, and are developed in distant organs; it is therefore very possible that the apparent odour of the gin, which has been sometimes recognised in the secretions may depend upon the presence of the flavouring ingredients, independent of the alcohol?

* During the severe campaigns of the late war, the Surgeons of the French army were in the practice of administering Opium and Cayenne Pepper to the soldiers, who were exhausted by fatigue.

† Treatise on Nervous Diseases, vol. 1. p. 221

At one period, substances supposed to possess narcotic virtues were placed about the bed to obviate watchfulness; the plant *Anethum*, or *Dill*, was very commonly suspended over the head for such a purpose, while in modern times the *Hop* has been introduced into the pillow.

In concluding the history of Narcotics, it may be observed, that there is, perhaps, no class of medicinal bodies, the individuals of which are less disposed to bend and conform to an artificial arrangement; each would seem to have its own particular mode of operation, and to affect sensibility in its own peculiar manner; and hence the practitioner will often find that, after the failure of one narcotic, the administration of another will induce sleep.

ANTISPASMODICS:

Substances which have the power of allaying the inordinate action of muscular structures, and of assuaging pain, without occasioning that state of insensibility which characterises the operation of narcotics.

There are certain medicinal bodies which would appear to exert a specific control over spasmodic action, from whatever cause it may have originated, such are *Assafœtida*, *Galbanum*, *Musk*, *Castor*, *Ammonia*, *Valerian*, *&c.* To such remedies the term antispasmodic more exclusively belongs, but in a more general view of the subject we must admit that this class branches, by indefinable gradations, into narcotics, and tonics; for since spasm may be connected with the most opposite states of the body, it is very evident that many of the individuals included in the class of antispasmodics, can only be relative agents: spasm, for instance, may arise from excessive irritability, as from teething, wounds, worms, &c., in which case a narcotic would prove beneficial; or it may depend upon a state of general debility, the proper remedy for which would be the administration of an Aromatic Stimulant, or the assiduous exhibition of some permanent tonic.

TONICS:

Substances, whose continued administration gives strength and vigour to the body.

It is very justly admitted, that a state of permanent tension in the fibres of the body is necessary for the existence of life, and that any undue departure from such a condition is followed by debility. Thus, Sir Gilbert Blane observes, that no muscle, whether voluntary or involuntary, can act unless its fibres are previously in such a state, that if divided they would shrink by their own resiliency, leaving an interval between the cut extremeties; the same may be said of the vascular system in all its ramifications, in order to give play to their contraction in grasping and propelling their contained fluids. It appears that there are certain medicinal bodies that have the power of affecting this state of tension, and when their effects contribute to its restoration, they are properly denominated *Tonics*. We are not, however, to consider them as pro

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ducing such a change by any mechanical operation upon the matter of which the fibre is composed, but by a direct action upon its living principle; it seems probable that certain poisons may thus produce sudden death by their agency on the vital principle, by which the tension of the heart and whole arterial system is immediately relaxed. In this point of view, *Tonics*, like the other remedies which we have described, may be *relative* or *absolute* in their operation. Venesection, purgation, or whatever will, under certain conditions of the body, occasion a salutary change in its vital powers, may produce a corresponding alteration in the tension of its fibres, and consequently fall under the denomination of a tonic remedy: but independent of the state of the body, there would seem to be certain substances that act as specific stimuli upon the living fibre, and are in certain cases indispensable for the maintenance of its healthy tone; such are vegetable bitters, which produce a powerful effect upon the digestive organs, and by nervous sympathy, upon the rest of the system. *Bitter Extractive*,* seems to be as essential to the digestion of herbivorous, as salt is to that of carnivorous animals; it acts as a natural stimulant, for it has been shown by a variety of experiments, that it passes through the body without suffering any diminution in its quantity, or change in its nature. No cattle will thrive upon grasses which do not contain a portion of this vegetable principle; this fact has been most satisfactorily proved by the late researches of Mr. Sinclair, gardener to the Duke of Bedford, which are recorded in that magnificent work, the "Hortus Gramineus Woburnensis." They show, that if sheep are *fed on Yellow Turnips, which contain little or no bitter principle, they instinctively seek for*, and greedily devour any provender which may contain it, and that if they cannot so obtain it they become diseased and die. We are ourselves conscious of the invigorating effects of slight bitters upon our stomach: and their presence in malt liquors not only tends to diminish the noxious effects of such potations, by counteracting the indirect debility which they are liable to occasion, but even to render them, when taken in moderation, promoters of digestion. The custom of infusing bitter herbs in vinous drinks is very ancient and universal; the *Poculum Absinthiatum* was regarded in remote ages as a wholesome beverage, and the Wormwood was supposed to act as an antidote against drunkenness. The Swiss peasant cheers himself amidst the frigid solitude of his glaciers, with a spirit distilled from *Gentian*, the extreme bitterness of which is relished with a glee that is quite unintelligible to a more cultivated taste. With regard to the natural use of *Bitter Extractive*, it may be laid down as a truth, that it stimulates the stomach,—corrects putrefying and unwholesome nutriment,—promotes tardy digestion,—increases the nutritive powers of those vegetable substances to which it is united,—and furnishes a natural remedy for the deranged functions of the stomach in particular, and through the sympathetic medium of that organ, for the atony of remote parts in general; and I shall hereafter show, that in its medicinal applications it

* Bitterness in vegetables has been supposed to reside in a peculiar proximate principle, which has been accordingly named the *Bitter Principle*. Such an opinion, however, does not appear to rest on sufficient evidence; on the contrary, experiment has shown that it is very generally connected with the extractive matter of the plant, as it is obtained equally by the action of water and alcohol; it is not volatile, nor are its energies impaired by decoction.

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certainly imparts additional activity to many remedies, while it renders the stomach and system more susceptible of their salutary energies. As an essential ingredient in the provender of herbivorous animals, it may I think be admitted as a fact, that its importance is *in an inverse ratio* with the nutritive powers* of the food, and we accordingly find, in conformity with that universal scheme of self-adjustment and compensation, which influences all the operations of nature, that cultivation, which extends the nutritive powers of vegetable bodies, generally diminishes their bitterness in the same proportion; the natural history of the Potato offers a good illustration of this fact, for the roots of this useful plant which have been so greatly improved by culture, are in their wild state both small and *bitter*.† Gummy matter, which seems to result from the first change of the sap, is undoubtedly rendered more digestible and nutritive by the presence of a *bitter;* pure gum is not very much disposed to yield to the assimilative functions; "it frequently passes through the bowels," says Dr. Chapman,‡ "very little changed, as I have witnessed a thousand times." We see therefore the value of the bitter principle, in the economy of the *Lichen Islandicus*, which is intended as the food of animals in northern latitudes; we are told that boiled linseed constituted the sole diet of the people of Zealand during a scarcity of long continuance, on which occasion, symptoms of great debility occurred, attended with those of dyspepsia; so again professor Fritze, in his Medical Annals, states that vegetable mucilage, when used as a principal article of diet, relaxes the organs of digestion, and produces a viscid slimy mucus, and a morbid action in the primæ viæ, an effect which analogy shows might be obviated by the addition of bitter extractive. For the same reason animals that feed in marshy lands, on food containing but little nourishment, are best defended from the diseases they are liable to contract in such situations by the ingestion of bitter plants.|| Upon these occasions nature is very kind, for the particular situation that engenders endemic diseases is generally congenial to the growth of the plants that operate as antidotes to them.

I have offered these views upon the subject of *Bitter Extractive*, from a conviction that they will essentially contribute to the establishing of

* Thus Sir H. Davy, in comparing the composition of the soluble products afforded by different crops from the same grass, found in every trial, the *largest quantity* of truly nutritive matter in the crop cut when the seed was ripe, and *the least bitter extractive* and saline matter; while in the autumnal crops these relations were found inverted. Elem. of Agricult. Chym.

† Molina, in his history of Chili, speaking of the Potato, says, "It is indeed found in all the fields of this country, but the plants that grow wild, called by the Indians *Maglia*, produce only very small roots of a bitter taste." Dr. Baldwin also found the wild parent of the potato plant at Monte Video, and Mr. Lambert informs us that this statement has been confirmed by Captain Bowles, who has not long since returned from the South American station; he says, "it is a common weed in the gardens, bearing small tubers, but *too bitter* for use" Royal Institution Journal, No XIX.

‡ Discourses on the Elements of Therapeutics and Materia Medica, by N. Chapman, M. D. Philadelphia, 1819.

|| Thus it has been found by experiments, that the Menyanthes Trifoliata, (the Water Trefoil,) which on account of its bitterness has been used as a substitute for Hops, is a cure for the rot in sheep, when given in doses of a drachm of the powdered leaves; and Dr. William Bulleyn, the cotemporary of Turner, the father of English Botany, observes in his work, entitled "THE BULWARK OF DEFENCE," that *Tormentil*, in pastures, prevents the rot in sheep.

just and philosophical notions, respecting the necessity and *modus operandi* of many vegetable tonics.

As the action of tonics is gradual, so their operation is not followed by that exhaustion consequent upon the use of diffusible stimulants.

The substances which compose the class of tonics are derived from the vegetable and mineral kingdoms; those of the former are generally bitter, and produce their effects by a primary action on the stomach, and are not absorbed into the circulation, as experiments upon *Bitter extractive* have most fully demonstrated; those derived from the mineral kingdom, comprehending several of the metals, appear in some instances to pass into the circulation, although several of them, like the vegetable tonics, act primarily on the *primæ viæ;* I apprehend this observation applies to the *nitrate of silver*, which certainly possesses considerable powers as a tonic in certain cases of dyspepsia, for which it may perhaps be indebted to the bitterness which distinguishes it.

AROMATICS:

Substances of a fragrant smell,* which produce upon the organs of taste a peculiar sensation of warmth and pungency, and occasion when swallowed, a corresponding impulse upon the stomach, which is rapidly communicated to the remote parts of the body.

The vegetable bodies which constitute the class of aromatic stimulants are very intimately related with that of tonics; indeed in the most efficient vegetables of the latter kind, the two qualities are generally blended, and the transition from these to the more pure bitters and aromatics is so imperceptible, that it is extremely difficult to arrange them in different classes; Dr. Murray has accordingly in his classification not attempted to separate substances which are so intimately connected. *Aromatic Stimulants*, however, in a practical point of view, must be distinguished from tonics, as the former are valuable for the *rapidity*, the latter, for the *permanency* of their effects. Their characteristic properties appear to depend chiefly, if not entirely, on an essential oil which, when extracted from the vegetable, exhibits all its aromatic power in a very concentrated form.

Medicines of this kind, when administered for the purpose of dispelling wind from the alimentary canal, have been termed *Carminatives*,† They would seem to act by imparting energy to the distended and weakened muscular coat of the stomach, by which the accumulated *gas* is propelled through the upper orifice; for this viscus, like the bladder, when greatly distended, becomes unable to relieve itself, partly in consequence of the exhausted state of the overstretched fibres of its muscular coat, and partly perhaps from a contraction of the *Cardia*, or upper orifice; for it has been already stated that a loss of power, and spasmodic action, are often the simultaneous results of debility.

* αρωμα, which is compounded of αρι, very, and οδμη, or οσμη, smell.

† The origin of this term is derived from the superstitious custom of curing such complaints by incantations in verse (*Carmina*,) or perhaps it may be understood metaphorically as expressive of the instantaneous relief which these medicines are capable of affording; operating as it were, *like a charm*.

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ASTRINGENTS:

Substances which, when applied to the human body, corrugate and condense its fibres, and at the same time, exert a tonic influence through the medium of its living principle.

Astringency in any substance may be at once recognised by the organs of taste; its power in corrugating the papillæ of the tongue, and in imparting a sensation of harshness and roughness to the palate, being too peculiar to be mistaken; this is a fortunate circumstance, for there does not exist any one chymical test by which we can invariably detect the property of astringency, since it is found to reside in many different classes of substances: thus, acids, especially the stronger mineral ones, are powerfully astringent; so are many of the metallic salts, as those of iron, zinc, copper, and lead; and some of the earths, when combined with acids, of which alum is a striking example. The vegetable kingdom, however, furnishes the greater number of astringent remedies; and chymistry has shown that this property uniformly depends upon a peculiar proximate principle, characterized by its power of forming an insoluble compound with animal gelatine; to this principle the name of TANNIN has been given. As tannin generally exists in union with gallic acid, and as the latter body is known by its property of striking an inky blackness with the salts of iron, solutions of this metal were long, but erroneously, regarded as the proper test of vegetable astringency; the fallacy of this is at once shown by the habitudes of Catechu, one of the strongest of our astringents, but which, nevertheless, will not yield the smallest degree of blackness to the solutions of iron, because it contains only tannin, the true principle of astringency, without a trace of its usual associate, the gallic acid. From the power which these substances possess of astringing, and condensing, the animal solids, their medicinal properties are supposed to arise, and we may perhaps, in this instance, admit such a mechanical explanation; but astringents possess also some power over the living principle of the matter which they astringe, for they are capable of acting as permanent stimulants, of curing intermitting fever, and of obviating states of general debility. Astringents would seem to moderate the morbidly increased secretions of distant parts, and to restrain hemorrhage, by their corrugating influence upon the *primæ viæ*,* which is extended by sympathetic action to the vascular fibre; it is not difficult for any person to conceive the possibility of such a sympathy, who has ever experienced the thrilling and singular feeling which is produced over the whole body, by the *acerb* taste of the sloe juice. As however the primary operation of these bodies, by their actual contact with the animal fibre, must be much more powerful than that which can result from the mere sympathy of parts, we find that the efficacy of astringents is principally displayed in the cure of diarrhœa, or serous evacuations from the intestinal canal; their operation, in checking profuse fluor al-

* When tannin is present in grasses, as Sir H. Davy found in that of *after-match crops*, it is voided in the excrement by animals who feed upon it, together with the bitter extractive, saline matter, and woody fibre. (Elem. of Agricult. Chym. Appendix, p. lxi.) We may therefore infer by analogy that it does not enter into the circulation.

bus, gleet, and the inordinate secretions of other distant organs, is much less striking and unequivocal, and it is a question whether in many of such cases the benefit arising from their use may not depend upon their tonic powers. As the morbid excess of different evacuations may arise from various and opposite states of the living system, so may the individuals of the other classes become astringents; and we are bound to admit upon this, as we have on other occasions, the existence of *absolute* and *relative* remedies.

Narcotics at the head of which stands opium, will frequently assume the character of astringents, by diminishing the irritability upon which increased discharges depend. In Diarrhœa, an astringent, properly so called, diminishes the flow of those acrid fluids into the intestines, by which their peristaltic motions are preternaturally increased, and it consequently represses the diarrhœa; a narcotic, under similar circumstances, might not repress the flow of the acrid matter to which I have alluded, but it would render the bowels less susceptible to its stimulus, and would therefore produce the same apparent alleviation, although by a very different mode of operation. There is yet a third species of remedy, which may operate in restraining a diarrhœa of this description; not by stopping the flow of acrid matter, nor by diminishing the irritability of the intestinal organs, as in the instances above recited, but, simply, by *acting chymically* upon the offending matter, so as to disarm it of its acrid qualities; such, for instance, is the nature of *absorbent* and *testaceous* medicines. In the cure of hemorrhage, if it be *active*, that is to say, connected with a state of strong tonic contractility of the blood-vessels, a very different remedy will be required as an astringent, than in cases of *passive* hemorrhage, in which the vascular fibres are in a state of relaxation or collapse. Sir Gilbert Blane has offered some valuable remarks upon this subject, with a view to settle the difference of opinion which has arisen respecting the treatment of flooding after child-birth. (*Medical Logic, Edit.* 2d. p. 100.)

Astringents are capable of being exclusively used as local applications, and when they are so employed for the purpose of stopping hemorrhage, they are termed Styptics.* With respect to these latter agents it must be confessed, that great popular error still exists, much of which has evidently arisen from deductions drawn from the effects of such remedies upon inferior animals; thus have several substances gained the reputation of *Styptics*, from the result which may have followed their application to the wounded and bleeding vessels in the extremities of the horse and ass; whereas the fact is, that the blood-vessels of these animals possess an inherent power of contraction which does not exist in those of man, and to which alone the cessation of the hemorrhage, fallaciously at-

* Various combinations, into which different metallic salts have generally entered as ingredients, have at different periods been extolled for their efficacy as *Styptics*: Helvetius published an account of a preparation composed of the filings of iron and tartar, mixed to a proper consistence with French brandy, and it was long used in France, Germany, and Holland, under the name of Helvetius's Styptic.

Eaton's Styptic. After the styptic of Helvetius had been discarded from the Continent, it was brought into this country, and for a long time continued to be employed with confidence, under the new title of Eaton's Styptic. It is now made in several different modes, and consists chiefly of an alcoholic solution of *sulphate of iron* with some unimportant additions.

tributed to the *Styptic*, is to be wholly attributed. In many cases an application may owe its styptic qualities to its power of coagulating the blood around the orifice of the wound; in this way the contact of heated metal will sometimes arrest the flow of blood from a cut surface.

LOCAL STIMULANTS.

This second division comprehends those medicinal substances, which have been generally classed under the head of EVACUANTS; for, as they stimulate particular organs, so do they occasion by their local operation, an increased secretion, or evacuation from them.

EMETICS:

Substances which excite vomiting, independent of any effect arising from the stimulus of quantity, or of that occasioned by any nauseous taste or flavour.

Before we can determine the *modus operandi* of emetics, it will be necessary to take an accurate view of the phenomena and pathology of vomiting. It is an important fact that any extraordinary stimulus applied to the stomach, instead of increasing its motions, as it would in other instances, actually inverts them: the wisdom of such a peculiar provision is manifest; it is intended to prevent the protrusion of the food into the duodenum before it has undergone those necessary changes in the stomach, by which it is prepared for the more elaborate process of chylification. The act of vomiting, however, is not effected, as Dr. Haygarth formerly supposed, by the sole influence of the stomach; the brain is an important accessary. Dr. Majendie goes so far as to attribute the operation of vomiting, exclusively, to the agency of this latter organ upon the abdominal muscles, and regards the stomach as a mere passive instrument in the act;* this doctrine was supported in an elaborate experimental memoir, presented by this indefatigable physiologist to the Royal Institute of France in the year 1812.

Although we shall not be disposed to receive this theory in its full extent, yet we cannot hesitate to admit that the influence of the nervous system is indispensably necessary for producing vomiting; and we accordingly find that this act will not take place, however forcibly the stomach may be goaded by emetics, where the energy of the nervous system is suspended, as in cases of profound intoxication, or in violent wounds and contusions of the head; while if the brain be only partially influenced, as by incipient intoxication, or by a less violent blow upon the head, its irritability is increased instead of being paralysed, and vomiting under such circumstances is excited by the slightest causes: the fact of such

* This theory, however, did not originate with Dr. Majendie, for Chiarac, a French physician of the 17th century, drew the same conclusion from an experimental inquiry (Histoire de l'Academie Royale des Sciences, p. 12. An. 1700.)

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opposite results being produced by the same impulse in different degrees of intensity, is no less curious than instructive. Dr. Richard Harrison, in his Gulstonian Lecture before the College of Physicians, treated the subject of vomiting with much ingenuity, and I am disposed to adopt the views which he offered. He observed, that although the experiments of Majendie sufficiently testify the importance of the pressure of the abdominal muscles upon the stomach in the act of vomiting, and which can only be explained by the influence of the brain and nervous system, yet that he has attributed too much to their agency: "it appears to me," continued he, "that vomiting may be explained in the following manner:—*the irritation of the stomach makes a call upon the brain for the aid of the diaphragm and the abdominal muscles, in order to expel its contents; the diaphragm then becomes contracted and fixed, the ribs drawn down, and the abdominal muscles drawn inwards, so that the stomach is pressed on all sides by voluntary muscles, which, together* WITH ITS OWN CONTRACTION, *expel the contents.*" Now it must be obvious that where the brain, from oppression or injury, is unable to transmit its influence to these muscles,* and disregards the call of the stomach, vomiting can only be excited with difficulty, or it will be prevented altogether.

Under such circumstances venesection may in some cases prove a powerful adjuvant, by unloading the vessels of the brain, and thus restoring to the nervous system its necessary excitability; where its powers have been paralyzed by the operation of a narcotic, a copious draught of some vegetable acid, or the affusion of cold water upon the surface of the body may impart efficiency to an emetic; the operation of *Nightshade* and some other narcotic poisons may be adduced in farther illustration of this subject;—an excessive dose of the *Atropa Belladonna* produces symptoms of alarming stupor, and so difficult is it to evacuate the stomach under such circumstances, that as much as fourteen grains of *Tartarized Antimony* have been administered without effect: now if in such a case a copious draught of some vegetable acid be given, the emetic will be more likely to succeed: here then we perceive, that the brain, being paralyzed by a narcotic poison, is unable to lend its aid to the muscles requisite for the operation of vomiting, until its energies are restored by the antinarcotic powers of a vegetable acid. The practical precaution which this view of the subject affords, is extremely important,—*not to allow the apparently inactive state of the stomach to induce us, inconsiderately, to augment the dose of an emetic:* for although the stomach, for the reasons just stated, may be unable to void its contents by vomiting, it may nevertheless retain its sensibility, and be therefore liable to inflammation: Dr. Harrison has reported a case of this kind, where the practitioner, in attempting to excite emesis in an epileptic patient, by a very large dose of *sulphate of zinc*, produced an inflammation in the viscus that terminated fatally.

Vomiting may also be produced by the *primary* operation of certain

* Upon the very same principle, a person may die from suffocation, in consequence of an injury in the brain; the respiratory muscles being unable to sustain the function of breathing, for want of a due supply of nervous influence. This happens in cases of Apoplexy, and in poisoning by Narcotics.

Those who wish for farther information upon this subject may consult the chapter on "THE PHYSIOLOGICAL CAUSES AND PHŒNOMENA OF SUDDEN DEATH," in my work on "MEDICAL JURISPRUDENCE," Vol. 2. p. 16.

agents upon the brain, by which its energy is disturbed, as by narcotics, or by the motions of swinging, whirling, and sailing: in such cases, the series of actions necessary for the establishing of vomiting, commence in the brain, and is propagated by nervous sympathy to the stomach.

When an emetic is taken into the stomach, an interval of twenty minutes, or longer, usually passes without any apparent effect; an uneasy sensation, which we term nausea, is then felt, and this continues to increase until vomiting begins; here then we perceive are two distinct stages, each of which is marked by its own proper symptoms; the relative intensity and duration of which will be found to vary according to the nature of the exciting causes; thus some Emetics, as *Sulphate of Zinc*, act without occasioning much nausea, while others, as *Tobacco*, excite it to a degree which is far greater than is proportioned to their emetic power: this is a fact of great importance in directing us in the selection of an emetic, for we shall find that in some diseases it is a great object to avoid that state of system which invariably accompanies nausea, while in others it affords the best mode of answering an important indication of cure.

Nausea would seem to depend upon the exertions of the stomach and muscles, not being proportioned to the effects of the brain, in order to produce vomiting. Where this balance however is maintained, as during the operation of an ordinary emetic, the following are the symptoms which characterize the two stages;—while the nausea only is present, the countenance is pale and shrunken, the pulse feeble, quick and irregular, and there is a feeling of cold; but as soon as vomiting commences, the face becomes flushed, the pulse quicker and stronger, although it seldom returns to its natural standard, until some time after the vomiting has ceased. A degree of languor, a disposition to sleep, and a general moisture upon the skin, are the circumstances which occur after the total cessation of the paroxysm.

The feeble state of the circulation, as indicated by the pulse, and the general coldness and languor experienced during a paroxysm of nausea, are to be ascribed to those sympathetic relations by which the brain, stomach, and heart, are reciprocally influenced

The advantages to be obtained from the administration of an emetic in the cure of disease, may either depend upon its *primary* or *secondary* operations, that is to say, upon the mere evacuation of the stomach, or upon those changes which occur in distant parts from sympathy; and the judicious practitioner, in the selection of an emetic, will always be guided by the nature of the indication which he intends to fulfil; if his object be to evacuate the stomach quickly and completely, he will avoid those emetics that are distinguished by their nauseating tendency, as in cases of disease which depend on a disordered state of stomach, connected with undue distention, and the presence of acrid and indigestible matter; if, on the other hand, his intention be to influence some remote organ through the sympathetic powers of the stomach, an emetic of an opposite tendency may be better calculated to answer such indications: in some cases, he is to seek a beneficial result from the mechanical action of the diaphragm and abdominal muscles, by whose pressure the gall-bladder and hepatic ducts are emptied of their contents, and hence jaundice, arising from the obstruction of biliary calculi, has been suddenly removed by the *concussion* of an emetic: a similar pressure upon the thoracic viscera

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may occasion expectoration, and relieve the bronchial vessels in cases of asthma, catarrh, and croup.

Vomiting, when produced by the operation of a mild emetic, does not appear to exhaust the excitability of the stomach, but on the contrary to increase its tone; for we generally find the process of digestion is carried on more vigorously afterwards; although it is probable that, by frequent repetition, a different result would be obtained, and we should find that its motion would become liable to inversion by slight stimuli; we may therefore question the propriety of that practice which is so strenuously recommended by Hippocrates,* and other ancient physicians, to administer emetics frequently to those in health, in order to prevent the incursions of disease.

The benefits arising from the secondary effects of an emetic are numerous and extensive. It has been observed that during nausea the force of the circulation is considerably abated, hence the use of these remedies in hemorrhage; and, as the energy of absorption is generally in an inverse ratio to that of the circulation,† we frequently obtain from

* Hippocrat. de Diæta. lib. iii. et alibi passim.

This predilection of the ancients for Emetics is the more extraordinary, as they were acquainted with those only which were of the most violent and unmanageable description; the Veratrum or White Hellebore, was sometimes fatal.

† Few discoveries in physiology have thrown greater light upon this important subject than that of M. Majendie, published in his JOURNAL DE PHYSIOLOGIE EXPERIMENTALE, (1er numero—Janvier, 1821) in a paper entitled, "Memoir sur le Méchanisme de L'Absorption." The results contained in this essay are the more interesting to me, as they were read at the Academy of Sciences, at Paris, some time after the publication of the third edition of my PHARMACOLOGIA, and it will be observed, in what a satisfactory manner they confirm the views which I offered at that time, respecting the influence of venesection in accelerating the absorption of Mercury. In the fourth edition (published in October, 1820, p 115,) these views were farther extended, and as I could not have been influenced by the experiments of M. Majendie, which were not published until sometime afterwards, it is very fair to conclude, that when two persons arrive at the same result by different trains of investigation, such a result must be correct. The conclusions established by the experimental inquiries of M. Majendie, with regard to absorption, appear to me to be so important, in reference to the object of the present work, that I shall pause, in this place, for the purpose of furnishing the reader with a short account of them. M. Majendie states, that while performing the experiment of injecting warm water into the veins of a living animal, he first conceived the idea of observing what effects would be produced upon the function of absorption by the artificial plethora, thus occasioned; having accordingly injected a quantity of water into the venous system of a middle-sized dog, he introduced a small portion of an active substance, whose effects were well known, into his side, when he was surprised to find that its usual operation was not manifested until after an interval much longer than usual; the same experiment was afterwards repeated upon another animal, and with similar results. In a third experiment, as much water (about two pounds) was injected, as the animal could sustain without destruction, in which case the poisonous substance produced no effect whatever, the powers of absorption appearing to be entirely suspended; and having waited during half an hour for the occurrence of those symptoms which, under ordinary circumstances, would have manifested themselves in two minutes, M. Majendie concluded that if vascular congestion be the cause of the suspension of absorption, the function ought to be restored by the removal of this artificial condition, an opinion which he proceeded to verify by experiment; the jugular vein of the animal, under trial, was accordingly opened, and the ingenious operator had the satisfaction to observe the effects of the poison gradually developing themselves in proportion as the blood flowed. M. Majendie next proceeded to confirm the truth of his position, by an experiment, the converse of those above related; an animal was bled, to the amount of about half a pound, and the poisonous substance applied to the pleura of the animal, as in the foregoing experiments, when it appeared that those effects which, under ordinary circumstances, were not evident

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a nauseating dose of an emetic, considerable assistance in the treatment of anasarca, and other dropsical swellings. Those medicines that are liable to produce at once, full vomiting, without any previous stage of nausea, are of course less calculated to fulfil such indications. In the same manner we should select a *nauseating* emetic, when our object is to promote the passage of a gall stone through the *ductus communis*, for the nausea so excited will relax the duct, while the mechanical concussion tends to push the obstructing matter forward. On the other hand, whenever our object is to evacuate the stomach, and to prevent absorption, we must take care to cut short the nauseating stage; a precaution which is highly important in the treatment of a case of poisoning. The state of the stomach produced by vomiting is very frequently extended, by sympathy, to the vessels of the skin; in consequence of which, a diaphoresis not unusually follows the operation. In the different varieties of febrile disease, this circumstance stamps additional value upon the class of emetics; while, at the same time, that they eject any offensive matter which may be present in the stomach, they thus control the accelerated circulation.

From the violent muscular exertions which take place in the act of vomiting, the administration of an emetic may be very injurious in certain states of the body. In consequence of the pressure applied to the descending aorta, and the interrupted circulation through the lungs, from impeded respiration, the blood returns with difficulty from the head during a paroxysm of vomiting, and in plethoric states of the body, or in cases of determination of blood to the cerebral or pulmonary organs, the act of vomiting cannot be considered as free from danger. The concussion of an emetic may also produce mischief in the advanced stage of pregnancy, and in *hernia* and *prolapsus uteri;* while in extreme debility, there is the danger of a syncope being produced, from which the patient may never recover, as I once witnessed in the last stage of Phthisis, where an emetic was imprudently given, with the intention of dislodging the pus with which the lungs were embarrassed.

By violent and protracted retching, a person will sometimes become jaundiced; the stomach, diaphragm, and abdominal muscles, are, under such repeated efforts, apt to be rendered, to an eminent degree, irritable; so that at each effort of the former to discharge its contents, the latter will frequently be thrown into strong spasmodic contractions, and the liver together with the gall bladder will be suddenly caught, and, as it were, squeezed in a powerful press; in consequence of which the bile will regurgitate, and be carried into the *Venæ cavæ;* for Haller has shown with what facility a subtle injection, when thrown into the hepatic duct, will escape by the hepatic veins; and upon which Dr. Saunders observes, "I know this to be a fact, for I have ascertained by experiment, that water injected in the same direction, will return by the veins in a full

until after a period of twelve minutes, manifested themselves after on interval of only thirty seconds. In order to show that these results actually arose from vascular distention, and not from the artificial state of dilution in which the blood was placed, M. Majendie instituted the followng experiment: a considerable quantity of blood was drawn from the vein of a dog, and replaced by a similar quantity of warm water, after which a measured quantity of Nux Vomica in solution was introduced into the side, when the poisonous effects were found to take place with the same rapidity, as if the blood had not been mixed with water.

stream, though very little force be used." When a jaundice is thus produced it will gradually disappear without the aid of any medicine; the kidneys are the principal means by which all unnecessary bodies are extracted from the circulating mass, a portion of bile will therefore under such circumstances be eliminated in every discharge of urine.

The different emetics employed in practice are derived from the vegetable and mineral kingdoms, some of which appear to produce their effects by an immediate impression upon the nerves of the stomach, while others require to be absorbed into the circulation before they display their energies. *Ipecacuanha* would seem to act primarily on the stomach, but *Tartarized Antimony* has been found, by experiment, to occasion vomiting, when injected into the veins of an animal; while the other mineral emetics, *viz.* the preparations of *Copper* and *Zinc*, undoubtedly operate on the stomach, and without inducing much nausea.

CATHARTICS:

Medicines which quicken or increase the evacuation from the intestines, or which, when given in a certain dose, occasion purging.

These remedies, from a general difference in their modes of operation, have been classed under two divisions—Laxatives and Purgatives. The former operate so mildly that they merely evacuate the contents of the intestines, without occasioning any general excitement in the body, or even stimulating the exhalent vessels of the canal; the latter produce a considerable influx of fluids from these vessels, and extend their stimulant effect to the system in general; and where these effects are very violent, the purgative is further distinguished by the epithet Drastic. Laxatives then may be said to empty the bowels simply, and to carry off extraneous matter, which is out of the course of the circulation; but purgatives, as they occasion a constitutional effect, may be made subservient to very important purposes. The effects of a purgative may depend upon three different modes of operation; viz.

1. *By stimulating the muscular fibres of the Intestines, whence their peristaltic motion is augmented, and the contents of the bowels more quickly and completely discharged.*

2. *By stimulating the exhalent vessels, terminating in the inner coat of the intestines, and the mouths of the excretory ducts of the mucous glands; by which an increased flow of serous fluids takes place from the former, and a more copious discharge of mucus from the latter; the effect of which is to render the fœcal matter thinner and more abundant.*

3. *By stimulating the neighbouring viscera, as the Liver and Pancreas, so as to produce a more copious flow of their secretions into the intestines.*

It appears that different purgatives have very different powers in relation to the several modes of operation above specified: some medicines,

for example, urge the bowels to evacuate their contents by an imperceptible action upon the muscular fibres, and little or no increase of serous discharge attends the evacuation, such are *Manna*, *Sulphur*, and *Magnesia;* there would seem, moreover, to be certain bodies that have the property of increasing the peristaltic motions by operating as mechanical stimulants upon the fibre; it would not be difficult to derive many illustrations of this fact, from the history of herbivorous quadrupeds, and I have been disposed to consider the harsh and coarse texture which certain grasses assume in moist situations, as a wise provision in Nature to furnish an increased stimulus to the intestines of the animals who feed upon them, at a time when their diminished nutritive qualities must render such a result desirable; but the operation of a mechanical laxative may be demonstrated by a more familiar example; the addition of bran to our bread, constituting what is known by the name of *Brown bread*, induces laxative effects, merely from the mechanical friction of the rough particles, or scales of the bran, upon the inner coats of the intestines, for the wheat without the bran in bread is not particularly laxative.* Other cathartics stimulate the fibres to a much greater degree, and the effects are either confined to a part of the canal, or communicated to the whole range of the intestines, from the duodenum to the extremity of the rectum; *Aloes* will furnish a good example of the former, and *Colocynth* may be adduced as an instance of the latter mode of operation. Other cathartics, again, direct all their stimulus to the exhalent vessels, and are accordingly distinguished by the force with which they produce serous evacuations; and for which they were formerly denominated *Hydragogues;* such are *Saline Purgatives*, and certain vegetable bodies to be hereafter described. Dr. Cullen has even supposed that some of these medicines may act solely in this way, and without increasing directly the peristaltic motion; there is however, as Dr. Murray very justly remarks, no proof of such an hypothesis, and it seems scarcely probable that any substance should act as a stimulant on these vessels, without at the same time stimulating the mobile fibres of the intestines. *Mercurial Purgatives* appear to possess, in an eminent degree, the power of exciting the functions of the liver, and of thereby occasioning an influx of bile into the intestines. From the indications which cathartics are capable of fulfilling, their utility in many diseases must be apparent; the extent of their importance and value were, however, never justly appreciated until the valuable publication of Dr. Hamilton on this subject, in which the author has pointed out with more precision than any preceding writers had done, the therapeutic principles which should regulate their administration. His practice has clearly proved that a state of bowels may exist in many diseases, giving rise to a retention of feculent matter, which will not be obviated by the occasional administration of a purgative, but which requires a continuation of the alvine stimulant, until the healthy action of the bowels is re-established. Since this view of the subject has been adopted, numerous diseases have received alleviation from the use of purgatives that were formerly treated with a different class of remedies, and which were not supposed to have any connexion

* The practical application of this fact may be useful, and digestion, in certain cases, may be thus promoted by the simple expedient of changing the quality of our bread.

with the state of the alvine evacuations; thus in fever, the peristaltic motion of the intestines is diminished, and their feculent contents are unduly retained, and perhaps, in part, absorbed, becoming of course a source of morbid irritation; this fact has been long understood, and the practice of administering cathartic medicines under such circumstances has been very generally adopted; but until the publication of Dr. Hamilton, physicians were not aware of the necessity of carrying the plan to an extent beyond that of merely emptying the *primæ viæ*, and they did not continue the free use of these remedies through the whole progress of the disease.

Cathartics are essentially serviceable also in several diseases of the class NEUROSES, which are generally intimately connected with a morbid condition of the alimentary passages; *Chorea* and *Hysteria*, have been very successfully treated in this manner. The diseases incident to puberty in both sexes are also best relieved by a course of purgative medicines, and their effects in *Chlorosis* have conferred upon many of them the specific title of EMMENAGOGUES.

But the therapeutical utility of Cathartics extends beyond the mere feculent evacuations which they may occasion. In consequence of the stimulating action which some of them exert upon the exhalent vessels, they abstract a considerable portion of fluid from the general current of the circulation, and are, on that account, beneficial as *Anti-phlogistics*. For the same reason they may act as powerful promoters of absorption, for there exists an established relation between the powers of exhalation and absorption, so that when the action of one is increased, that of the other is augmented.

Certain Purgatives, as I have just stated, exert their influence upon the neighbouring organs, and are calculated not only to remove alvine *sordes*, but to detach and eliminate foul congestions from the biliary ducts and pores.

With such facts before us, it is impossible to concede to the opinion of Dr. Hamilton,* that the different species of purgative medicines *do not possess distinct powers over the different species of matter to be evacuated*; on the contrary, there is reason for reviving the ancient theory, too inconsiderately abandoned, and which acknowledged these different distinctions in the operations of cathartic medicines, under the appropriate names of *Hydrargogues*, *Cholagogues*, *&c.*

The importance of cathartic medicines having been shown, and the distinctions in their modes of operation established, it only remains to say a few words upon the subject of their abuse. All the remedies of this class, but more especially those of considerable power, require caution in their administration, even in those diseases where they are indicated by peculiar symptoms, especially if there be any tendency to inflammation, or to extreme debility, although this latter symptom is often rather apparent than real, and is at once removed by the brisk operation upon the bowels; during pregnancy and immediately after delivery, and during the flow of the menses, the prudent practitioner will use a discretionary caution in their exhibition. The too frequent use of these

* Since the publication of this opinion, in the 5th edition of the Pharmacologia, Dr. Hamilton has honoured me by a letter on the subject, but I am still bound to confess that my sentiments remain unaltered.

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medicines will induce marasmus, and render the bowels so morbidly irritable, that purging is easily excited by the ordinary stimulus of our aliments; while in some habits the contrary obtains, and the resource to which the valetudinarian flies for relief only increases the torpor of the intestines, and confirms his costiveness.

The mode of adapting, combining, and administering Cathartics, will present subjects for our future consideration.

EMMENAGOGUES:

Medicines which are capable of producing the Menstrual discharge.

As Amenorrhœa, or retention of the menses, is generally the effect of a mobid state of the body, it follows that remedies capable of acting as Emmenagogues can only be *relative* agents, unless indeed we are disposed to accede to the opinion so generally maintained in the writings of the older physicians, but now generally discarded, *that certain substances exert a specific* action upon the uterus.* It may certainly be asserted without fear of contradiction, that there are many substances which, when received into the stomach, have their stimulant operation more particularly determined to one part than to another; alkalies, for example, to the kidneys; cantharides to the bladder; mercury to the salivary glands, &c. Reasoning therefore by analogy, it was not unphilosophical to conclude, that similar medicines might exist with respect to the uterus; but experience has negatived the supposition, there being no proof of any of the substances styled *Emmenagogues* producing their effects by any *specific* influence upon the uterine system. If the term *Emmenagogue* be assumed conventionally, according to this view of the subject, it may be retained without any fear of error, otherwise it would be wiser to remove the name from our classification.

The suppression of the catamenia usually depends upon a debilitated state of the body, although it is sometimes the consequence of a plethoric diathesis; in the former cases tonics, in the latter, venesection, may display the powers of an emmenagogue; upon which occasion, I have frequently derived the greatest benefit by cupping the patient upon the loins. Where the disease occurs in young women, about the age of puberty, it is very generally connected with extreme debility of the system; the preparations of iron, bark, and other invigorating medicines, are accordingly the most likely to succeed in its cure. Whereas in full florid habits, when the catamenia are suddenly suppressed, *Laxatives*, *Diaphoretics*, or *blood-letting*, afford the surest means of relief.

There are two other classes of medicines which may occasionally prove emmenagogue—Acrid Purgatives which act upon the rectum,

* The Melampodium, or Black Hellebore, was recommended as an agent of this description in the strongest terms, by Mead: Savin (Juniperus Sabina) is another vegetable which has been generally considered as a specific Emmenagogue; with some authors, the Rubia Tinctorum, Madder; with others, the Sinapis alba, have been regarded as remedies of this nature; and lately Polygala Senega has been extolled by the American practitioners; in modern times, however, few substances have been more confidently recommended as uterine stimulants than the Secale Cornutum, or Ergot, but of which I have no practical knowledge.

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and hence by *contiguous sympathy* upon the uterus, as *Aloes*, &c., and STIMULATING DIURETICS, as *Cantharides*, the *Turpentines*, &c., which are supposed to excite the womb, sympathetically, by their stimulus upon the bladder. Nor is the advantageous influence of mercury to be overlooked, which, in cases of morbid action in the secreting functions, proves a Herulean remedy.

DIURETICS:

Medicines which increase the urinary discharge.

This effect is produced by very different modes of operation; and as some of them are mutually incompatible with each other, it is essential that we should understand the *modus operandi* of each individual of which the class consists, in order that we may direct its application with precision.

There is undoubtedly no tribe of medicinal agents more precarious in their nature and effects than that of Diuretics; this fact in a great measure depends upon the uncontrollable character of the organs upon which they act, but it must at the same time be admitted, that their failure frequently depends upon their modes of operation being directly incompatible with the state of the system at the time of their administration.

The following classification may perhaps serve to bring together the principal facts which are known upon the subject, and at the same time to display them in an order which is calculated to demonstrate their practical bearings and relations.

DIURETICS,

ARRANGED ACCORDING TO THEIR SUPPOSED MODES OF OPERATION.

CL: I.—MEDICINES WHICH ACT *PRIMARILY* ON THE URINARY ORGANS.

1. *By stimulating the secreting vessels of the kidneys*, BY CONTACT.

a The medicines not undergoing any decomposition *in transitu.*

1. *Potassa.*
2. *Potassæ Nitras.*
3. *Oleum Terebinthinæ.*
4. *Juniperus Communis.*
5. *Cantharides.*

b The Medicines undergoing decomposition *in transitu.*

1. *Potassæ Acetas.*
2. *Potassæ Super-tartras.*
3. *Scilla Maritima.*
4. *Colchicum Autumnale.*
5. *Copaifera Officinalis.*
6. *Spartii Cacumina.*

CL: II.—MEDICINES WHICH ACT *PRIMARILY* ON THE ABSORBENTS, AND *SECONDARILY* ON THE KIDNEYS.

Mercury.

CL: III.—MEDICINES WHICH ACT *PRIMARILY* ON THE STOMACH AND PRIMÆ VIÆ, AND *SECONDARILY* ON THE ABSORBENTS.

1. *By diminishing arterial action, and increasing that of Absorption.*

   1. *Digitalis.* 2. *Nicotiana.*

2. *By increasing the tone of the body in general, and that of the absorbent system in particular.*

   Bitter Tonics, &c., &c.

3. *By producing Catharsis, and thereby increasing the action of the Exhalents* directly, *and that of the Absorbents* indirectly.

   1. *Elaterium.* 2. *Jalap, &c., &c.*

I. Of Medicines which act Primarily on the Urinary Organs.

1. *By stimulating the secreting vessels of the kidneys, by actual contact.*

   a The substance not undergoing any decomposition *in transitu.*

It is easy to imagine that any substance which is capable of entering the current of the circulation, and of stimulating the kidneys by a direct application to their secerning vessels, may occasion a more copious urinary discharge; in this manner the different saline* preparations,

* Saline bodies would appear to be the peculiar stimuli of these organs, the principal use of which is to separate such saline matter from the blood, as would otherwise accumulate in the system. That these saline diuretics actually pass off by the kidneys, may be satisfactorily shown by an examination of the urine, in which the bodies in question may be chymically detected. Let any person swallow several doses of Nitre, taking care that the bowels are not disturbed by the medicine, and he will find by dipping some paper into his urine, and afterwards drying it, that it will deflagrate, and indicate the presence of nitre.

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Potass, *Soda*, *Nitrate of Potass*, *&c.*, are brought to the kidneys in the course of the circulation, and exciting the vessels to an increased action, promote the secretion of a larger proportion of watery fluid from the blood, in consequence of which, the absorbents are indirectly stimulated in order to supply the deficiency, and in this manner dropsical swellings are reduced.

Water, as a simple diluent, will promote the action of the kidneys, and it is very judiciously remarked by Dr. Cullen, that by withholding the use of fluids in dropsy, you will diminish the quantity of fluids secreted, and allow the secretories of the kidneys to fall into a state of inactivity and collapse. This is a sufficient answer to those who defend the practice of enjoining an abstinence of all drinks in dropsy.

b. *The diuretic remedy undergoing decomposition* IN TRANSITU.

The digestive organs appear to possess the power of readily decomposing all saline compounds into which *vegetable* acids enter as ingredients, and of eliminating their alkaline base, which, being in the course of the circulation, carried to the kidneys, excites them into action, and promotes the excretion of urine; and it is probably in this way that the *Acetate*, *Citrate*, *Supertartrate*, and other analogous combinations of *Potass* and *Soda* prove diuretic: on the other hand, it is equally evident that salts containing the *mineral* acids are not under the control of the decomposing powers of the *chylo-poietic* organs, and consequently do not undergo any changes *in transitu*, although some of these salts, as I have just stated, especially the more soluble ones, are absorbed entire, and prove diuretic. *Sulphate of Potass*, from its insolubility, is not readily absorbed, and its composition will not allow the developement of its base; we perceive therefore that it has not any tendency to produce an influence upon the urinary secretion.

Certain vegetable bodies likewise appear to occasion diuresis by a similar mode of operation, and it is worthy of notice that these medicines generally contain a bitter principle, which is probably separated by the analyzing powers of the stomach; as exemplified in *Scilla maritima*; *Colchicum autumnale*; *Lactuca Virosa*; *Gratiola officinalis*; *Spartium Scoparium* (Summitates;) *Juniperus communis*; *Copaifera Officinalis* (Balsamum,) &c. The stimulant powers of a bitter vegetable principle upon the *primæ viæ*, have already been fully noticed under the consideration of TONICS, (*page* 80,) and it is reasonable to suppose, that an analogous principle, if introduced into the circulation, may exert a corresponding impulse upon the organs with which it comes into contact.

It particularly merits attention, that the diuretic operation of any body that acts by being absorbed, is at once suspended if catharsis follows its administration, whether in consequence of the largeness of its dose, its increased solubility, or from the effect of its combination with some purgative; for it is a law, *that the processes of assimilation, and absorption from the duodenum, are arrested, or very imperfectly performed during any alvine excitement;* the different effects of the saline compounds of the alkalies with tartaric acid, elucidate the truth of this law in a very striking manner—thus, *Super-tartrate of Potass*, or Cream of Tartar, in well regulated doses, acts, as we all know, upon the

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kidneys; the tartaric acid being, as I suppose in this case, abstracted and assimilated by the digestive process, and at the same time the alkaline base (Potass) eliminated, and subsequently carried into the circulation; but if we increase the solubility of the compound, by reducing it to the state of a neutral tartrate (*soluble tartar*) or by combining it with *Boracic acid*, or some body that has a similar effect; or what is equivalent to it, if we so increase the dose* of the *cream of tartar*, that full catharsis follows its administration, then diuresis will not ensue, since no decomposition can take place under such circumstances, nor can it be carried by absorption into the circulation. *Nitre* and those salts which are carried to the kidneys without previous decomposition *in transitu*, are subject to the same law; for, if we combine them with purgatives, their presence can no longer be recognised in the urine, as I have ascertained by experiment. *Oil of Turpentine*, in doses of two fluid-drachms, may so excite the urinary organs as to produce even bloody urine; whereas a fluid-ounce will scarcely occasion any apparent influence upon those functions, because the increased dose acts upon the bowels, and consequently prevents its passage into the circulation.

Sulphate of Magnesia does not readily produce any diuresis, because it operates upon the bowels, but the experiments of Vitet and Bracy Clarke have shown, that if this saline compound be administered to the horse, whose bowels are not easily affected by purgatives, it acts powerfully upon the kidneys;† and I will take occasion in this place to observe that, on account of the inirritability of the bowels of the horse, diuretic medicines are more certain in their operation, than in the human subject; a fact which, in itself, shows the importance of attending to the state of the bowels, during a course of those diuretics which require to be absorbed before they can produce their specific effects.

Equally necessary is it to attend to the state of the vessels of the skin, for if during the administration of a Diuretic, these vessels be excited by external warmth, its action may be diverted from the urinary organs to the exhalents on the surface, and occasion diaphoresis; but if the surface of the body be kept cool, this diversion will not occur: so greatly indeed does cooling the surface determine to the kidneys, that the usual diaphoretic medicines may, by an attention to this circumstance, be converted into powerful diuretics.

C. II. Medicines which act *Primarily* on the Absorbents, and *Secondarily* on the Kidneys.

It has been shown, in the former division, that by increasing the action of the kidneys, we diminish the quantity of water in the blood, and consequently occasion an extraordinary action of the absorbents to supply the deficiency, whence dropsical accumulations disappear; it remains to be stated that an operation, which may be considered the converse of

* The *Secondary* Diuresis which sometimes takes place under such circumstances, and succeeds Catharsis, may offer an apparent exception to this law; but this must not be confounded with that which is the result of a *primary* action upon the urinary organs by the absorption, and consequent contact, of a specific stimulant.

† Certain mineral waters, containing cathartic salts in a state of extreme dilution, if insufficient to excite the bowels, sometimes pass off by the kidneys; an effect which can always be prevented by accompanying their exhibition with some laxative.

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the one just described, is not unfrequently established; the absorbent vessels, in this case, are first roused to extraordinary action, and the blood therefore becomes surcharged with serous matter, in consequence of which the kidneys are stimulated, and it is eliminated through the urinary passages: so that in the former case the absorbent may be said to be called into action by the kidneys, while in the latter, the kidneys are, obviously, subservient to the increased energy of the absorbent system. The preparations of Mercury are perhaps the only medicinal bodies which we can strictly consider as specific stimulants to the absorbent system; and of their power in directly acting upon these organs there are such ample proofs, that it is unnecessary to adduce any additional evidence upon the subject. In instances of increased absorption from the agency of other medicines, the effect must be considered as rather arising from their *secondary* than primary operations; the most important of which will constitute objects of inquiry in the succeeding divisions of the subject.

C. III. Medicines which act *Primarily* on the Stomach or System, and *Secondarily* on the Urinary Organs.

A Diuretic effect is very frequently occasioned by substances which act on the stomach and *primæ viæ*, producing a peculiar state of these organs, which *sympathetically* affects the whole body, and more particularly the absorbent system, and the vessels concerned in the secretion of urine from the blood. As this primary influence upon the stomach, and the effects to which it gives rise in remote parts, are very different in their character, according to the nature of the remedy employed, and the state of the system at the time of its administration; the present attempt to investigate and generalize these relations, and to adopt them as the basis of a classification, may ultimately lead the practitioner to some distinctions of practical utility.

1. *By diminishing Arterial Action and increasing that of Absorption.*

It would appear that the action of the vessels employed in the circulation of the blood, and the energy of the absorbents are, to a certain extent, antagonist powers; the experiments of Majendie demonstrate that the absorption of a poisonous substance is retarded by a plethoric, and accelerated by a depleted state of the sanguineous system; the fact is practically established by numerous phenomena in pathology. Dr. Blackall has very satisfactorily shown the existence which subsists between increased arterial action and diminished absorption. Hence it follows that remedies capable of controlling the circulation may affect the activity of absorption, increase diuresis, and cure dropsy; in this manner the *Digitalis Purpurea* acts as a sorbefacient, and it may be remarked that it seldom or never produces its diuretic effects, without a concomitant reduction of the frequency of the pulse; its power too appears only when it is administered in dropsy; in a state of health it will reduce the pulse, but not increase the discharge of urine. Tobacco has also somewhat analogous powers in promoting absorption, and its operation is accompanied with a corresponding depression of vascular action.

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Venesection, upon the same principle, may occasion, in certain cases of dropsy, a discharge of the accumulated fluid.

2. *By increasing the tone of the body in general, and that of the Absorbent System in particular.*

That diminished absorption, and the consequent accumulation of serous fluids in the cellular texture, and different cavities, frequently depends upon general debility is very obvious, whence fevers, whether of the intermittent or continued kind, which have been long protracted, are followed by *œdematous* swellings. In states of extreme debility the exhalent vessels would seem, from their laxity, to permit the thinner parts of the blood to pass too readily through them; this is proved by the circumstance that palsied limbs, in which such a laxity may be presumed to exist, are frequently affected with *œdema*, and the truth of this explanation is still farther corroborated by the advantages which accrue on these occasions from the mechanical support of pressure from bandages. In such cases, those remedies which are capable of renovating the vigour of the body can alone prove of any signal service. Dr. Blackall presents us with an illustrative case of this nature, on the authority of Mr. Johnson of Exeter, in which the tonic powers of well fermented bread occasioned in the space of a few hours an effect so powerfully diuretic, as to have cured the sailors on board the Asia East Indiaman, who had been attacked with the Dropsy, in consequence of the use of damaged Rice.

Thus then do Diuretics, in some cases, CURE BY EVACUATING, while in others, as in the instance above cited, they EVACUATE BY CURING.

A case has lately occurred in my own practice, which not only affords a striking illustration of the present views, but is well calculated to convey to the inexperienced practitioner a very instructive lesson of caution. A man of the age of thirty-five, of the most dissolute habits, was attacked after a debauch of several days continuance, with inflammatory symptoms in the chest; a very large quantity of blood was suddenly abstracted, and the bleeding was repeated after the interval of a few hours. The respiration became laborious, and I was desired to visit the patient; I found that little or no urine had been evacuated since the attack, and that there were evident symptoms of effusion, the legs were swollen, and the difficulty of breathing was rapidly increasing. Under these circumstances I directed a large dose of *Ammonia* with some stimulating diuretics, which were to be repeated at short intervals. On the following day the distressing symptoms had subsided, a large quantity of urine had passed, and the patient expressed himself greatly relieved; unfortunately, however, in consequence of a slight increase of his distress in the evening, an injudicious friend in attendance, took more blood from the arm—the dropsical effusions rapidly increased, and life was extinguished in the course of three days by confirmed Hydrothorax.

3. *By producing Catharsis, and thereby increasing the action of the Exhalents* directly, *and that of the Absorbents* indirectly.

It has been already stated, under the consideration of Cathartics, that

certain medicines of that class excite the exhalents of the alimentary canal, and occasion a very copious discharge of serous matter; by this operation the blood is deprived of a large portion of water, and the absorbents are thus indirectly stimulated to supply the deficiency; *Elaterium*, and some other *hydragogue* cathartics, may be thus employed with extraordinary success for the cure of certain forms of Dropsy, where the vital powers of the patient can sustain the violence of the remedy;—in the whole circle of medicinal operations there is nothing more wonderful than this, that an impression made on the internal surface of the *primæ viæ*, by a few particles of matter, should thus convey by magic as it were, an impulse to the most remote extremities, rousing their absorbents to action; and, in case of *œdema* there, awakening the sleeping energies of these vessels, which like millions of pumps at work, transmit the morbid fluid to the intestines and urinary passages, effecting a detumescence of the hydropic limbs in the course of a few hours, and thus affording a striking illustration of the sympathetic action of medicines, and an instructive example of the operation of those of the sorbefacient class.*

The observations which I have thus offered will lead the practitioner to select the particular diuretic which is best calculated to fulfil the indications of each individual case; and they will at the same time point out those which cannot be administered in combination, without a violation of the law of medicinal compatibility. With respect to the general efficacy of these medicines it may be stated, that where the disease originates from *organic* affections of the chylopojetic viscera, it will not be cured by the mere evacuation of the water by diuretics; but that where it has taken place from diminished absorption, these remedies may be reasonably expected to effect a cure.

DIAPHORETICS.

The term *Diaphoretic* has been applied to those medicines which increase the natural exhalation of the skin, and when they act so powerfully as to occasion sweating, they have been commonly distinguished by the name of *Sudorifics*, but as no difference exists between these remedies, but in the degree of force with which they act, we may very properly comprehend the whole under the general title of Diaphoretics: the fluid effused is also in both cases similar, but in the one it is discharged more slowly, and is carried off by the conducting† power of the air, in

* See Sir Gilbert Blane's Medical Logic, Edit. 2, page 190.

† The cutaneous discharge is very materially modified by the state of the atmosphere, in its relations to moisture and dryness: when the air contains much moisture it is a bad conductor of the perspirable matter, which, therefore, instead of being carried off in an insensible form, is condensed upon the surface; hence we appear to perspire greatly upon the slightest exercise, whereas the cuticular discharge is at such times absolutely less. We have all experienced the sensation of heat, and disposition to sweating, during the moist weather which so frequently occurs in this country in April and May, the wind being at the time stationary at southwest or south. On the contrary, during the prevalence of an east wind, the most violent exercise will scarcely prove diaphoretic, and yet the quantity of cutaneous exhalation is far greater than during that state of atmosphere when the slightest exercise deluges us with perspirable matter.

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the insensible form of vapour, while in the other case it is so copiously effused from the exhalent vessels, as to appear in the liquid form.

As obstructed perspiration may depend upon very different, and even opposite states of the system, so may the most adverse medicines fall under the denomination of diaphoretic remedies.

In some affections, a deficient diaphoresis may be associated with increased vascular action, and in others, with a slow languid circulation.

Diaphoretics may be considered as operating, either by directly stimulating the cutaneous capillaries;—by increasing the general action of the vascular system;—by relaxing the morbidly constricted mouths of the perspiratory vessels;—or, lastly, by producing at once both the latter of these effects.

In conformity with the plan adopted on other occasions, I shall proceed to investigate the powers of this class of medicines, according to their supposed modes of operation.

DIAPHORETICS

Occasion their effects—

I. By Stimulating the Cutaneous Capillaries.

A. By external application.
The Stimulus of Heat, Frictions, &c.

B. By Medicines which enter the circulation and stimulate the cutaneous vessels *by contact.*
Mercurials—Sulphur.

C. By Medicines which act on the surface *sympathetically*, through the medium of the Stomach.
Cold Drinks, &c.

II. By Increasing the General Action of the Vascular System.
Violent Exercise—Ammonia—Guaiacum—Alcohol—Warm Bath.

III. By relaxing the morbidly constricted mouths of the Perspiratory Vessels.
Antimonials—Cold Affusion—Venesection—Saline Diophoretics.

The action of the cutaneous vessels may be augmented by heat, without necessarily increasing, at the same time, that of the heart and arteries; hence it is that heat is, of itself, often sufficient to produce sweating, while it generally accelerates the operation of a sudorific medicine. To this general proposition, however, there are some very important exceptions; and, indeed, in certain conditions of the cutaneous surface, the stimulus of heat will be even found to impede, rather than to promote, diaphoresis; thus in the hot stage of a continued fever, there would seem to exist a peculiar constriction of the perspiratory vessels, accompanied with extreme heat and dryness. In such a state, remedies of the third class must be applied, or conjoined with those of the former. The warm bath may be said to partake of *all* the qualities upon

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which our classification is founded; it will stimulate the cutaneous capillaries,—increase vascular action, generally, and, by its emollient powers, relax the morbidly constricted mouths of the perspiratory vessels. During the ardent heat of fever, the external application of cold is the most efficient sudorific, as the valuable reports of Dr. Currie have very satisfactorily established.

Although the *external* application of cold was not often employed in the hot stage of fever, until within the last thirty years, yet the administration of cold *drinks* appears to have been practised by the ancients, as an expedient to produce perspiration. Galen, and his immediate disciples, as well as the physicians of the sixteenth century, seem to have frequently administered cold water for the purpose of exciting sweat in fevers.* Celsus also describes the beneficial effects which arise from copious draughts of cold water in ardent fevers, "fereque post longam sitim et vigiliam, post multam satietatem, post infractum calorem, plenus somnus venit, per quem *ingens sudor effunditur*, idque præsentissimum auxilium est."† Cold water, when introduced into the stomach in the hot stage of fever, must produce its diaphoretic effect through the sympathetic relation which subsists between that organ and the skin. Nauseating doses of *Antimony*, and of other emetics, occasion a relaxation of the surface from the same mode of operation, and in this latter case, if the force of the circulation be at the same time increased by tepid diluents, the diaphoretic effect is more certain and considerable.

Alcohol, *Guaiacum*, and other powerful stimulants, produce their effects by merely accelerating the circulation; but in employing such remedies for the purpose of exciting sweat, we must be careful to adapt them to the circumstances of the case, and to the degree of action which prevails. In all febrile diseases attended with much increased heat, or connected with local inflammation, diaphoretics of this description must be very cautiously administered, for by accelerating the circulation they might counteract any benefit which they would otherwise confer by relaxing the vessels of the skin. In the whole history of medical opinions there is scarcely a theory which has proved so fatal in its practical applications as that maintained by Van Helmont, and his disciples, *viz.* that *acute diseases were to be cured by expelling some morbific matter, after its proper concoction*—a theory which suggested the administration of the most stimulating sodorifics, together with high temperature‡ in every grade of febrile exacerbation. The fatal effects of such a practice during the seventeenth, and early parts of the eighteenth centuries, are incalculable, and may be very satisfactorily contrasted with the beneficial results which have accrued, in the same diseases, in the present age, from the use of diaphoretics of the refrigerant kind.

Saline Diaphoretics, as they readily pass with the chyle, may be supposed to enter the circulation, and be thus brought to act, directly, on the cutaneous vessels; at the same time it seems extremely probable

* Lommius de Febribus.

† De Medicina. Lib. iii. c. 7.

‡ This practice is still cherished by the vulgar, especially in some of the more remote districts of the kingdom. It is with this view that the Cornish nurse continues to keep down the excess of population, by administering Gin and Treacle, in her smoky chimney corner, to children labouring under measles, in order to *throw out* the eruption.

that such remedies may also occasion an impression on the stomach, which is sympathetically communicated to the vessels of the skin; they have undoubtedly little or no influence on the general vascular system, and neither augment the force nor the velocity of the circulating current.

It is not, however, in febrile affections alone that this class of remedies proves highly beneficial; the very intimate sympathetic connexion which subsists between the functions of the lungs and skin, renders the use of such medicines particularly advantageous in the cure of the diseases incident to the former of these organs; a fact upon which we shall hereafter offer some remarks under the history of *Expectorants*.

So again, in the treatment of bowel affections, in consequence of the intimate relation which exists between the cutaneous capillaries and those of the internal organs, gentle diaphoretics offer a valuable resource in their cure. How frequently do Diarrhœa, Enteritis, &c., ensue from the sudden suppression of perspiration by cold?

From the influence which these medicines exert upon the extreme vessels of the skin, they are also highly serviceable in various obstinate cutaneous affections, as *Herpes*, *Lepra*, &c.

As evacuating the serous part of the blood must necessarily have an indirect effect in promoting absorption, *Sudorifics* have been occasionally exhibited in dropsy, especially in that form of the disease called *Anasarca*. It has been already observed that cases too frequently occur in which the discharge of urine cannot be increased by art; upon such occasions practitioners have sometimes had recourse to a trial of Sudorifics,* but from the great difficulty which generally exists in exciting sweating in such affections, the indication has rarely been fulfilled. Where however a sudorific does succeed, it is less liable to debilitate than the other alternative of a drastic purgative.

There is still another point of view in which the therapeutic importance of Diaphoretics may be considered. It is generally acknowledged that by cutaneous transpiration a portion of excrementitious matter is ejected from the system; hence by the failure or imperfect performance of this function, a deleterious fluid is retained which may give origin to disease; to such a cause may perhaps be attributed the generation of Calculi, and other diseases of the urinary system, as we shall have occasion to notice under the head of *Lithonthryptics*.

The increased efficacy which these medicines derive from combination with each other, will form a subject of interesting inquiry in the succeeding essay.

* *M. Du Hamel* has recorded the cases of two countrymen, considerably advanced in life, who were cured of Dropsy by remaining for some time in a baker's oven, soon after the bread had been drawn. *Varrikbillan*, ninth Caliph of the race of the Abassides, is said to have been cured by a nearly similar method. His physician caused him to enter a lime-kiln soon after the lime had been removed, when in the course of a few days he was totally cured of his dropsy. The ancients excited sweating in this disease, by burying the patient up to the neck in heated sand or ashes (*Celsus*, Lib. iii. c. 30.), and Lysons cured cases by placing his patients in rooms heated to a very high temperature.

In the history of the Royal Academy of Sciences, for 1708, a case is related of a woman, who, tired out by the protracted Dropsy under which her husband laboured, *charitably* administered to him a very large dose of opium, with the intention of despatching him, but the medicine immediately produced such a copious sweat that it restored him to health!

EXPECTORANTS:

Medicines which are supposed to be capable of facilitating the excretion of mucus from the breast, *expectore*, that is, from the trachea, and cells and passages of the lungs.

If the term *Expectorant* be intended to express a medicinal substance which has the power of promoting the expulsion of fluid from the lungs, by some *specific action* on the parts concerned, we can have no hesitation in at once rejecting the word, and denying the existence of such remedies: if however the term be received, conventionally, as comprehending all those substances which are capable, according to the state of the system in each particular case, of producing expectoration, it will be extremely proper to recognise, and practically useful to retain, such a class of medicinal agents. In order that their *modus operandi* may be correctly understood, the following classification is submitted to the reader.

A CLASSIFICATION OF EXPECTORANTS,

According to their supposed modes of operation.

CL: I.—MEDICINES WHICH INCREASE PULMONARY EXHALATION, AND THEREBY DILUTE THE MUCUS IN THE FOLLICLES OF THE LUNGS.

a. By removing constriction of the Pulmonary Exhalant vessels.

Blisters.
Venesection.
Nauseants.

b. By stimulating these vessels by the *actual contact* of a medicinal substance.

Allium. *Fœtid Gums.*
Scilla?
The different Balsams.

c. By stimulating the top of the trachea, and thereby increasing the action of the exhalant vessels of the lungs, by a species of *Contiguous Sympathy.*

Stimulating Lozenges, Linctusses, the Inhalation of certain vapours, &c.

CL: II.—MEDICINES WHICH DIMINISH THE INORDINATE FLOW OF FLUID INTO THE LUNGS, AND RENDER THE EXPECTORATION OF THE REMAINDER MORE EASY.

a. By removing the debility of the Exhalants.
Sulphate of Zinc. *Bitter Tonics.*

b. By increasing the power of the Absorbents.
Digitalis. *Nicotiana.*

c. By determining to the skin by gentle diaphoresis.
Tartarized Antimony.

d. By exciting serous discharges from the bowels.
Saline Purgatives.

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CL: III.—MEDICINES WHICH OPERATE, MECHANICALLY, IN PROMOTING THE REJECTION OF ACCUMULATED MUCUS.

a. By stimulating the muscles of Respiration.
Ammonia.

b. By exciting vomiting, and thereby compressing the thoracic viscera.
Emetics.

I. Of Medicines which increase Pulmonary Exhalation.

a. By removing constriction of the Pulmonary Exhalant vessels.

There can be no doubt but that, in certain states of disease, the exhalants of the lungs, like those of the skin, are affected by a spasmodic constriction, in consequence of which the usual quantity of fluid for the lubrication of these parts, is not effused, whence a train of morbid phenomena arise; this appears to happen in *Pneumonia Asthma*, and certain other diseases of the pulmonary organs. In order to remove such a constriction, remedies of the Antispasmodic class may be exhibited with advantage; nauseating doses of Tartarized Antimony, or of Ipecacuanha, are likewise calculated to fulfil the same indication, by an operation analogous to that by which Diaphoresis is produced. If the term might be allowed we should call such remedies *Pulmonary Diaphoretics.* It is in this way that Venesection, Blisters, and other anti-phlogistic remedies, may in certain states of the lungs restore a healthy excretion from these vessels.

b. By stimulating the Pulmonary Exhalants, by the actual contact of a medicinal substance.

There certainly appear to be substances which enter the circulation, and are more peculiarly determined to the pulmonary vessels, since their odour is to be distinctly recognised in the air that is expired. *Garlic* may be adduced as an example of this kind; so penetrating is its odorous principle, that if it be only applied to the soles of the feet it may be perceived in the breath. Such substances may stimulate the exhalant vessels through which they pass, and by this stimulus the secretion may be increased, and the mucus contained in the follicles diluted, so as to be poured out in a less viscid form, and consequently in a state to be more easily brought up by expectoration.

c. By stimulating the top of the trachea, and thereby increasing the activity of the Exhalant vessels of the lungs, by a species of contiguous sympathy.

The salutary operation of those various remedies, which are allowed to pass slowly over the fauces, sufficiently establish the fact which is here

announced. In this manner I apprehend that much benefit may arise from the use of a *Linctus*, and I am satisfied from experience that certain cases of hoarseness are to be frequently removed by such an application of stimulating syrups.

The inhalation of certain vapours will also enable us to make a more direct application to these parts; as, however, it is my intention to dedicate a chapter to the consideration of this form of remedy, it is unnecessary to dwell upon it in this place.

II. Of Medicines which diminish the inordinate flow of fluid into the lungs.

a. By removing the debility of the Exhalants.

It not unfrequently occurs in persons either debilitated by age or disease, that the exhalant vessels of the lungs lose their tone, and pour out a larger quantity of fluid than is necessary for the lubrication of these organs; this is particularly observable in the disease called *humoral asthma*, and in the catarrh of old persons: if this excess be restrained by strengthening the tone of the system generally, or by astringing these vessels in particular, the expectoration of the remainder will be rendered much more easy: according to my experience, *sulphate of zinc* displays considerable powers in moderating this effusion of fluid, and it appears to produce this effect by increasing the tone of the exhalant vessels of the lungs; several medicines also, which are included in the former division of this classification, may, by stimulating these organs, not only promote the exhalation when it is too scanty, but repress it when it is too abundant.

b. By increasing the power of the Absorbents.

In some cases, the mucus inundation may not depend upon any fault in the exhalants, but upon a torpid state of the pulmonary absorbents: our remedy for this evil is to be found amongst that class of medicines which have the power of promoting absorption, as small doses of some mercurial preparation, *Digitalis*, and perhaps *Nicotiana*, *&c.*

c. By determining to the skin by a gentle diaphoresis.

It is evident that an increase of the cutaneous exhalation is generally attended with a relative diminution in the other serous excretions of body; this is so obvious with respect to our urinary discharge, that every person must have noticed the variation of its quantity at different seasons of the year: in like manner the exhalation from the lungs, although less capable of becoming an object of observation, is not less affected by the state of the cutaneous discharge; hence medicines capable of promoting it, are calculated to diminish the quantity of serous exhalation from the lungs; and it is upon this principle, that well regulated doses of the compound powder of Ipecacuan, frequently furnish the oppressed asthmatic with a valuable resource.

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d. By exciting serous discharges from the bowels.

Upon the principle announced in the preceding section, the operation of a saline cathartic may relieve the pulmonary organs when loaded with a preternatural accumulation of fluid, and consequently assist expectoration. On the contrary, if the exhalation be deficient, this class of remedies may increase pulmonary irritation, and check expectoration, a fact which coincides with the concurrent testimony of many able practitioners.

III. Of Medicines which operate *mechanically.*

a. By imparting vigour to the respiratory muscles, engaged in the act of expectorating.

It must be admitted that, to a certain extent, expectoration is a voluntary operation, connected with the action of a variety of muscles, which in a state of extreme debility are not easily excited into action: every practitioner must have noticed this fact during the treatment of the coughs of exhausted patients, and have witnessed the distress necessarily arising from it; in this condition, the exhibition of a stimulant may so far renew the exhausted excitability of these organs, as to enable them to undergo the necessary exertions.

b. By compressing the thoracic viscera, through the operation of an emetic.

The beneficial results which frequently attend the concussion of an emetic, in cases of mucous accumulations in the lungs, are too well known and understood to require much elucidation: in the act of vomiting, the thoracic viscera are violently compressed, the neighbouring muscles are also called into strong action, and both expiration and inspiration are thus rendered more forcible, and the expulsion of mucus from the cavity of the lungs necessarily accomplished,

The safety and expediency of such a resource must, however, in each particular case be left to the discretion of the medical practitioner.

Besides the remedies above enumerated, there are some others which afford relief in certain coughs, and have therefore in popular medicine, been considered as *Expectorants;* but their operation, if they exert any, is to be explained upon principles altogether different from that of facilitating expectoration, and will more properly fall under the head of *Demulcents.*

Atmospheric changes, in relation to moisture and dryness, deserve some notice before we conclude the history of expectorant agents: the subject teems with curious and important facts, and the advantages which the asthmatic patient derives from such changes merit farther investigation. That the lungs are constantly giving off aqueous vapour is made evident by condensing the expired air on a cold surface of glass or metal; and it is easy to imagine that when the atmosphere is saturated with moisture, its power of conducting off this vapour will be proportionally diminished, and that an accumulation of fluid may thus take place in the

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lungs; on the other hand, we may suppose the air to be so dry as to have an increased capacity for moisture, and to carry off the expired vapour with preternatural avidity; in either of these cases, the excretions from the lungs will be materially influenced; whether to the benefit or disadvantage of the patient will depend, in each particular instance, upon the nature of the disease under which he suffers. I have known a person who could breathe with more freedom in the thick fogs of the metropolis than in the pure air of a mountainous region, and it would not be difficult to adduce many examples in illustration of a diametrically opposite constitution of the pulmonary organs.

From the same cause we may frequently observe remarkable changes occur in the character of a cough, at the breaking up of a frost; in some cases the expectoration will be checked, and in others promoted by a sudden change from a dry to a moist atmosphere. Can a more instructive illustration be offered of that important fact, which I have been labouring in every page to impress upon the mind of the young practitioner, that, *remedies are only relative agents?*

In the course of considerable experience in the treatment of pulmonary complaints, and in the influence of climate and seasons upon them, I have repeatedly observed the rapid transition from moisture to dryness to occasion very remarkable effects upon the disease; and I much question whether an attention to such a condition of the atmosphere does not deserve as much consideration in the election of a suitable place of residence for such invalids, as the more obvious circumstance of temperature. I have been long in the habit of recommending to persons confined in artificially warmed apartments, to evaporate a certain portion of water, whenever the external air has become excessively dry by the prevalence of the northeast winds, which so frequently infest this island during the months of Spring; and the most marked advantage has attended the practice. But in such cases the practitioner must ever be guided by the symptoms of each particular case; it would be worse than useless to lay down any general precept for his guidance. We cannot then be surprised that such a difference of opinion should exist amongst practitioners of equal eminence, respecting the influence of a marine atmosphere; some advocating its advantages to the pulmonary invalid, and others maintaining with equal confidence the injurious tendency of such localities; each party appeals to *experience* in justification of his opinion, and with equal candour and justice; but the cases from the results of which the medical inference has been drawn, however parallel they may have appeared, differed in those essential points to which we have alluded, and upon which the question of climate would seem to turn. There is another circumstance connected with the subject of atmospheric moisture which it is also essential to remember,—that the air gains a considerable increase in its power of conducting caloric, by becoming saturated with aqueous vapour; thus, when a thaw takes place, and the thermometer rises a few degrees above 32°, the air, instead of impressing us with the sensation of increased temperature, actually appears much colder.

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SIALOGOGUES:

Substances which increase the salivary* discharge. This class comprehends two orders of medicines, viz.

1st. Those which increase the salivary excretion by *external* application to the secreting vessels, by mastication, as the following acrimonious and pungent substances, *Anthemis Pyrethrum; Colchearia Armoracia; Daphne Mezereum; Nicotiana Tabacum, &c.*

2nd. Those whose *internal* exhibition affects these organs through the medium of the circulation, of which *Mercury* is the only true example; for all the preparations of this metal, when administered in certain quantities, produce salivation.

The acrid Sialogogues, or Masticatories, by stimulating the excretory ducts, and increasing the secretion of saliva, sometimes relieve the pain of toothach, and are commonly resorted to for that purpose; they are besides supposed capable of relieving other congestions, or inflammatory dispositions, in more remote parts of the head, by the derivation they occasion from the neighbouring vessels, especially the branches of the external carotid.

Mercury, in its metallic state,† is perfectly inert, and does not exert any influence whatever upon the living body; this fact is sufficient, if any serious refutation were necessary, to overturn the theory which attributes its sialogogue property to the gravity of its particles, by which "it is disposed to retain the *direct line* in which it is propelled from the heart, and is therefore more certainly determined to the vessels of the head." It has been also supposed to act by diminishing the *lentor* of the blood, and disposing it to pass more easily into the salivary glands, so as to increase their secretion; equally gratuitous and improbable are the chymical hypotheses which have been offered to explain this curious and singular property; Dr. Cullen endeavoured to solve the problem, by supposing that "*Mercury has a particular disposition to unite with ammoniacal salts, and that such salts are disposed to pass off by the salivary glands more copiously than by any other excretion.*" Dr. Murray, however, very justly remarks that mercury has not any peculiar tendency of this kind; and that if it had, these salts are not more abundant in the saliva, than in some other secretions. Dr. Murray then proceeds to submit a theory which he considers better calculated to explain the phenomenon; he observes, that the urine appears more peculiarly designed to convey matter which has been received into the circulating mass, but which is still excrementitious, from the system. To pass, however, with this fluid, it is necessary that the matter conveyed should be soluble in it; and when it is so, we can discover it in the secretion by chymical tests. If there is any property connected with it, therefore, which shall prevent this solubility, it probably will prevent the substance from being secreted.

* σιαλος, saliva; et αγω, excito.

† I of course except its application in the form of vapour, in which state it proves extremely active. See Hydrargyrum.

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Now, the *phosphoric acid*, abundant in urine, must in this mode counteract the secretion of mercury in any form of preparation, by forming with it a compound, insoluble, and to which the slight excess of acid cannot communicate solubility; the mercury, therefore, existing in the circulating mass, when brought in the course of the circulation to the secreting vessels of the kidneys, will not pass through their whole course; but if conveyed so far as to be combined with *phosphoric acid*, will, from this combination, be incapable of being conveyed onwards, and will therefore be retained in the composition of that part of the blood which does not enter into the secretion, but returns into the circulation. It must be discharged by some other emunctory; a portion of it appears, from some facts, to pass off by the insensible perspiration; but the *tenuity* of this secretion, if the term may be employed, must be unfavourable to this mode of discharge. The salivary secretion is one by which it may be more easily transmitted; and this transmission may even be facilitated by the affinity exerted to the *Oxide of Mercury* by the *Muriatic Acid*, and *Soda*, and *Ammonia*, which are the chief saline ingredients in saliva; for it deserves to be remarked that triple compounds of these substances are, to a certain extent, soluble in water; and if the *Mercury* is thus secreted, it will of course stimulate the secreting vessels through which it passes, and increase the discharge.

Sir Gilbert Blane* has lately advanced another hypothesis to account for the effects of mercury as a sialogogue; he considers the salivary glands as one of the outlets for the *ramenta* of the bones, for by analyzing the saliva we discover the principles of which they consist; indeed the osseous matter not unfrequently concretes on the teeth, and sometimes on the salivary ducts; in the form of what is called *Tartar:* "does not this fact," says Sir Gilbert Blane, "in some measure account for these glands being the parts upon which determination is made by the operation of mercury, which consists in exciting an active absorption of solid parts, as I have elsewhere observed?"†

But do not the kidneys, and other excretory glands also furnish outlets, through which the *detritus* of the body is eliminated. How does it happen, therefore, that the kidneys are not as equally affected as the salivary glands by the action of mercury? In the present state of our knowledge it will be more prudent to rest on the phenomenon as an ultimate fact, than in attempting to ascend higher in the scale of causes, to involve ourselves in impenetrable darkness.

During the prevalence of the theory which attributed to *nitric acid* all the antisyphilitic powers of mercury, it was even maintained that this acid also excited ptyalism; experience however has disproved the effects thus attributed to it, and no one attempts to support its pretensions, as a sialagogue, except indeed as it may perchance, by its acrid qualities, influence the excretory ducts of the glands, externally, in the act of being swallowed.

It has very lately been stated by Dr. Macleod,‡ that the *Hydro-cyanic acid* occasionally produces soreness of the gums, and a disposition to

* Medical Logic, Edit. 2. p. 75.

† Transactions of a society for the Improvement of Medical and Chirurgical knowledge, Vol. iii. p. 119. London, 1822.

‡ Medical and Physical Journal for October, 1811.

ptyalism; this, if true, is a very remarkable fact, and well deserves attentive consideration.

Some theorists may, perhaps, be inclined to consider certain Nauseating Medicines as possessing sialogogue properties. It cannot be denied that an increased discharge of saliva will take place during the operation of such remedies, but it is very transient, and can never be rendered available to any therapeutic object. I shall however have occasion to refer to this fact hereafter, and to the inference deduced from it by Dr. Eberle, in explanation of the effect of nauseating medicines in promoting the operation of mercury.

ERRHINES, OR STERNUTATORIES:

Substances which, by direct application to the pituitary membrane, occasion a discharge from the nostrils either of a mucous or serous fluid. This class contains several different species, whose operation varies in intensity, as well as in duration.

Errhines have been regarded as useful in consequence of the evacuation they occasion, but in this respect their value has been greatly overrated; it has been stated, that they diminish the quantity of fluid circulating in the neighbouring vessels, and even extend their influence to all the branches of the external carotid; and Dr. Cullen says that he has, apparently from this operation, known headach, pain of the ear, and some cases of ophthalmia, cured or relieved by the use of Errhines. There can be no doubt that local stimulants of this kind will frequently remove pain from the head and neighbouring parts, but not merely by occasioning vascular depletion, as Dr. Cullen supposed, but by a stimulant operation conveyed through the medium of nervous communication, or contiguous sympathy.

Dr. Cullen has moreover supposed, that these substances may be useful in preventing apoplexy or palsy. Morgagni* however relates a case in which sneezing induced a fatal attack of this disease; and Van Swieten† has satisfactorily shown, that continued paroxysms of sneezing tend to load the vessels of the head with blood; for the violent contraction of the chest impedes, for a time, the passage of the blood through the lungs, and therefore obstructs the return of the venous blood from the brain, the vessels of which are in consequence greatly distended; the face therefore reddens and becomes turgid, the eyes are suffused with water, and appear full and distended. Its occasional dangerous violence is said to have given origin to the benediction so universally bestowed on those who sneeze.‡

It has been a subject of popular inquiry, how far the habitual use of snuff may prove beneficial or injurious; and whether the habit, when

* De Sed. et Caus. Morb. Epist. xiv. art. 27.

† Comment. ad Aph. 271.

‡ This is one of the most ancient superstitions which have descended to us. It was customary in Greece, when any one sneezed, to exclaim Ζῆθι, 'May you live;' or Ζεῦ σῶσον, 'God bless you.' Aristotle, in his problems, has attempted to account for the origin of the custom, but unsatisfactorily; Pliny, (Nat. Hist. lib. 28. c. 2) asks—"Cur Sternutantes salutentur?"

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once fully established, can be discontinued with impunity? It may be remarked that snuff, by habitual use, soon ceases to produce the effect of an Errhine, for which reason its discontinuance cannot, generally, be regarded as likely to be attended with any danger; in those cases, however, in which the discharge is perpetuated, a contrary judgment should be pronounced, for all artificial discharges become constitutional by long continuance, and can therefore be seldom checked with impunity. Dr. Cullen states, from experience, that "whenever the nasal discharge has been considerable, the laying aside the custom of taking snuff has been productive of evil."

EPISPASTICS. *Vesicatories. Blisters.*

External applications to the skin, which produce a serous or puriform discharge, by previously exciting a high state of inflammation.

When these agents act so mildly as merely to excite inflammation, without occasioning the effusion of serum, they are denominated RUBEFACIENTS.

Various substances have at different times, been proposed for the accomplishment of this object,—such as *Nitric Acid*, *Boiling Water*, *Strong Acetic Acid*, *Tartarized Antimony*, *&c.* It is, however, generally admitted, that no substance ever employed, equals, in efficacy, or certainty, the *Cantharis Vesicatoria*, the common blistering, or Spanish fly; and those effects may serve to illustrate the *modus operandi* of this class of remedies.

By the application of a *Blister*, the extreme blood vessels are excited into increased action, by which inflammation is occasioned, and the exhalants made to pour out a thin serous fluid which separates the cuticle from the true skin, and forms a vesicle or blister.

From this simple view of the subject it will appear evident, that blisters may produce their salutary effects by several different modes of operation; by a just estimate of which the practitioner will be enabled to reconcile the discordant opinions which have been delivered upon the subject, and to employ these agents with greater satisfaction and advantage.

Blisters may act—

1. As DERIVATIVES, i. e. *by producing a derivation of the circulation from the inflamed and engorged vessels of the neighbouring organs to the blistered surface.* This mode of operation was long overlooked by physicians, who ascribed all the beneficial effects of a blister to the evacuation which it produced, while the humoral pathologist, moreover, considered the matter so discharged to be of a morbific nature. That such agents owe their salutary tendency to causes independent of their powers as evacuants, is at once rendered evident by the relief which they afford, when used only as Rubefacients.

2. As EVACUANTS—*by occasioning an effusion of Fluids.* In this case the vesicated part may be considered in the light of a new excretory

organ, the formation of which requires the establishment of a new current or determination of blood; so long as the discharge continues, so long will there be an especial demand of blood in the blistered part, and a consequent derivation of the circulation from the inflamed and engorged vessels of the neighbouring organs.* The nature of the fluid effused is at first serous, but after some time it becomes purulent, and this stage of its operation must be considered as, by far, the most beneficial; hence the great advantages derived from a "*perpetual blister.*"

3. As General Stimulants, *by raising the vigour of the circulation.*† That Blisters have such a tendency there exists too many proofs to allow us to doubt. Hence in fevers they frequently prove valuable auxiliaries, but since the application of any stimulus, in such diseases must be regulated by the degree of excitement, it is evident that they can only be made with success in particular stages; this simple fact will at once explain the cause of that want of unanimity in physicians with respect to the value of blisters in febrile diseases. Rush considered that there was one particular period, in the course of a continued fever, intermediate between its stage of high excitement and the appearance of a collapse, in which blisters will generally produce unequivocal good effects, and to this he gave the name of the *Blistering point.*

4. As Antispasmodics.—*Relieving pain through the medium of Contiguous Sympathy.* This effect would frequently appear to be independent of the operations above enumerated; a similar principle seems to exist with regard to the *pain* excited by blisters, which may also be applied to the explanation of the advantages derived from them in several diseases. It has long been remarked that, by exciting one pain we may often relieve another, and hence blisters afford relief in toothach, and other painful affections. Epilepsy and Hysteria, arising from irritation, have been removed by such applications, apparently from their exciting powers.

It remains for us to make a few observations upon the abuse of these remedies, for, notwithstanding the popular adage that "*Blisters are always safe things,*" that "*if they do no good, they can do no harm,*" they will be found, like all other potent applications, capable of producing much mischief when directed by unskilful hands. In stages of high vascular excitement in the pulmonary organs, blisters have increased the irritation they were designed to allay, and in some cases have promoted a tendency to effusion; in the treatment of acute Hydrocephalus the common practice of blistering the head appears very questionable, and has too often, I am well persuaded, accelerated the fatal termination, by increasing the disposition to serous effusion.

* Eberle's Treatise on the Materia Medica.

† It is said that whenever Dunning, the celebrated barrister, was called upon to make the finest display of his eloquence, whether forensic or parliamentary, he constantly applied a blister to his chest, which he found to have the effect of imparting an unusual tone and vigour to his body, and elevation to his mind.

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ISSUES (*Fonticuli*) and SETONS (*Setacea.**)

The effects of these processes bear a strong analogy to those which are produced by Vesicatories; they are, however, more permanent, and are, on that account, better adapted to the relief of those chronic affections which would seem to require a remedy of long continued influence. In pulmonary affections, for instance, a seton in the side is frequently attended with very considerable benefit. The popular belief in humoral pathology, which continues to influence the mass of mankind, has perhaps assigned to these remedies a greater share of credit than that to which they are really entitled, but it must still be acknowledged that when an ulcer having existed a great length of time, is healed, or *dried up*, or any constitutional discharge is suddenly checked, the health may become affected. In such cases the establishing a discharge by means of an issue is undoubtedly a safe, and often a beneficial operation.

III. OF CHYMICAL REMEDIES.

There is no principle in physiology better established than that which considers vitality as a power engaged in continual conflict with the physical, chymical, and mechanical laws, to which every species of inanimate matter is invariably subject. Every phenomenon of the living body might be advanced in illustration and support of this general position. The animal machine is constantly surrounded and assailed by agents, whose elective attractions for the principles of which it consists, are so numerous and energetic, that its decomposition would inevitably and speedily result, were not the adhesion of its molecules maintained by the conservative influence of a superior power. The compositions and decompositions which manifest themselves in the elaborate operations of chylification, sanguification, and secretion, are carried on by agencies totally distinct from those which govern the combinations of inert matter, and must be investigated upon principles essentially different. How then, it may be asked, can a medicinal substance be brought to act *chymically* upon the *living* body? Notwithstanding the general proposition, that the animal processes to which we have alluded, are governed by laws peculiar to life, yet it must be admitted that such processes are occasionally influenced,† modified, and controlled by powers strictly chymical

* From *setum*, a horse hair, a substance which was formerly used for the accomplishment of this object.

† It sometimes happens that the stomach and digestive organs are so weakened by disease as to lose their control, or what Dr. Fordyce called their 'governing power,' in which case they would appear to be unable to prevent the matters which they contain from acting chymically upon each other, and occasioning decompositions and new combinations: in such cases substances are sometimes developed in the internal organs by the action of disease, which are capable of producing a chymical effect upon the fluids; for instance,—an acid is not unfrequently generated in the bowels of children which decomposes the bile and produces a green precipitate, and green stools are the consequence; in other cases the acid combines with the *Soda* of the bile, and the precipitate thus occasioned is thick, viscid, very bitter, and inflammable, and we have stools looking like pitch. In Yellow Fever, and in several other diseases, the

in their operation; although in some cases it will be seen that such effects afford only apparent exceptions to the general law: for several of the remedies whose operations have been regarded as purely chymical, exert their influence on parts which cannot be strictly considered under the control of the living principle; of which *Antacids*, and certain *Antidotes* and *Antiseptics*, to be hereafter explained, may be considered as examples: in like manner will cataplasms of acetic acid hasten the exfoliation of carious bone; a practice which has lately been employed with much success in the Infirmary at Gloucester. Upon the same principle alkaline applications may be made to dissolve coagulated blood; suppose, for the sake of illustration, that the bladder should become filled with coagulum through hemorrhage from the prostate gland, and that the most serious consequences were to be apprehended from the distention; in such an emergency, a dilute and tepid solution of potass, if injected through the catheter, might prove eminently serviceable; although such a practice would require the utmost skill for its safe direction, since the removal of the plug, thus afforded by Nature to the bleeding vessel, might be followed by an immediate return of active hemorrhage. On the contrary, other agents destroy the vitality of the organ before they can produce any change in the matter of which it is composed, as the action of *Escharotics* will clearly demonstrate.

REFRIGERANTS:

Substances which directly diminish the force of the circulation, and reduce the heat of the body, without occasioning any diminution of sensibility or nervous energy.

These remedies may be considered either as external and local, or as internal and general. In the first case, there will not be much difficulty in substantiating their claims to be considered *Chymical Agents*, but in the latter case, the theory of their operation is unsatisfactory and obscure; and even the facts which are adduced to establish the existence of such a class of remedies, are of a very problematical character.

Topical Refrigerants. In the case of external inflammation, refrigeration may be produced by the application of cold substances, such as water, ice, or certain saline solutions, or by the abstraction of heat by means of evaporation, which is very effectually accomplished by the use of lotions composed of spirit or ether. By these methods we are capable of directly diminishing the activity of the vessels of the part; thus, in burns and scalds, the pain is instantly relieved, and the inflammation effectuallyreduced.

bile which is brought up by vomiting is frequently of a vivid green colour, and some writers have attributed the phenomenon to a morbid condition, or action of the liver or gall bladder; the fact however is, that the bile itself undergoes a chymical change in the Duodenum and Stomach. That bile does undergo such a change from decomposition, is proved by a variety of facts observed to take place *out* of the body; it is well known, for instance, that the fæces of infants, although yellow when voided, frequently become green after some time: and Dr. Heberden observes, in his Commentaries, that the urine of a certain jaundiced patient, which was of a deep yellow, became after a few hours green; in such cases it is probable that an acid is generated by the reaction of the elements of which the bile consists.

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INTERNAL REFRIGERANTS. There are certain saline substances which, by undergoing a rapid solution, and acquiring an increased capacity for caloric, produce a diminution of temperature, and if this takes place in the stomach, the sensation of cold which it will produce is equivalent to a partial abstraction of stimulus; which, being extended by sympathy to the heart, occasions a transient reduction in the force of the circulation, and by this, or by a similar sympathetic affection, causes a sensation of cold over the whole body; in this manner Dr. Murray explains the refrigerant operation of nitre, which after all is of a very doubtful nature. We shall perhaps not feel much difficulty in accepting this theory, and in allowing that general refrigerant effects may be temporarily produced, by occasioning an impression of cold upon the stomach. The theory which is proposed to explain the refrigerant operation of vegetable acids and certain other substances, and which we have now to consider, is derived from those chymical views respecting animal heat, in which the consumption of oxygen in the act of respiration is considered the principal source. Dr. Murray,* who has given a luminous exposition of this theory, says "it is established by numerous experiments and observations, that the quantity of oxygen consumed in the lungs is materially influenced by the nature of the ingesta received into the stomach. When the food and drink are composed of substances which contain a small proportion of oxygen it is known that the consumption of oxygen in the lungs is increased, and this even in a short time after the aliment has been received; thus Mr. Spalding, the celebrated diver, observed, that whenever he used a diet of animal food, or drank spirituous liquors, he consumed in a much shorter time the oxygen of the atmospheric air in his diving-bell; and therefore he had learned from experience to confine himself to a vegetable diet, and to water for drink, when following his profession.† During digestion too, it was established by the experiments of Lavoisier and Seguin, that a larger proportion of oxygen than usual is consumed."

But it is known, that the animal temperature is derived from the consumption of oxygen gas by respiration; and, that an increase in that consumption will occasion a greater evolution of caloric in the system, and consequently an increase of temperature in the body, while a diminution in the consumption of oxygen will have an opposite effect. If, then, when the temperature of the body is morbidly increased, we introduce into the stomach substances containing a large proportion of oxygen, especially in a loose state of combination, we may succeed in reducing the general temperature. This we accomplish in part by a vegetable diet, but still more effectually by the free use of the *Acids*. The vegetable acids in particular, which are found by experience to be the best refrigerants, are readily acted upon by the digestive powers, and assimilated with the food; and as the large quantity of oxygen which they contain is already in a concrete state, little sensible heat can be produced by the combination of that element with the other principles

* System of Materia Medica. vol. 1. p. 453.

† The same fact has been long known by the Divers in the Indian Pearl-fisheries; see my Work on Medical Jurisprudence, Introduction, Vol. 1. p. v.

of the food. The nutritious matter which is received into the blood, containing thus a larger proportion of oxygen than usual, will be disposed to abstract less of it from the air in the lungs, and consequently less caloric will be evolved; the temperature of the body will be reduced; and this, again operating as a reduction of stimulus, will lessen the number and force of the contractions of the heart."

Such is the philosophical web which chymical ingenuity has wove for us,—the device is beautiful, but the fabric will be found too frail to endure the touch. The experiments of Dr. Crawford, in proof of the chymical origin of animal heat, are highly ingenious and plausible, but it is now generally admitted that the temperature of animals depends upon the living principle* which animates them, and that although the absorption of oxygen, in the act of respiration, may directly contribute something to its production, yet that its chief action is that of serving as a stimulus to the living power in generating it; for, as Sir Gibert Blane† remarks, oxygen plays an interesting and active part as an exciting power throughout all nature, both animate and inanimate. If the heat of the body depended on respiration alone, any one might, by a voluntary effort of quick, deep, and prolonged respiration, increase the temperature of his body at will; the effect also of the emotions of the mind, in generating both heat and cold, adds Sir Gilbert, is proof sufficient of temperature depending on a vital, and not on a chymical cause.

ANTACIDS:

Remedies which obviate acidity in the stomach, by combining with the acid, and neutralizing it.

This is the most decided instance of chymical action which occurs in the history of medicinal operations. We have an acid whose presence excites morbid symptoms in the *primæ viæ*, and these are immediately removed by the administration of any one of those substances which are capable of forming a natural compound with the acid in question, *out of the body*, and the same proportions are required in both cases for saturation. If a carbonated alkali be employed, the same disengagement of carbonic acid takes place in the stomach as would occur in the laboratory, and a new compound is produced, whose operation varies according to the chymical nature of the substance employed; thus, the salt which magnesia forms with the acid in the stomach proves slightly purgative, while that which lime produces under similar circumstances is distinguished by an opposite property.

* See a paper upon this subject by Mr. Brodie, Phil. Trans. 1811.
† Medical Logic, Edit. 2, p. 50.

ANTILITHICS AND LITHONTHRYPTICS.

ANTILITHICS* are remedies which have the power of preventing the formation of those mechanical deposites from the urine, which gave origin to calculous concretions; and may belong either to the class of Vital, or Chymical Agents.

LITHONTHRYPTICS† are those medicines which, by a chymical operation, are capable of dissolving calculous concretions.

It has been already shown, while treating the subject of Diuretics, that certain substances, when internally administered, are capable of passing the barriers of digestion, and of entering the circulation; and that, moreover, these bodies may be again separated by the secretory vessels of the kidneys, and be ejected from the body in the urine. It cannot therefore be contended, that the urinary calculus is placed beyond the sphere of direct medicinal influence, nor can any argument, founded upon the alleged incompatibility of chymical and vital action, be fairly maintained in this case; for the urinary calculus, as well as the urine itself,‡ may very justly be considered as extraneous to the living body. The existence of such a class of remedies as that of Lithonthryptics being thus established, we have to consider the mode and possible extent of their operation in the different varieties of the disease, which they are thus calculated to palliate or cure. In entering upon this inquiry, it is not my intention to prosecute the subject farther than may be necessary to explain the *modus operandi* of the remedies in question, and in conformity with the object and plan of this work, to establish some general principles that are to direct us in their election, combination, and administration; for farther details the practitioner must consult the systematic treatises of *Prout*§ and *Marcet*,‖ and the very able papers of Mr. *Brande*,¶ and Dr. *Wilson Philip*.**

The urine may be considered as one of the most heterogeneous of the animal fluids;†† and since a knowledge of its composition, and that of the morbid changes of which it is susceptible, must constitute the basis of all our knowledge respecting the formation and cure of calculous affections, the following results of an elaborate analysis by *Berzelius*, are submitted with a view to elucidate our pathological researches.

* From ἀντὶ against, and λίθος a stone.

† From λίθος, and θρυπτω to break.

‡ The kidneys have a more obtuse sensibility, and not such energetic activity as other glands possess; vital action is less concerned in the secretion they carry on, and their functions more easily fall under chymical and hydraulic explanations.—(Richerand)

§ An Inquiry into the Nature and Treatment of Gravel, Calculus, and other diseases connected with a deranged operation of the Urinary Organs; by W. Prout, M. D. F. R. S.

‖ On the Chymical History and Medical Treatment of Calculous Disorders, by A. Marcet, M. D. F. R. S.

¶ Journal of the Royal Institution, Vol. VI.

** Medical Transactions of the College of Physicians, Vol. VI.

†† The ancients considered the urine as a kind of extract of animal substances, a true lixivium, by which every thing impure in the animal economy was washed away, and hence they gave it the name of Lotium.

Animal Principles.	Water	933.00
	Urea	30.10
	Lithic Acid	1.00
	Pure Lactic Acid, Lactate of Ammonia, and Animal matters not separable from these	17.14
	Mucus of the Bladder	.32
Alkaline and Earthy Salts.	Sulphate of Potass	3.71
	——— of Soda	3.16
	Phosphate of Soda	2.94
	——— of Ammonia	1.65
	Muriate of Soda	4.45
	——— of Ammonia	1.50
	Earthy Phosphates with a trace of Fluate of Lime	1.00
	Silex	.03
		1000.00

Besides the above ingredients, which appear to be essential to healthy urine, Dr. Prout observes that in different diseases it may contain Albumen, Fibrin, and the red particles of the blood; Nitric acid; various acids, which are found to be modifications of the Lithic; Oxalic acid; Benzoic acid; Carbonic acid;* Xanthic Oxide; Cystic Oxide; Sugar; Bile; and Pus.

It will be necessary in this place to make a few observations upon the nature and habitudes of those principles, which are more immediately active in the production of calculi—

1. *Urea* is a principle peculiar to urine, and must be regarded as a result of the action of the kidneys upon some of the constituents of the blood, perhaps, as Dr. Prout suggests, upon its albuminous matter. For a long time it was regarded as the peculiar principle upon which the colour and other sensible qualities of the urine depended; Berzelius however has corrected this fallacy, and considers that the Lactic acid, and its accompanying animal matters, are the bodies which impart to this fluid the characteristic smell and colour which distinguish it.†

2. *Lithic*, or *Uric*‡ *Acid.* As this principle is not found in the blood, but is constantly present in healthy urine, it follows that it must

* Mr. Brande first stated the existence of this acid in urine; but Berzelius expressed his doubts respecting the fact. The experiments of Dr. Marcet, however, are certainly favourable to the conclusion of the former chymist, and Dr. Prout informs us that he has himself seen small calculi discharged from the bladder composed principally of the carbonate of lime.

† The reader will find some interesting observations upon this subject in Dr. Prout's Treatise, p. 22.

‡ The name of Uric Acid was suggested by Dr. Pearson; it is, however, as Dr. Marcet very justly remarks, objectionable, on account of the close resemblance which the term bears to that of Urea, a substance totally distinct from Lithic Acid.

be generated by the action of the kidneys. M. Majendie* has lately endeavoured to prove that its secretion depends upon the *Azote* received in alimentary substances, and for the following reasons, *viz.* 1. Azote is a component part of *Lithic Acid*†—2. Those persons who use a large proportion of animal food, and fermented liquors, are liable to calculous disorders—3. When animals are confined to food which contains no Azote, no Lithic acid is formed—but of this anon —Berzelius and other animal chymists have supposed that this acid exists in urine in a free state; but Dr. Prout, whose arguments appear very satisfactory and decisive, is of opinion that it is always in combination with ammonia (*Lithate of Ammonia*) from which however it is very easily separated by the addition of any acid, even the carbonic, in the form of a red powder. It moreover appears to be susceptible of several important modifications, with which it behooves the pathologist to be acquainted; the profession is greatly indebted to the ingenuity and industry of Dr. Prout for some very essential additions to our knowledge, respecting the habitudes of *Lithic acid* with different bodies.

Erythric Acid. When nitric acid diluted with about an equal bulk of water, is poured upon pure lithic acid, and a moderate heat is applied, an effervescence takes place, and the lithic acid is dissolved; if we then concentrate this solution by a gentle evaporation, we obtain transparent colourless crystals, which have been found to constitute a peculiar acid, to which M. Brugnatelli has given the name of *Erythric acid.*

Purpuric Acid. Dr. Prout has discovered that if into a strong solution of the above crystals in water, whilst boiling hot, we carefully drop some pure ammonia, the solution acquires a beautiful purple‡ colour, and crystals of *purpurate of ammonia* speedily begin to form and subside. If these crystals are treated by means of potass and sulphuric acid, pure *Purpuric acid* is obtained in the form of a yellowish, or cream-coloured powder.

* Recherches physiologiques et médicales sur les causes, les symtomes, et le traitement de la gravelle, 8vo. Paris. 1818.

† Ultimate Principles of Lithic Acid.

	According to M. Berard, and adopted by M. Majendie.	According to Dr. Prout.
Azote	39.16	31.12
Carbon	33.61	40.00
Oxygen	18.89	26.26
Hydrogen	8.34	2.22
	100.00	100.00

‡ This fact derives its pathological interest from the probability that, in certain states of disease, the Lithic acid assumes this peculiar modification, giving to the sediments of urine those beautiful hues which were formerly considered by Proust, as the effect of an acid, which he named the Rosacic; now as the Purpuric acid, or rather the Purpurate of Ammonia, says Dr. Prout, is nothing more than Lithic acid modified by the action of Nitric acid, and as I have already shown that the Pink and Lateritious sediments occasionally contain nitric acid in some peculiar state of combination, the nature and origin of the colouring matter cease to be problematical.

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3. *The Phosphates.* As the Phosphoric acid and its compounds perform an important part in the generation of calculi, their origin* and history demand particular attention from the chymist. The Phosphoric acid frequently exists in the urine in a free state, when it would appear to act, like any other acid, as a precipitant of the Lithic acid; this however is not the circumstance that renders its presence formidable; it is to the abundance of its compounds that we are to look for mischief. In healthy urine the phosphoric acid appears to exist in union with soda and ammonia, and partly with lime and magnesia; the latter salts being retained in solution by an excess of acid; but the proportion of these bodies is liable to considerable variation.†

Having thus briefly noticed those particular points in the chymistry of the subject with which the therapeutic principles are more immediately connected, we shall be better prepared to examine and appreciate the several plans of treatment which have been proposed for the prevention, cure, or palliation of calculous disorders; and here the subject naturally divides itself into two parts; the one comprehending the *modus operandi* of Anti-lithics, or those remedies which prevent or correct the calculous diathesis; the other, explaining the solvent action of Lithonthryptics over concretions already formed.

The line of demarcation by which healthy and morbid urine are separated, is so slight that it is difficult to define its limits; nor would the circumstance appear to be materially important, for the boundary is daily exceeded, not only with impunity, but even without our consciousness of the event; and Dr. Prout has accordingly denominated such occasional deviations, the "*Sediments of Health.*"

The same enlightened author considers that mechanical deposites from the urine, although composed of the same general ingredients, may, in a pathological point of view, be conveniently divided into three classes,

* Whence is derived the large quantity of Phosphoric acid which is daily evacuated from the system?—The researches of modern chymistry have furnished a very satisfactory solution of this problem, by demonstrating its presence in those animal and vegetable substances which are used by us as food. *Mr. Barry*, in prosecuting his interesting and important experiments on the preparation of Pharmaceutical Extracts *in vacuo*, discovered the curious fact, that Phosphoric acid is to be found in all the extracts in a soluble state; and on extending the investigation, says he, it was ascertained that this acid, besides that portion of it which exists as phosphate of lime, is contained in a vast variety of vegetables, and more especially in those which are cultivated. Medico-Chirug. Trans. Vol. 10, p. 240.

† The urine of infants and nurses contains very little phosphate of lime and phosphoric acid; it is not until after ossification is finished, that these elements are found in abundance in the urinary fluid. That of old men, on the contrary, contains a great quantity of them; the bony system, already overcharged with phosphate of lime, refuses to admit more of it. This saline substance would ossify every part, as it does sometimes in the arteries, ligaments, cartilages, and membranes, if the urine were not to remove the greater part of this superabundant portion. In Rachitis it is by the urine that the phosphate of lime passes off, the absence of which causes the softness of bones. (Richerand.) If we might be allowed to theorise, I should say, that this disease depends upon a deficient action in the powers of assimilation, in consequence of which the phosphoric acid is incapable of entering into its assigned combinations, and is therefore eliminated as excrementitious. Dr. Glisson considered the disease to depend upon some fault in the spinal marrow, whence he termed it Rachitis, from ῥαχὶς Spina Dorsi.

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viz. *Pulverulent* or *Amorphous Sediments;* 2. *Crystalline Sediments*, usually denominated gravel; and 3. *Solid Concretions*, or calculi formed by the aggregation of these latter sediments. The first of these may be passed over, as unconnected with the present subject; the latter however constitutes an essential object of research; for a complete acquaintance with the chymical history of calculi can alone furnish the true indications of cure.

Scheele,* with whom the inquiry originated, conceived that every calculus consisted of a peculiar concrete acid, soluble in alkaline lixivia, and which Morveau denominated the *Lithic Acid;* but the subsequent researches of Fourcroy, Vauquelin, Wollaston, Pearson, Henry, Brande, Marcet, and Prout, have demonstrated the existence of *several* bodies in the composition of urinary calculi, viz. *Lithic Acid; Phosphate of Lime; Ammoniaco-magnesian Phosphate; Oxalate of Lime; Cystic Oxide;*† and *Xanthic Oxide;*‡ to which may be added an *animal cementing ingredient.* The varieties of calculi produced by the combination or intermixture of these ingredients, are represented in the following Tabular Arrangement.

* Transactions of Stockholm.

† Cystic Oxide, discovered by Dr. Wollaston in 1815: it does not affect vegetable colours, and has all the chymical habitudes of an oxide.

‡ Dr. Marcet discovered two calculi, which were not referable to any of the known species; but they are not introduced into the following table, as they may never again occur; at all events, from their extreme rarity, they cannot be considered as objects of practical interest. To one of these he has given the name of Xanthic Oxide, because it forms a lemon coloured compound when acted upon by Nitric acid. To the other nondescript calculus he has bestowed the appellation of Fibrinous, from its resemblance to Fibrine.

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A TABULAR VIEW OF THE DIFFERENT SPECIES OF URINARY CALCULI.

Species of Calculi.	EXTERNAL CHARACTERS.	CHYMICAL COMPOSITION.	REMARKS.
1. Lithic or Uric.	*Form*, a flattened oval; *Specific gravity*, generally exceeds 1.500; *Colour*, brownish or fawn like; *surface* smooth, texture laminated.	It consists principally of *Lithic acid*; when treated with nitric acid, a beautiful pink substance results. This calculus is slightly soluble in water, abundantly in the pure alkalies.	It is the prevailing species; but the surface sometimes occurs finely tuburculated. It frequently constitutes the *Nuclei* of the other species.
2. Mulberry.	*Colour*, dark-brown; *texture*, harder than that of the other species; *Sp. grav.* from 1.428 to 1.976. *Surface*, studded with tubercles.	It is *Oxalate of Lime*, and is decomposed in the flame of a spirit lamp, swelling out into a white efflorescence, which is *Quick-lime*.	This species includes some varieties which are remarkably smooth and pale coloured, resembling a *hemp seed*.
3. Bone Earth.	*Colour*, pale brown or gray; *surface* smooth and polished; *structure*, regularly laminated; the laminæ easily separating into concrete crusts.	Principally *Phospate of Lime*. It is soluble in muriatic acid.	
4. Triple.	*Colour*, generally brilliant white; *surface* uneven, studded with shining crystals; less compact than the preceding species; between its laminæ, small cells occur, filled with sparkling particles.	It is an *Ammoniaco-magnesian phosphate*, generally mixed with phosphate of lime; pure alkalies decompose it, extricating its ammonia.	This species attains a larger size than any of the others.
5. Fusible.	*Colour*, grayish-white.	A compound of the two foregoing species.	It is very fusible, melting into a vitreous globule.
6. Cystic.	Very like the Triple Calculus, but it is unstratified and more compact, and homogeneous.	It consists of *Cystic Oxide*; under the blow-pipe it yields a peculiarly fetid odour. It is soluble in acids, and in alkalies even if they are fully saturated with carbonic acid.	It is a rare species.
7. Alternating.	Its section exhibits different concentric laminæ.	Compound of several species, alternating with each other.	
8. Compound.	No characteristic form.	The ingredients are separable only by chymical analysis.	

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Let us now inquire into the circumstances under which the several substances enumerated in the foregoing table, are found to be deposited; and first of the *Lithic Acid Diathesis.* It has been already stated, that the lithic acid exists in the urine in combination with ammonia, so as to be held in solution under ordinary circumstances; if however any free acid be generated, the lithic acid is immediately precipitated, giving rise to the appearance so well known under the name of *red gravel;* from this view of the subject the lithic acid deposite must be considered as arising, not from the excess of that substance in the urine, but from a decomposition of the compounds into which it enters by the agency of a free acid. M. Majendie is therefore incorrect in attributing its appearance to the quantity of azote in the ingesta; an opinion which has been very ably controverted by Dr. Philip, in a paper published in the sixth volume of the Medical Transactions. It appears, moreover, that whatever tends to disturb the process of digestion, by favouring the production of acid, may be considered as the exciting cause of the lithic deposites; especially where the cutaneous functions are imperfectly performed; for Dr. Philip is of opinion, that the precipitating acid, in a healthy state of the system, is thrown off by the skin; and he supposes that even when generated in excess, it may be diverted to the surface of the body by merely increasing the insensible perspiration. The medical treatment of the lithic diathesis is thus rendered simple and satisfactory; and if the opinion of Dr. Prout be true, that at least two thirds of the whole number of calculi originate from lithic acid, the extreme importance of the subject is too apparent to require comment. Remedies, medicinal and dietetic, that are capable of correcting dyspeptic symptoms, such as slight bitters,* will doubtless prove valuable resources; while all those agents which have a tendency to correct and regulate the insensible perspiration, will necessarily fall under the head of anti-lithic remedies. Mr. Copland Hutchison in a paper which has been published in the Transactions of the Medico-Chirurgical Society, has shown a comparative rarity of calculous disorders in British seamen. Can the quantity of muriate of soda taken with their food, from its stimulating influence upon the cutaneous functions, be considered as affording a plausible explanation of this fact? The *Phosphatic Diathesis* seems to be accompanied with considerable derangement of the chylo-poietic viscera, and Dr. Prout very justly remarks, what I have frequently observed, that the stools are extremely unnatural; as the phosphates are retained in solution by an excess of acid, it would appear as if an alkaline principle was occasionally developed, and it is not unreasonable to suppose that this may be sometimes derived from bilious regurgitations;† in some cases, the alkali is derived from the spontaneous decomposition of urine itself, especially where the

* I am by no means disposed to reject altogether, as a popular fallacy, the general opinion in favour of the anti-lithic virtues of malt liquor; the observations which have been already offered (page 80) will explain how such agents may occasionally operate in assisting digestion. In the observations made upon the Bills of Mortality in the year 1662, by an ingenious citizen, concerning the increase of some diseases, and the decrease of others, it is observed "The Stone and Strangury decreaseth, from the drinking of Ale."

† In consultation with Dr. Baillie, some few months before his death, he said to me "although I have never published the opinon, I am satisfied that after a patient has long laboured under diseased liver, the blood becomes surcharged with alkaline matter."

bladder has lost its *governing power*,* as from some injury† of the spine; or from some local affection of the bladder or prostate gland; wherever the urine undergoes an incipient process of decomposition, ammonia will be generated, and an *ammoniaco-magnesian phosphate*‡ be immediately precipitated: hence in cases where the bladder is unable to discharge its contents, this deposite is very apt to take place, as in diseases in the prostate; and this explains the reason why the triple phosphates are so frequently formed in elderly people, who cannot wholly evacuate their bladder.

It will appear evident from these cursory observations, that some varieties of Calculi will be influenced by acids, and others by alkalies, and that the exhibition of such remedies will be liable to palliate, or to aggravate the symptoms, according to the character and composition of the offending calculus, and according to the prevailing diathesis of the patient; as a general rule to direct us in the chymico-medical treatment of these cases, Dr. Marcet states, that "*Whenever the lithic acid predominates, the alkalies*§ *are the appropriate remedies, but that when the calcareous or magnesian salts prevail, the acids are to be resorted to.*" But if it be asked how we are to discover the nature of the calculous affection, so as to direct the suitable remedy? the reply is obvious—by an examination of the sediment deposited by the recent urine, or by an analysis of the small fragments which are frequently voided with it; the Phosphates subside from the urine as a *white*, lithic acid, generally, as a *red* deposit; and since the phosphates are held in solution in the urine by an excess of acid, it is evident that whenever such acidity is diminished by the hand of nature or art, a white sabulous deposit will ensue; hence, says Mr. Brande, it occurs in the urine of persons who drink soda water, or take magnesia; the remedy of such a deposit, when it takes place habitually, is a course of acidulous medicines; on the contrary, since *lithic acid* is precipitated by the acids, alkalies are naturally suggested for the prevention of that deposit. In the *compound* calculi, acids and alkalies may be equally injurious or beneficial, for since these bodies are composed of a variety of ingredients, the action of any one solvent must be partial, and may convert the smooth calculus into a rough and highly irritating body, or vice versa. In the *alternating* calculi it may be judicious to exhibit these remedies alternately, as the symptoms of the case and the deposit of the urine may indicate. After all, however, the solvent powers of Lithonthryptic remedies must be very limited, and in advanced cases we

* See an explanation of this term in the note, at page 115

† It is, says Dr. Prout, a very old observation, that injuries of the back produce *alkaline urine*; "it also appears," continues this author, "to hold in other animals as well as in man; thus I have frequently observed jaded and worn out horses pass great quantities of lime in their urine; I have known the same also to take place in dogs, and particularly of the sporting kinds; and in both these instances have thought it probable, that the circumstance was connected with some strain or injury of the back produced by over-exertion, or other causes."

‡ I have in my possession a splendid specimen of this triple salt, in large and well defined crystals, covering a portion of a decayed beam; it was sent to me by my friend Mr. Marshall, from whom I learnt that it had been taken from a privy belonging to a public house in Southwark. I lent the specimen to the late Mr. Wilson, in order that he might exhibit it in his lectures before the College of Surgeons, and he has published a description of it in his work on the Urinary and Genital Organs.

§ A question has arisen respecting the comparative efficacy of the two fixed alkalies upon these occasions. See *Sodæ Sub-carbonas*.

can never expect to procure more than palliation. With respect to the agency of these different remedies, as *Antilithics*, I would observe, that while experience bears us out in confiding in the production of certain chymical effects from their use, we must not forget that much is to be effected by their judicious administration as *vital* agents: and it will be hereafter my duty to point out the many advantages that may be obtained, by combining in one formula, medicines which individually belong to each class.

Independent of any chymical effect, alkaline substances are found by daily experience to allay the morbid irritability of the urinary organs in a manner not yet explained; alkalies may also prove *generally* serviceable in these disorders, by acting immediately upon the digestive organs, for the disposition of forming calculi is always, more or less, accompanied with the indications of deranged digestion; and it is probable that the first link of the series of actions, which cause this disposition, has its origin in the stomach.

The alkaline carbonates are found to answer as effectually as the pure alkalies, and they have the advantage of being less liable to disagree with the stomach. Mr. Hatchett has proposed the carbonate of magnesia, in doses of ℈j to ʒj, as a valuable substitute for alkaline remedies in cases of lithic calculi; but as its insolubility must render its absorption equivocal, the beneficial operation of the substance must principally depend upon its neutralizing any excess of acid in the primæ viæ, and in this way there can be no doubt of its lithonthryptic agency; "but," says Dr. Marcet, "such is the tendency which the public has to overrate the utility of a new practice, or to take a mistaken view of its proper application, that there is every reason to believe that the use of magnesia has of late years become a frequent source of evil in calculous complaints." Lime-water has been also recommended for the purpose of fulfilling the same indications, and as not being liable to produce that irritability of stomach which frequently attends the long continued use of the fixed alkalies; besides which, some chymists have maintained that it exerts a peculiar solvent power over the cementing animal matter of the concretion, and thereby destroys its cohesion.*

Where an acid is indicated, the *Muriatic* will in my judgment be found as convenient and effectual as any that can be administered. Mr. Brande proposes *Cream of Tartar* for this purpose; upon this point I differ with him, for this salt, to say the least of it, is questionable in its mode of operation; for although its first impression upon the stomach is that of an acid, the subsequent processes of digestion decompose it, and eliminate its base, which being absorbed acts upon the urinary organs as an alkali. I have seen a white sabulous deposit, consisting of the Phosphates, in the urine of persons after the constant use of *Imperial* as a beverage, which I am at a loss to explain upon any other principle. Sir Gilbert Blane has also very satisfactorily shown, that a fixed alkali produces the same effect upon the urinary organs whether it be exhibited alone, or in combination with citric acid; in this latter case the salt undoubtedly undergoes a decomposition *in transitu*, as I have more fully explained under the consideration of Diuretics, (*page* 95.) During an alterative course of Lithonthryptic remedies it may be beneficial to in-

* For an account of the celebrated remedy of Mrs. Stephens, see *Liquor Calcis.*

terpose occasionally a purgative medicine, but we must not combine it with the lithonthryptic, at least, if we wish this latter medicine to reach the urinary passages; for it is a law which I have already attempted to establish (*see page 96,*) that *Catharsis suspends the process of alimentary absorption.*

There remains to be considered another mode of applying a solvent, and which would seem on the first view of the subject to be full of promise,—that of injecting the proposed menstruum into the bladder. Unfortunately, however, the irritable state of this organ will generally preclude the possibility of preserving the menstruum, for a sufficient length of time, in contact with the calculus to accomplish any material solution; nor am I aware that any case, in favour of such a practice, stands recorded. An ingenious and novel application of the powers of Electro-chymistry has been lately* proposed by MM. Prevost and Dumas, as capable of affording means for the solution of the calculus within the bladder; the suggestion is highly plausible, and ought not to be hastily rejected without trial. Could the functions of the part be protected against the influence of so powerful an agent, it is evident that, by a galvanic battery of sufficient intensity, a calculus composed of alkaline or earthy salts might be transferred from the bladder by the simple introduction of a double sound, communicating on one hand with the calculus, and, on the other, with two vessels filled with water, in which are plunged the opposite poles of a galvanic apparatus.† This arrangement would transfer the acid constituents into the vessel connected with the *positive* end, and the bases into that of the *negative* end. So far, however, as the experiments have hitherto been carried, this degree of galvanic operation would seem to excite too much irritation in the bladder to be admissible; but it still offers a resource of an apparently more practicable nature. This consists in giving to the calculus a tendency to crumble from the slightest force; such a friability, in short, as shall render it easily broken into pieces sufficiently small to be evacuated through the urethra, especially by the aid of dilating that passage, an operation upon which much has lately been said and written. A fusible calculus from the human subject was submitted to the action of a pile, consisting of 120 pairs of plates, for twelve hours in succession. The platinum wires, constituting the poles, were placed in contact with the calculus, about six or eight lines distant from each other, and the whole plunged in a vessel filled with pure water. During the galvanic action, the bases and phosphoric acid first arrived at their respective poles, then re-entered into combination, when the salt thus reformed was precipitated in the state of powder. The calculus weighed 92 grains before the experiment, and was reduced at its termination to 80. The process being continued, at the end of sixteen hours it presented a mass of such friable texture as to be reduced into small crystalline particles by the slightest pressure; the largest of which did not exceed the size of a lentil, so that it might have easily passed through the urethra.

In order to ascertain how far this decomposition could be effected in the living body, the ingenious experimentalists selected a dog of rather

* Journal de Physiologie; Juillet, 1823.

† For a farther account of this extraordinary law of Electro-Chymistry, the reader may consult my work on the ELEMENTS OF MEDICAL CHYMISTRY.

large size, into whose bladder they introduced a fusible calculus attached to a sound, and between two conductors of platinum; the bladder was next distended by injecting tepid water, and the apparatus subjected to galvanic influence. After a little struggling, the animal became calm, and was subjected to the operation during an hour. On removing the sound, the calculus showed unequivocal marks of decomposition. The same process was repeated, night and morning, during six days, when the friability of the calculus rendered it impossible to continue the experiment. It had lost weight in the same proportion as in the preceding trial. The bladder, which was afterwards examined, exhibited no appearance of injury or disease.* The authors assert that this organ does not suffer any inconvenience from this more moderate degree of galvanic action, and suggest, as a proof of the mildness of its influence, that we should immerse the tongue in a vessel filled with water, in which a calculus is undergoing decomposition, and it will be found that the tongue, which is far more sensible than the bladder, will scarcely perceive the galvanic action, even when decomposition is going on briskly. The authors add, that this process cannot offer any advantage for the removal of those calculi which consist wholly of *Uric acid*, or which contain a large proportion of it.†

ANTIDOTES.

Synon: *Alexipharmics. Alexiterials. Counter-poisons:*

Medicines which are capable of preventing the ill effects of a poison; or, of counteracting its fatal virulence.

There is perhaps no subject upon which the credulity of mankind has been so extravagantly exercised as on that of Poisons; nor is there, certainly, any class of remedies whose history has suffered so many vicissitudes from the caprice of hypothesis, as that of Antidotes.‡

It is not my intention, on the present occasion,§ to enumerate the many extraordinary virtues|| which credulity has, at different times, assigned to such medicines; nor shall I consume the time of the reader by attempting to expose the absurdity of those fearful powers with which

* These experiments have been repeated at the Jardin des Plantes, with similar results; it farther appears that a certain quantity of *Nitrate of Potass* added to the water injected into the bladder will expedite the decomposition.

† This, it must be confessed, is singularly unfortunate, if the opinion already expressed be true (page 120) viz. that at least two thirds of the whole number of calculi originate from this acid.

‡ The word *Antidote* is derived from ἀντὶ, *against*, and δίδωμι, *I give*; as being a medicine given *against* poison, either by way of cure or preservative. The word is also sometimes used in a more general sense, for any compounded medicine; thus *Peter Damian* speaks of a person who in his whole life never took an antidote. It is likewise used by some authors in a less proper sense, for any remedy against any disease, chiefly if it be inveterate, and arise from some ulcer or abscess; and lastly, the term has been used to signify a perpetual form of medicines, otherwise called *Opiates*, or more properly *Confections*.

§ The reader will find this subject treated more fully in the second volume of my work on Medical Jurisprudence.

|| See the history of *Theriaca* at page 28, note.

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ignorance, terror, and imposture, have invested certain poisons,—a subtlety so extreme as to defeat the most skilful caution, and a virulence so manageable as to be capable of the most accurate graduation; so that while the former attribute was believed to ensure their deadly operation, although exerted through the most secret and least suspicious medium, as that of gloves,* tapers, or letters, the latter was said to enable the accomplished assassin to measure the allotted moments of his victim with the nicest precision, and to occasion his death at any period that might best answer the objects of the assassination.†

The abandonment of such notions may be considered as one among the many advantages which have arisen to medicine, from the cultivation of physiology.

Without farther introduction, I shall proceed to the main object of this work, and inquire how far a *chymical* agent may be capable of neutralizing, or of decomposing, a poisonous substance in the human body; and endeavour to ascertain the degree of confidence to which it may in each particular case be entitled; equally important is it to learn, whether certain *vital* agents may not be serviceable in cases of poisoning, either by promoting the elimination of the poison, or by producing a state of the system best calculated to resist its deleterious operation.

It may be safely asserted that we possess very few true antidotes; for although several of the mineral poisons may be neutralized or decomposed by various re-agents, yet their destructive action is generally so rapid, that the mischief is effected before any chymical changes can avail; and, in other cases, the substances resulting from the chymical action, are as poisonous as the original ingredients, as in the case of the decomposition of *Corrosive Sublimate*, by the alkalies and earths, when the precipitated oxide is as virulent as the original salt; while, under certain circumstances, I suspect that the vital powers of the stomach are in direct opposition to those changes and decompositions which so readily, and so uniformly, take place in our laboratories. To *vital agents* then, the practitioner must principally look for succour; but before we can establish any general rules for the treatment of poisoning, it is essential to distinguish between the different modes in which poisonous substances produce their effects, or at least to determine the parts of the

* JOHN, king of Castille, as Tissot relates, was poisoned by a pair of boots, prepared by a Turk; HENRY IV. by gloves; LOUIS XIV. fearing a project to poison PHILIP V., prohibited his opening letters, or putting on gloves (*Tissot Traite des Nerfs, T. 1, P. 11, page 13;*) Plouquet has the following remark upon this subject. "Huc et ignota illa venena pertinent, quibus epistolæ chirothecæ, et ejusmodi infici, et vim adeo toxicam induere dicuntur, ut lectio ejusmodi epistolæ, indutus chirothecæ subitam mortem causentur." (*Comment Med. super Homicid.* page 184.) POPE CLEMENT VII. is said by Zacchias to have been poisoned by the fumes of a taper, (*Quæst. Med. Leg.*) and a priest is reported to have offered to destroy QUEEN ELIZABETH by poisoning her saddle. (*Sir Edward Coke, in the trial of Sir John Hollis.*) Bishop Burnet, in the history of his own times (vol 2. p. 230.) says, that some believed CHARLES the Second to have been poisoned through the medium of snuff.

† This conceit does not appear to have been confined to the ignorant alone, for we learn from Spratt's History of the Royal Society, that very shortly after the institution of that learned body, a series of questions was drawn up by their direction, for the purpose of being submitted to the Chinese and Indians, which clearly shows their belief in the possibility of such an operation, viz. "Whether the Indians can so prepare that stupifying herb, Datura, that they make it lie several days, months, years, according as they will have it, in a man's body, without doing him any hurt, and at the end kill him, without missing half an hour's time?"

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living system through which they act; for it will be found, that each poison has its own *modus operandi*, from which alone can be derived the particular indications of cure.

The hypotheses devised by the ancient physicians, to account for the destructive powers of these substances, were principally derived from mechanical notions respecting the supposed form of their particles, which they imagined capable of lacerating and disuniting the animal fibres by the sharpness of their spiculæ;* it is, however, now satisfactorily established that the action of a poison in the human stomach is very rarely, if ever, *mechanical;* sometimes *chymical;* but for the most part *vital* in its operation.

Each of the three kingdoms of Nature furnishes a number of poisons, the investigation of whose chymical properties and physiological actions, and that of the symptoms to which their administration gives rise, the lesions of structure which they occasion, and of the medical treatment which they require, constitutes an elaborate branch of science, designated by the term Toxicology, and of which I have more fully treated in my work on Medical Jurisprudence.

Poisons differ materially from each other, not only with respect to the modes in which they produce their effects in relation to the several vital organs, but with respect to their application; some of those, for instance, which, if introduced into a wound, are speedily fatal, may be taken into the stomach with complete impunity, as in the instance of the venom of the viper and other snakes, which appears to exert no influence on the stomach; others, on the contrary, display their deleterious action on the stomach alone, such as caustic acids, and alkalies, corrosive sublimate, and some chymical poisons; while others, again, are equally destructive whether applied to the inner surface of the stomach, or to the lower intestines, in the form of clyster, or even to the mucus membrane of the mouth or nose; to the eye; to the vagina and orifice of the uterus, or to an abraded portion of the skin. There is, moreover, a class of substances which may be termed *Aerial* poisons, for they may exist in the state of gas, or be held dissolved in the atmosphere, and be received by respiration, or by the mucus membranes of the nose and throat; the saliva may also thus become the medium for transferring various subtile poisons from the atmosphere to the animal body; this is well illustrated by the fact of the transfer of metallic influence, as related in the case of a gentleman in perfect health who became salivated in consequence of sitting for one hour by the side of a person who was in a state of mercurial ptyalism, in order to give him a lesson in botany.

It also deserves notice, that a poison acts with different degrees of force and celerity in different parts of the same tissue; its absorption, for instance, would appear to be energetic in proportion to the number of veins,† although several apparent exceptions to this law might be ad-

* Dr. Mead adopted this opinion, but he became so convinced of its inadequacy that, in the later editions of his work on Poisons, he withdrew the hypothesis. It is hardly necessary to observe that upon its abandonment, a host of popular antidotes at once fell into disuse; for as long as the injury was supposed to arise from mechanical irritation, oils, fats, and other similar remedies were held capable of obtunding the acrimony. So has the abandonment of other conceits and hypotheses cleared away many absurd articles from the list of Antidotes; see page 26.

† The introduction of poisons into the body through the medium of the circulation of the blood is frequently alluded to by the physiologists of the seventeenth century.

duced, and it is evident that the plethoric state of the part with respect to its blood-vessels has a considerable share in modifying the effects; this observation, however, has no relation to those poisons which operate on the system through the sympathetic communication of the nerves; Mr. Brodie, for instance, found that the poison of bitter almonds acted more speedily when applied to the tongue than when injected into the intestine, though the latter presents a much better absorbing surface.

Foderé in the fourth volume of his *Medicine Legale*, arranges poisons according to their action on the living system, and which, with a slight alteration in the order of the classes, has been adopted by *Orfila*, and most other writers on Toxicology. Poisons are thus reduced into six classes: viz. 1. Corrosive or Escharotic, as the *Preparations of Mercury*, *Arsenic*, *Antimony*, *Copper*, *Tin*, *Zinc*, *Silver*, *Gold*, and *Bismuth*; the *concentrated Acids*, and *caustic alkalies*, and *Earths*; *Cantharides*; *glass and enamel powder*; *diamond dust*.* 2. Astringent Poisons, of which the *preparations of Lead* constitute the only species. 3. Acrid or Rubefacient Poisons, which, with a few exceptions, are furnished by the vegetable kingdom, as certain *drastic purgatives*, *Hellebore*, *Euphorbium*, &c. 4. Narcotic Poisons, *Opium*, *Henbane*, the *Cherry-laurel*, *Stramonium*, &c. 5. Narcotico-Acrid, embracing such articles as produce the united effects of the two former, and which constitute some of the most deadly poisons, as the *Ticunas*, *Nux-vomica*, *Belladonna*, *Tobacco*, *Hemlock*, *Digitalis*, &c. 6. Septic Poisons, *contagious miasmata*, *pu-*

I have lately met with a curious passage in a work entitled "Popular Errours in Physick, first written in Latine by the learned physitian, James Penrose, Doctor in Physick. London, 1651." "The venome is carried by the veines and arteries, as appeares in that all the blood of them that have been bitten by a viper doth turne into a pale greennesse. And seeing that the veines in the papps are so very slender, and doe not come unto the heart, but with a great many long windings, I affirme, and it is more probable, that if the viper be applyed to the feet, which are farthest remote from the heart, it will sooner infect the heart than if to the papps, but soonest of all if it be applied to the armes. And now the story of Cleopatra comes to my minde. Petrus Victorius blames the painters, that paint Cleopatra applying the aspe to her papps, seeing it is manifest out of Plutarch in the life of Antonius, and out of Plinie likewise, that she applyed it to her arme. Zonarus relates that there appeared no signe of death upon her, save two blue spots on her arme. Cæsar also in her statue which he carryed in triumph, applyed the aspe to her arme; for in the armes there are great veines and arteries, which do quickly, and in a straight way convey the venome to the heart, whereas in the papps the vessels are slender. And therefore in Saint Paul the miracle was so much the greater, in that he felt no harme from the viper, which layd hold on his hand, for if it had assailed him on the breast, he had had respite enough to take some antidote."

* There can be no doubt but that death has been produced by the mechanical operation of various insoluble bodies, although we cannot believe the numerous tales recorded on the subject of diamond dust (supposed to constitute the basis of the celebrated "Powder of Succession") or of powdered glass, &c. Numerous cases are recorded where life has been destroyed by the lodgement of substances in the intestines; and we have lately heard of the fatal effects produced by alvine accumulations from the habitual use of Magnesia. With respect to the danger from the ingestion of glass and enamel in powder, there still exists much difference of opinion; Caldani, Mandruzzato, and M. Le Sauvage, report experiments made upon men and animals, in which no bad consequences followed; on the other hand, Schurigius (Chylologia) and Cardanus (De Venenis) cite instances where persons have died of ulcerations of the stomach from such causes; and M. Portal, Foderé, (Medicine Legale) Plouquet (Comment. super Homicid.) Stoll, (Ratio Medendi, part vi, p. 60) Gmelin (Hist. General de Ven. mineral.) Frank (Man. de Toxicol.) furnish testimony in support of the opinion which assigns to such bodies a highly deleterious action.

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trid exhalations from animal matter, Sulphuretted Hydrogen, the venom of the viper, &c.

The value of this classification has been very justly stated to consist in its combining to a certain degree, the advantages of a pathological arrangement with those of one founded on the basis of Natural History; for, while it is strictly pathological, it at the same time distributes the different poisons, with some few and unimportant exceptions, in an order corresponding with that of their natural history. The First two classes, for instance, present us with substances of a mineral origin; the Third and Fourth, with those which are chiefly of a vegetable nature; and the Sixth, with objects principally belonging to the animal kingdom. The importance of acknowledging a division, which has a reference to the organic and inorganic kingdoms of Nature, is considerable in a chymical point of view; for in enumerating the various experiments to be instituted for the detection of poisons, we are thus enabled to bring together a connected series of processes, nearly allied to, intimately connected with, and in some respects mutually dependent upon, each other. At the same time it must be acknowledged, that this classification has many defects and some fallacies. In the first place, it has little or no reference to the enlarged views of the modern physiologist, respecting the "*modus operandi*" of Poisons; nor indeed is its construction susceptible of such modifications and improvements, as can ever render its degree of perfection progressive with the advancement of science. In the next place, the classes are in many particulars ill defined, and indistinctly, if not erroneously, divided. How questionable, for instance, are the boundaries which separate *Corrosive* from *Acrid* poisons? the respective species, even, of each class are, in many cases, less allied to each other, than are the great divisions to which they are subordinate. As an exemplification of this fact we have only to compare the physiological actions of *Arsenic* and *Corrosive Sublimate*, both of which are arranged under the class of Corrosive Poisons. The former of these substances undoubtedly occasions death by being absorbed, and thus acting as a vital agent; the latter, by its local action, as a caustic on the textures with which it immediately comes into contact. In the same manner, if we examine the individual actions of the different species composing the class of "*Acrid* Poisons," we shall discover the same want of uniformity; thus, the *Spurge Flax*, and the *Iatropa Curcas*, act by occasioning a local inflammation, while the *Hellebore*, being rapidly absorbed, exerts a fatal action on the nervous system, and produces only a very slight inflammation. The class of Narcotic Poisons is certainly more absolute in its definition, and more uniform in its physiological affinities, and therefore less objectionable than the divisions to which we have just alluded; but the propriety of the class "*Narcotico-Acrid*" is by no means equally unexceptionable; indeed Orfila himself questions it, "because the narcotic or sedative effects only follow the previous excitement." Some of the poisons of this division also are rapidly absorbed, and act, through the medium of the circulation, on the nervous system, without producing any local inflammation; while others, on the contrary, merely act upon the extremities of the nerves, with which they come in contact, and, without being absorbed, occasion death by a species of sympathetic action.

These few objections, and many more might be urged, are sufficient to

demonstrate the imperfection of the classification under consideration, and which must render it wholly unavailable to the physician in the treatment of cases of poisoning, who must derive his plan of cure from the physiological action of the substance against which he has to contend; thus, for instance, *Arsenic* and *Corrosive Sublimate* are both corrosive poisons, but so materially do they differ from each other in their physiological actions that, when swallowed, they will require for the preservation of the individual, a very different system of treatment.

For such reasons I have ventured to propose a new arrangement of Poisons, which may furnish the practitioner with a general theorem for the administration of Antidotes.

The *First Class* of our arrangement comprehends such poisons as operate, through the medium of the nerves, upon the organs immediately subservient to life; in their application it is obvious that they cannot require to be introduced into the stomach; they may convey their destructive influence by an application to any part duly supplied with nerves, and whose extremities are exposed to their action. It had been long admitted that a poison might occasion death, by acting on the nerves of the stomach and intestines without being absorbed; but to the experimental labours of Mr. Brodie* we are principally indebted for our present correct views of the subject. The class admits of two important divisions, into one comprehending those poisons which destroy the functions of the brain, and into another, including those which direct their influence upon the heart. We shall offer a few observations upon the facts which have suggested such a division, and upon the practical advantages which may attend its adoption.

It was observed by *Bichât*, and the observation has been fully confirmed by *Brodie*, that the influence of the brain is not *directly* necessary to the action of the heart; and is *immediately* necessary to life only because the muscles of respiration owe their action to its influence.† For when the functions of the brain are destroyed, even when the head is removed, the heart continues to contract for some time afterwards, and then ceases only in consequence of the suspension of respiration, which is under the direct influence of the brain. Assuming this as a fact, it will appear evident that certain poisons may, by affecting the brain, so paralyze the muscles of respiration as to occasion death by suffocation, and by such a mode of operation I imagine that those substances, arranged in the former division of my first class, prove mortal. *Mr. Brodie* accordingly found that, by the administration of a large dose of alcohol to a rabbit, the pupils of its eyes became dilated, the extremities convulsed, and the respiration laborious, and that this latter function was gradu-

* See "Experiments and Observations on the Different Modes in which Death is produced by certain Vegetable Poisons." By B. C. Brodie, Esq. F. R. S in the 181st Volume of the Philosophical Transactions for the year 1811

† M 'Lallemand has published the history of a fœtus, in which the brain and spinal marrow were equally deficient, notwithstanding which, it even exceeded the usual size, the heart was also perfect, and it was evident that the circulation had been properly performed. No sooner however was the monster born than it perished, because the diaphragm and other muscles of respiration were unable to perform their functions without the aid of nervous excitement; no air was therefore inhaled into the lungs, and in a few minutes the heart ceased to contract from the deficient supply of oxygenized blood. See MEDICAL JURISPRUDENCE, Vol. ii. "On the Physiological Causes, and Phœnomena of Sudden Death."

[*To face page 214.*]

A SYNOPTICAL TABLE OF POISONS,

NEWLY ARRANGED

ACCORDING TO THE DIFFERENT PRIMARY OPERATIONS, BY WHICH THEY PRODUCE THEIR EFFECTS,

With a view to furnish a General Theorem for the administration of Antidotes.

CLASS I. POISONS WHICH ACT PRIMARILY, THROUGH THE MEDIUM OF THE NERVES, WITHOUT BEING ABSORBED; OR EXCITING LOCAL INFLAMMATION.

Order 1. *By which the functions of the Nervous System are suspended, or destroyed.*

(*Death by Suffocation from paralysis of the Respiratory muscles.*)

Alcohol.	Essential Oil of	Opium ?†
Aconite.	Almonds.†	Salts of Lead ?
Oil of Tobacco.	Camphor.†	Croton Tiglium.‡

Order 2. *By which the heart is rendered insensible to the Stimulus of the Blood.*

(*Death by Syncope.*)

Infusion of Tobacco. Upas Antiar.

CLASS II. POISONS WHICH, BY ENTERING THE CIRCULATION, ACT THROUGH THAT MEDIUM, WITH DIFFERENT DEGREES OF ENERGY, ON THE HEART, BRAIN, AND ALIMENTARY CANAL.

(*Death in many forms.*)

Arsenic.	Meadow Saffron.	Prussic Acid.
Emetic Tartar.	Squill.	Deadly Nightshade.‡
Muriate of Baryta.	Opium ?‡	Hemlock.
Hellebore.	Lettuce.	Camphor.‡
Savine.	Henbane.	Coculus Indicus.

CLASS III. POISONS WHICH, THROUGH THE MEDIUM OF THE CIRCULATION, EXPEND THEIR ENERGIES UPON THE SPINAL MARROW, WITHOUT DIRECTLY INVOLVING THE FUNCTIONS OF THE BRAIN.

(*Death by Tetanic Convulsions.*)

Nux Vomica—and the whole tribe of *Strychnus.*

CLASS IV. POISONS WHICH PRODUCE A DIRECT LOCAL ACTION ON THE MUCOUS MEMBRANE OF THE ALIMENTARY CANAL.

(*Death by Gangrene.*)

Corrosive Sublimate.†	Cantharides.
Verdigris.	Bryony.
Muriate and	Elaterium.
Oxide of Tin.	Euphorbium.
Sulphate of Zinc.	Colocynth.
Nitrate of Silver.	Hedge Hyssop.
Concentrated Acids.	Ranunculi.
Caustic Alkalies.	Nitre.

† This mark denotes that the substance, against which it is placed, may also act by being absorbed.
‡ Signifies that the article has also a local action.

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ally performed at longer and longer intervals, and that it at length entirely ceased. Two minutes after the apparent death of the animal, he opened the thorax, and found the heart acting with moderate force and frequency, *circulating dark coloured blood;* he then introduced a tube into the trachea, and produced artificial respiration by inflating the lungs, and he found that by these means the action of the heart might be kept up to the natural standard, as in an animal from whom the head is removed. The same phenomena resulted from the injection of two drops of the *Essential Oil of Bitter Almonds,* diffused in half an ounce of water, into the rectum of a cat; and from the application of the empyreumatic oil of *Tobacco* to the tongue, and rectum of cats and dogs. Now it is obvious that the functions of the brain are immediately disordered by the influence of these poisons on the tongue, stomach, and lower bowels of animals, so instantaneously, that it is impossible absorption should have already taken place.

Although the general proposition seems to be established, that the brain is not *immediately* necessary to the action of the heart, yet it must not lead us to the conclusion that the heart is therefore incapable of being affected by violent impressions on the nervous system; the fact is quite otherwise, for although the brain may be removed, and the circulation be nevertheless maintained by artificial respiration, yet an injury of another kind inflicted on the brain, may be followed by those immediately fatal consequences which decapitation itself would not produce; thus is a blow on the head commonly followed by syncope, and there are certain poisons that would seem to act in the same manner, such is the *infusion of tobacco,** which suspends the action of the heart long before the animal ceases to respire, and kills by producing syncope, although in this latter case it has been questioned whether the spinal marrow may not be primarily affected, which has been shown by recent experiments to have an intimate relation with the action of the heart. Be this as it may, it is sufficiently obvious, that the second division of the first class is sanctioned by theory, and confirmed by experiment.

We come now to speak of the Second Class,—of those poisons which enter the circulation, and act through that medium on the heart, brain, and alimentary canal. These organs, however, are affected in very different degrees by different poisons, or even by the same poison, under different circumstances. *Mr. Brodie* has shown that vegetable poisons, although when introduced into the alimentary canal affect life, in consequence of the nervous sympathy which subsists between these surfaces and the common sensorium, yet, that the same poisons applied externally to a wound, produce their effects exclusively through the medium of

* It is a very curious fact, that the *Oil* of Tobacco should differ so essentially in its physiological action from the infusion of that vegetable poison; the former we have stated, affects the brain only, the latter we now learn, when taken into the alimentary canal, suspends the action of the heart. This apparent anomaly at first led Mr. Brodie, as he has since informed me, to suspect the accuracy of his experiments: and I suggested to him, whether a probable explanation might not be derived from the late chymical researches into the composition of tobacco, which have shown the existence of two active principles, viz. *Nicotin,* and an *Essential Oil?* Where an infusion is employed, we seem to obtain the influence of the former, and the effects are displayed upon the heart; but where the oil is applied, the *Nicotin* has been removed, and the brain is the organ principally affected—see Tabaci Folia.

the circulation, being conveyed to the brain only by mixing with the blood in its vessels, and not by being conveyed through the lymphatics, for a ligature upon the great blood-vessels prevents their producing deleterious effects; whereas a ligature upon the thoracic duct, or general canal through which all the absorbents pour their contents into the blood, does *not* in the least retard or prevent the operation of the poison. There are also several of the mineral poisons which, whether introduced into the stomach, or applied externally to a wound, poisons the animal in consequence of being carried into the circulation. It had long been supposed that Arsenic occasioned death by inflaming the stomach; but *Mr. Brodie* has very satisfactorily shown that its influence arises from its absorption, and that it must be regarded rather as a *vital*, than as a *chymical* agent. In the first place, he has found the inflammation of the stomach, in several cases, so slight, that on a superficial examination it might have been easily overlooked, and, in most of his experiments with Arsenic, death took place in too short a time to be considered as the result of inflammation; and in the next place, in whatever manner the poison is applied, whether *externally* to a wound, or *internally* to the membrane of the stomach, the inflammation is confined to the stomach and intestines; and, indeed, it is commonly more violent, and even more immediate, when applied to a wound, than when internally administered; and it also precedes any inflammation of the wound. This important fact was proved by an experiment made by Mr. Hunter and Sir Everard Home, and subsequently by the repeated investigations of Mr. Brodie.

It has been just stated that after a poison has found its way into the circulation, it expends its virulence upon some particular organs. In some cases this is much more striking than in others. The preparations of *Baryta*, and of *Tartarized Antimony*, attack the heart, and occasion death by syncope. *Arsenic* is less definite in its action, it influences both the brain and the heart, but with different degrees of force in different cases, so that it is often difficult to ascertain which of these organs is the first to fail in its functions. *Hydro-cyanic Acid* is absorbed, and destroys life by its action upon the nervous system, whose energies it would seem to extinguish without any ostensible injury to the respiration and circulation; for in all those animals which were killed by it in the experiments of *Orfila*, *Brodie*, and others, the heart was found acting regularly, and circulating dark-coloured blood; and in some cases, this phenomenon was visible for many minutes after the animal was in other respects apparently dead.

Some substances would seem to direct their powers to various parts of the alimentary canal; and the appearances so produced might be mistaken for the effects of the local action of the poison, had they not been clearly proved by experiment to have arisen from an application addressed through the medium of the circulation; thus is inflammation of the *primæ viæ* induced by the contact of Arsenic with an external surface of the body!

The *Third Class* of my arrangement includes those poisons which enter the circulation, and, through that medium, expend their influence upon the spinal marrow, without *directly* involving the functions of the brain. *M. Majendie*, in the year 1809, submitted to the first class of the

French Institute a series of experiments which had conducted him to the extraordinary result above stated. He found that an entire class of vegetables (the *bitter Strychnus*) possesses this singular property.

The *Fourth Class* comprehends all those substances which destroy life by a local action upon the alimentary canal, not by any impression upon their nerves, but by simply inducing a fatal lesion in the membranes.

Through one or more of the above modes of operation all poisons may be said to produce their fatal effects. In some cases a poisonous substance will be found to act in several different ways; thus, the *Nightshade* is evidently absorbed, carried into the circulation, and is enabled, through that medium to act upon the brain; at the same time it exerts a local action upon the stomach, although less violent than that occasioned by the acrid poisons; it moreover would appear, upon some occasions, to act directly through the medium of the nerves, like those substances which have been received in our first class, or else, how shall we explain the fact of the pupil of the eye becoming permanently dilated by the contact of the *Belladonna* with the tunica conjunctiva? It would appear therefore that this plant unites within itself all the three great modes of action, upon which I have just attempted to establish a physiological arrangement of poisons. So again, *Corrosive Sublimate*, although placed in the fourth division, as being a substance which destroys by inflicting local mischief, is nevertheless capable of being absorbed. The embarrassments, however, which might be supposed to arise from this double mode of operation, are of but trifling importance. It is to the primary operation of a poison to which we are to direct our attention, the subsequent effects are less important in as much as they are more capable of being controlled.

Having thus offered a summary of our present views respecting the physiological action of poisons, we are prepared to lay down a general plan of treatment, which, it will be seen, can only be successful when conducted on principles strictly conformable with the just notions which the preceding experiments have so satisfactorily established.

Where a poisonous substance has, either through accident or design, found its way into the alimentary canal, three important indications are, if possible, to be fulfilled; and under these heads I shall offer such observations as may serve to instruct the practitioner in the philosophy of the general treatment, reserving the details to be observed in that of each poison, for more particular notice in the second part of the work, where the history of these substances will be individually considered. The indications to which I allude are the following, viz.

1. *The immediate ejectment of the poison from the body, by the operation of vomiting and purging.*

Whatever may be the nature of the poison, we should endeavour with all possible expedition, to eject it from the body; and upon the promptness with which this is effected, the safety of the patient will generally depend; for the dangerous effects of such substances advance in a very increasing ratio, with the time they remain in contact with a living surface. A question may arise, whether in some cases it would not be judicious to attempt in the first instance the neutralization or decomposition

of the poison; where a mineral acid, or a caustic alkali has been swallowed, it would undoubtedly be right to neutralize, and dilute it, as soon as possible, and then to excite vomiting, which may be advantageously effected by thrusting the finger down the throat, or by tickling the internal fauces with a feather: where an emetic is at hand, whatever may be its nature, it should be promptly given, but if circumstances will allow us the opportunity of selection, *Antimony*, *Ipecacuanha*, *&c.*, should be rejected, and *Sulphate of Zinc*, or *Sulphate of Copper*, for several reasons, be preferred; in the first place they do not require much dilution* for their action, a circumstance of no small importance in the treatment of poisons that act by being absorbed; in the next place, they are extremely expeditious, a dose of fifteen or twenty grains producing almost instantaneous vomiting, without exciting that previous stage of nausea which so frequently characterizes other emetics, and which occasions a state of the vascular system highly favourable to the function of absorption, (as I have so fully explained at page 89.)

The practice of emptying the stomach by means of a syringe, as proposed by Boerhaave, has lately been revived with all the confidence of a *new* invention. There are cases of narcotic poisoning in which there can be no doubt it would furnish the practitioner with a valuable resource, but I much fear that it will be found to be less successful than its more sanguine advocates have anticipated; for where the stomach has so far lost its power as to be insensible to the stimulus of a potent emetic, the chances of recovery are small; the practice, however, in such cases ought never to be neglected, for it cannot possibly do harm, and may perhaps be beneficial.

After all has been ejected, which the operations of art can effect, we are to proceed, without delay, to the fulfilment of the second indication; viz.

2. *The Decomposition of any remaining Portion, and the adoption of measures best calculated to obviate its absorption.*

Where the substance is in a solid form, and acts by absorption, we should be very cautious how we favour its solution; while, if it exists in a liquid state, our object must be to render its active portion insoluble; this problem involves a series of questions which are wholly *chymical*. In order to prevent, or retard, the absorption of the active matter, we must, to a great degree, depend upon the agency of *vital* adjuvants; this latter indication however does not apply to *Corrosive Sublimate* and other substances which act upon the stomach locally, and are not absorbed; copious dilution also, in such cases, will frequently disarm the poison of its virulence,† but it should be followed as quickly as possible by vomiting. In cases where the poison requires to be absorbed, before it can display its energies, it would be generally unsafe to adminis-

* Dry Vomit of Marriott. This once celebrated vomit, called Dry, from its being exhibited without drink, consisted of equal proportions of Tartarized Antimony and Sulphate of Copper.

† Sydenham relates a case of poisoning by Corrosive Sublimate; which was successfully treated by copious draughts of water, and repeated vomiting (Opera Medica Epist. 1, p. 200;) and Orfila, in his laborious work on poisons, presents us with a mass of satisfactory evidence upon the same subject.

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ter any solvent. Nothing therefore can be less true as an aphorism, nor more dangerous as a precept, than the unqualified assertion of Boerhaave, "*Aqua omnia venena enervat, quæ cum aqua misceri possunt.*" (Prælect. in Instit: T. vi. p. 289.) *Alkaline* solutions and *Magnesia*, in cases of the ingestion of arsenic, accelerate its fatal effects, by promoting its solution,* whereas *Lime*, or its *Carbonate*, has an opposite tendency,† in consequence of the insolubility of *Arsenite of Lime;* so again, Orfila has shown that the pernicious qualities of the *Muriate of Baryta* are counteracted by the administration of any soluble *Sulphate*, which renders the former substance *insoluble*. In cases where *Verdegris* has been swallowed, the administration of vinegar greatly increases its virulence, as M. Drouard has ascertained, by converting the substance into a soluble *acetate of copper*. This view of the subject will explain why the pure earth *Baryta* is so slow, and comparatively inert, in its effects upon the system, while its *muriate* is distinguished by the extreme rapidity and virulence with which it operates. The propriety of administering *vinegar*, *lemonade*, and different acid potations, in order to counteract the baneful effects of *Opium*, which has been so often questioned, will thus also receive ample explanation; it must appear that, if any quantity of the substance of opium remain in the primæ viæ, acid, or mucilaginous drinks will, by favouring its solution and absorption, accelerate its fatal effects;‡ but should it have been previously ejected from the stomach, that then the anti-narcotic influence of a vegetable acid§ may remove the consecutive stupor and delirium, and thus realize the expectations which Virgil has so poetically raised.

"*Media fert tristes succos tardumque saporem*
Felicis Mali: quo non præsentius ullum
(Pocula si quando sævæ infecere novercæ
Miscueruntque herbas, et non innoxia verba)
Auxilium venit, ac membris agit atra venena."

"Nor be the Citron, Media's boast unsung,
Though harsh the juice, and ling'ring on the tongue.
When the drugg'd bowl mid witching curses brew'd
Wastes the pale youth by step-dame hate pursu'd,
Its powerful aid unbinds the mutter'd spell
And frees the victim from the draught of hell."

* Circumstances, however, may occur, which will render it even judicious, with certain precautions, to administer a solvent, in order to remove the particles of the substance, which sometimes adhere with such obstinacy to the coats of the stomach as to defy the exertions of an emetic to detach them, especially if the poison be arsenic; but let the practitioner remember that this practice can never be allowed until all that can be ejected by vomiting or purging has been previously removed; then perhaps the ingestion of Magnesia, or an Alkaline Salt, as proposed by Mr. Marshall, might be admissible, but it should be quickly followed up by fresh emetics and purgatives.

† London Medical Repository, August, 1817.

‡ The truth of this statement has been very satisfactorily established by the experiments of Orfila (Toxicologie générale considerée sous les Rapports de la Physiologie, de la Pathologie, et de la Medicine légale) as well as by several that have been performed in this country.

Tortosa (Istituzioni di Med. For.) has remarked that Opium may act mortally without losing much of its weight in the stomach—I should question the truth of this assertion.

§ Vegetable acids are in Nature rarely the vehicles of poisons, the most deleterious plants being inert in those parts that are impregnated with acid; the pulp of the fruit of the Strychnus, amongst many others, offers an illustration of this fact. Virey.

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Chardin, in his travels through Persia, informs us that when a Persian finds himself in a distressed situation, he has recourse to a piece of opium as large as the thumb, and that immediately afterwards he drinks a glass full of vinegar; by which he is thrown into a fit of laughter, terminating in convulsions and death.

With regard to the use of *Antidotes*, it has been already stated how little they are to be depended upon; in certain cases, however, we are bound to acknowledge their power, but they should be very rarely trusted, unless subsequent to, or in conjunction with, the operation of an emetic; in many cases the effects of this latter remedy may be promoted by the ingestion of liquids holding the particular antidote in solution, a practice which offers the double advantage of accelerating the elimination of the poison, and at the same time of decomposing any which may remain. Orfila has fully established the fact of *Albumen* being a counterpoison to *Corrosive Sublimate;* vomiting may therefore be very judiciously promoted in cases of such poisoning by water holding the white of egg in solution; with equal effect, where *Verdegris* has been swallowed, sugared water may be used as a diluent to encourage emesis; and *Muriate of Soda* in solution will be found the most efficient antidote to *Nitrate of Silver;* and *Sulphate of Magnesia* to *Acetate of Lead.* Where an emetic salt, like *Tartarized Antimony*, has been taken, copious dilution with common water will in general so provoke vomiting, as to render it its own antidote; but it may be useful to remember, that the *Infusion of Galls*, and according to Berthollet, the *Decoctions of Bark*, at the temperature of from 30° to 40° *Fah.* have the power of decomposing it; while Orfila considers milk the most efficient counterpoison to the *Sulphate of Zinc.*

Having ejected from the stomach all the poisonous matter we can by vomiting, and attempted to decompose what remains, we are to pursue such measures as may be calculated to prevent the absorption of the poison into the circulation; it has been already observed that on this account nauseating emetics should be avoided; the reader is now requested to refer to our *exposé* of the celebrated doctrine of *Majendie*, (*page* 89, *note*) and he will see that *Venesection* proves one of the most powerful means of exciting the function of absorption: hence in poisoning by arsenic, such an expedient should never be recommended,* while a particle of that substance remains in the body; where *Corrosive Sublimate* has been swallowed, the same precaution is unnecessary. The last indication which remains to be fulfilled is—

3. *To anticipate the occurrence of the Consecutive Phænomena, and to combat them by appropriate treatment.*

This is to be conducted on the general principles of Therapeutics; the treatment must necessarily vary in each particular case. Where the

* Notwithstanding this fact, we find Venesection recommended in works on Toxicology, as a safe precaution to be used against the inflammatory action produced by arsenic.

The application of a ligature above an abraded surface to which a poison has been applied, prevents its effects upon the constitution, not so much by obliterating the capacity of the vessels, as by inducing a local plethora, and so suspending the process of absorption.

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exhaustion of nervous energy is to be feared, as after poisoning by *Prussic Acid*, ammonia, and other diffusible stimulants, together with external warmth, will furnish the best resource; for the same reason Venesection should be performed with great caution and judgment after a narcotic poison. Where, on the other hand, inflammatory action is to be anticipated, it is unnecessary to detail the plan of treatment which may be adopted with the greatest chance of success. In cases where the nervous system is stupified, the symptoms may be combatted by vegetable acids, infusion of coffee, &c., but where it is in a state of preternatural excitement, recourse must be had to opiates.

ESCHAROTICS:*

Substances whose application to the animal solids, erodes, or decomposes them.

The operation of these bodies may, in general, be considered chymical; for having destroyed the life of the part to which they are applied, they cause, as if by a species of resulting affinity, the elements of the animal matter to enter into a new state of combination; this is well exemplified in the action of caustic potass, where the nascent elements thus disengaged by the decomposition of the animal substance, reunite in proportions to generate an oily matter, which may be observed to form a film over the ulcerated surface, while the excess of nitrogen and hydrogen constitute ammonia, which is disengaged during the action of the caustic; and may be rendered sensible by inverting over the surface, a small jar moistened with muriatic acid, when the fumes of *Muriate of Ammonia* become visible.†

Their surgical value consists in their power to remove excrescences, to establish an ulcer, or to convert an ulcerated surface into a simple sore.

IV. OF MECHANICAL REMEDIES.

This subdivision includes those classes of remedies, whose operation depends entirely upon *mechanical* principles; and we must agree with Dr. Murray in considering them as the least important of all the articles which we have enumerated, and which cannot therefore constitute objects of elaborate inquiry.

* *Escharotic* from ἐσχαρόω, *crustam* induco, to scab over, to burn into a crust.

† Or in a still more striking manner, by holding over the surface of the sore a piece of white paper moistened by the mixed solutions of Nitrate of Silver and Arsenious Acid, when the disengaged Ammonia will by the operation of double affinity enable the Arsenious Acid to decompose the salt of Silver, and to display the presence of the Arseniate of that metal by its characteristic yellow indication. I am not acquainted with any test for Ammonia so summary and satisfactory as this. See Arsenicum in an after part of this work.

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ANTHELMINTICS:

Remedies which expel worms* from the intestinal canal.

It has been already stated, (*page* 91) that certain bodies have the power of increasing the peristaltic motions of the intestinal canal, by operating as mechanical stimulants upon its fibres; in this manner the filings of tin and iron, or the irritating down which covers the pods of the *Dolichos Pruriens*, are supposed to act in dislodging and evacuating the worms from the intestines. But there is a variety of remedies employed as vermifuges, which must owe their effects to a very different mode of operation; *Bitters* for instance appear to prove an absolute poison† to these animals, while they, at the same time, give an increased tone to the organs of digestion; from whose debility the generation of worms would seem to arise. Other remedies, again, obviously depend upon their simple cathartic property, for the powers which they possess in the evacuation of worms. See *Terebinthinæ Oleum—Cambogia.*

In the cure of Ascarides the local application of the remedy becomes necessary, in the form of glyster, and which acts both *mechanically* in washing out the gut, and *medicinally* in proving obnoxious to the animals, according to the experience of some of our best practitioners, a strong decoction of the *Semina Santonici* proves most efficacious upon these occasions.

DEMULCENTS:

Medicines which are capable of shielding sensible surfaces from the action of acrid matter, by involving it in a mild and viscid medium.

It cannot be denied that where these remedies admit of direct application, considerable benefit may arise; in the progress of a catarrh, we have all experienced the relief that may be occasioned by lubricating the fauces with demulcents, which, by soothing the top of the trachea, quiets, by a kind of contiguous sympathy, the whole pulmonary structure; in certain states of intestinal irritation, the same remedies have furnished considerable benefit, and in ophthalmia, relief has been obtained by the application of a demulcent to the inflamed conjunctiva, by which it is defended from the irritation of the tears; see also *Formula* 61; but in parts beyond the reach of the first passages, and to which no fluid can arrive but through the medium of the secretions, it is very difficult to explain the principle upon which their beneficial operation can depend; and it seems indeed highly probable that they act in

* There are four species of worms generated in the human intestines, viz. The Tænia, or tape-worm—Tricocephalus, or Trichuris—Ascaris Vermicularis, or Ascarides—and Lumbricoides.

† It is a very curious fact that vegetable bitter should be so essential to the well-being of the higher order of animals, as explained at page 81, and yet prove so generally destructive to insects. Flies are almost immediately destroyed by an Infusion of Quassia, and Nature has protected the ear from the invasion of insects by providing an intensely bitter secretion.

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such cases as simple diluents, for the process of digestion must necessarily deprive them of their characteristic viscidity. The administration of demulcent drinks in gonorrhæa is probably of no farther service in assuaging the *ardor urinæ*, than an equivalent quantity of pure water; although Dr. Murray observes, "it is sufficiently certain, that many substances, which undergo the process of digestion, are afterwards separated in their entire state from the blood, by particular secreting organs; and there is, continues he, no gland which has this power more particularly than the kidneys; substances received into the stomach and digested, afterwards passing off in the urine with all their peculiar properties." This is undoubtedly very true, but mucilaginous substances rarely or never pass off in this manner; if they evade the assimilative functions, they pass through the alimentary canal, and are thus eliminated. I can state, as the result of experiment, that the urine undergoes no change except in the relative proportion of its water, by the copious and repeated administration of mild mucilages. Dr. Saunders has very justly remarked that the long list of *Ptisons*, *Decoctions*, *&c.*, usually prescribed upon these occasions, generally owe their virtues to the watery diluent itself.

The pharmaceutical applications of this class of medicines constitute, perhaps, not the least part of their value, by which we are enabled to introduce acrid substances into the stomach with safety and effect; but such services will more properly fall under our notice in a future part of the work.

DILUENTS:

Watery liquors, which increase the fluidity of the blood, and render several of the secreted and excreted fluids less viscid.

There are certainly few remedies whose operation is more simple, obvious, or important; and yet there are scarcely any whose value has been more mistaken, or whose application has been so frequently perverted through the suggestions of false theory; water is the universal beverage of animals, and the necessity of its supply is indicated by thirst, a sensation which, in excess, is borne with less tranquillity even than that of hunger; in certain morbid states of the body its presence is to be regarded as indicating the necessity of copious potation; and yet how often has the prejudiced physician, under such circumstances, aggravated the pressure of disease, by adding the sufferings of Tantalus. In febrile affections, the irritation of thirst tends to keep up the disease, and hence diluents, besides the other beneficial effects which they may produce, must be regarded as important remedies. There are also diseases of the alimentary canal which may be removed by the same agents; when water is conveyed into the intestines it will have a tendency, by mixing with, and diluting the biliary secretion, to diminish its acrimony, and thus to obviate a source of morbid irritation; the dilution of the chyme and chyle may also have a salutary tendency, and favour the absorption of the finer and more nutritive parts of the lacteals; and by increasing the fluidity of the mass, expedite the numerous combinations which it is destined to undergo. The blood itself is also thus modified

in its fluidity; although it has been very truly observed that in healthy bodies, or such as are without any obstruction of the excretions, an unusual distension of the vessels cannot be produced, or at least long subsist; for it is evident that such an increased quantity of water in the blood will immediately pass off by one or other of the excretions; this effect, however, in itself, renders the operation of diluents of signal service in the treatment of the disease; in consequence, for instance, of their disposition to pass off by urine, they furnish valuable resources in diseases of the urinary organs, allaying the pain of strangury, and the irritation from an inflamed bladder. From these observations, the practitioner will be led to appreciate the value of diluents; and many of the beneficial effects which are daily experienced from the copious potation of mineral waters, are, without doubt, to be wholly attributed to simple dilution. See *Aqua*.

It is here necessary to say a few words upon the misapplication of this order of remedies. Dr. Davy found by experiment that when an animal is bled to death, the last portions of blood that flow are of a much lower specific gravity than that which flows first, in consequence of the former containing more water, which it may be inferred was derived by the increased activity of the absorbents, exerted chiefly on mucous and serous membranes. Since then venesection promotes and accelerates absorption,* it is clear that, in inflammatory diseases, where we have recourse to blood-letting, in order to diminish the volume of circulating fluids, we ought not to suffer the patient to indulge in an unrestrained use of liquids, which he eagerly demands to satisfy a thirst which, in all probability, is the natural consequence of increased absorption. In such cases, it is often better to take liquids in small divided doses, which will have the effect of moderating the thirst, without overloading the arterial system, and bringing on that tension and plenitude which are liable to be produced by swallowing too large a proportion of liquids.

In the use of water upon such occasions, it may moreover be observed, that its temperature ought to be attended to; as a general rule it may be laid down, that in the *cold* stage it should be *hot*, in the *hot*, cold, and in the *sweating*, tepid.

With regard to the value of diluents, as capable of promoting the operation of other remedies, many observations of great practical importance might be adduced; but this subject will be more properly elucidated when we come to consider the influence of solubility in modifying the activity of medicinal substances, and which constitutes a very curious and interesting object of chemico-medical inquiry.

While speaking of Diluents it may be cursorily noticed, that water appears, under certain circumstances of the body, to suffer decomposition, and to have its elements appropriated to new combinations. Count Rumford has endeavoured to prove, that the surprisingly small quantity of solid food which is sufficient for nourishment, when converted into rich and palatable soup, is owing to the culinary process having prepared the water for chymical decomposition,† and that this is ultimately effect-

* The reader is also referred to an account of Majendie's experiments as related at page 89 of this volume.

† Fish, especially those of the cetaceous tribe, constantly decompose water, and live upon its hydrogen.

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ed during the act of Digestion.* It cannot be denied that the exhorbitant potation of water has a tendency to produce fat, but this may depend upon the vascular distention which is thus occasioned. Gin drinkers, before they become materially injured by the habit, grow extremely corpulent, as may often be witnessed in unfortunate cyprians of the lower orders. Can the hydrogen of the spirit contribute to this effect?

EMOLLIENTS:

Substances whose application diminishes the force of cohesion in the particles of the solid matter of the human body, and thereby renders them more lax and flexible.

According to this definition, which we derive from Dr. Cullen, the primary operation of emollients would appear to be purely mechanical, for they are insinuated into the matter of the solid fibre, and either diminish its density, or lessen the friction between its particles; this explanation will undoubtedly apply to those emollients which consist of unctuous bodies, and which are introduced into the animal fibre by friction; but it is evident that the beneficial effects of *Cataplasms* and *Fomentations* cannot be so explained; for in these instances, none of the materials can be absorbed through the entire cuticle; and yet the relaxation and consequent ease which such warm applications produce on inflamed surfaces, is very considerable, but it must be wholly attributed to the relaxing effects of warmth and moisture upon the extreme vessels of the surface, propagated by *contiguous sympathy* to the deeper seated organs.

The operation of those substances which afford relief to excoriated surfaces by their bland qualities, as mucilaginous lotions in erysipelatous affections, is too obvious to require explanation.

Having thus investigated the manner in which medicinal substances produce their effects upon the living system, we shall be better prepared to appreciate the advantages which are to be derived from their combination with each other, and to escape the too common error of uniting in one formula, remedies which are rendered adverse by the incompatibility of their physiological actions.

* Rumford's Essays. Vol. 1, p. 194—202.

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