THE

ELEMENTS

OF

MATERIA MEDICA.

Part First.

THERAPEIA GENERALIS.—GENERAL THERAPEUTICS.

THERAPEUTICS (*Therapeia, Therapeutice, Therapeutica*, from Θεραπευω, *I cure*) is that branch of medicine which has for its object the treatment of diseases. It is divided into *general* (*Therapeia generalis*) and *special* (*Therapeia specialis.*)

Authors are not agreed as to the proper limits of Therapeutics. In the most extended sense of the word, and which I have adopted in the text, it embraces all the known means of cure, and, consequently, all surgical operations. Guersent, (*Dictionnaire de Médecine*, tom. xx. art. *Thérapeutique*. 1828) however, excludes Amputations, Lithotomy, Tracheotomy, &c. from its domains, though he includes Bloodletting, Issues, Setons, Acupuncture, and all those operations which are useful in the treatment of diseases, by producing modifications of the vital properties.

Sprengel (*Institutiones Medicæ*, tom. i. p. 7) applies the term *Iatreusologia* (from ιατρευω, *I cure;* and λογος, *a discourse*) to general Therapeutics.

ACOLOGY (*Acologia*, from ακος, *a remedy*, and λογος,) or *Iamatologia* (C. H. E. Bischoff, *Die Lehre von den chemischen Heilmitteln*. Bd. i. S. 22. Bonn, 1825) (from ιαμα, *a remedy*, and λογος,) is that department of Therapeutics devoted to the consideration of remedies.

Some authors (Sprengel; and C. H. E. Bischoff; *op supra cit.*) limit Acology to the consideration of surgical and mechanical remedies.

REMEDIES (*Remedia*, from *re* and *medeor*, I heal; *Auxilia medica*) are agents used in palliating or curing diseases.

They are of two kinds: *psychical*, or *mental;* and *somatical*, or *corporal*. The first affect the bodily functions, and influence disease by the agency of the mind; the second act on the body directly.[1]

1. REMEDIA PSYCHICA.—PSYCHICAL OR MENTAL REMEDIES.

Affections of the mind influence the corporal functions,[2] favour or oppose the action of morbific causes on the system, and modify the progress of diseases.

[1] Strictly speaking, this division may, perhaps, be inaccurate. We know that changes in the condition of the brain produce corresponding alterations in the state of mind; and it may be fairly inferred, that changes in the state of the mental faculties are necessarily associated with some molecular alteration in the cerebral substance. If this be true, all remedies are somatical or corporal. But, in the absence of direct and positive evidence of this, we may continue to speak of *mental* as distinguished from *corporal* agents, just as we speak of *functional* as distinguished from *organic* diseases.

[2] For some pertinent observations on the powerful influence of mental causes in deranging the functions of the body, see Dr. J. Johnson's *Essay on Indigestion*, 10th ed. 1840.

Their employment as therapeutical agents is necessarily limited; on account of the difficulty experienced in producing, regulating, and controlling them. Yet they are by no means unimportant, or to be neglected.

They may be conveniently divided into two sets or classes,—the one including those affections which immediately result from the presence of objects external to the mind, and which may be denominated *external affections;*—the other comprising those affections which arise in consequence of certain preceding affections of the mind itself, and which may be termed *internal affections.*[1]

Class 1. **External Affections of the Mind.**—To this division belong those phenomena or states of the mind commonly termed *sensations*, and which may arise either from influences external to the body (*external sensations,*) or from organic causes existing within the body (*internal sensations.*) They suggest, by the association of ideas, other affections, which, as they arise from preceding states of the mind, are truly internal. But, in considering external affections as remedial agents, it is scarcely possible to estimate their influence independent of the internal affections which immediately arise from them. Indeed, the great remedial value of some external affections depends on the internal affections which they suggest; as in the case of Music, the therapeutical effects of which are referrible, not to the mere perception of the sounds, but to the resulting emotions.

The mental affections of this class, which will require a brief notice, are the external sensations; viz., those ascribed to the organs of smell, taste, hearing, vision, and touch.

1 & 2. Smell and Taste.—α. An important object in the art of prescribing is to cover the unpleasant taste and smell of medicines by other substances possessed of an agreeable flavour and odour.

β. In some nervous affections we endeavour to increase the faith of our patients in the powerful agency of the remedies employed, by augmenting the odorous and sapid qualities of the substances used.

3. Hearing.—α. Monotonous noises favour sleep; as the humming of bees, the ticking of a clock, the murmur of a rivulet, a dull discourse, &c. We avail ourselves of this fact in therapeutics, and combat want of sleep by directing an attendant to read aloud to our patient.

β. Silence frequently disposes to sleep. Under some circumstances, however, it "may become a stimulus, while sound ceases to be so. Thus, a miller being very ill, his mill was stopped, that he might not be disturbed by its noise; but this, so far from inducing sleep, prevented it altogether; and it did not take place till the mill was set a-going again." (Dr. Robert Macnish's *Philosophy of Sleep*, p. 32. Glasg. 1830.)

γ. *Music* has been employed in the treatment of diseases (especially those of the mind) from very remote times (F. A. Steinbeck, *Diss. Inaug. De Musices atque Poëseos*, Berol, 1826.) The most ancient notice of its remedial use occurs in the Bible, (*Samuel*, xvi. 15—23,) where the Sacred Historian tells us that David cured the melancholy of Saul by music. This happened more than a thousand years before Christ. The ancient Greeks also had recourse to music in medicine, though Hippocrates makes no mention of it. It would appear to be principally adapted for the relief of the melancholic form of insanity; but its beneficial effects are very transitory, and have been greatly exaggerated. Esquirol (*Des Maladies Mentales*, tom. ii. p. 538. Paris, 1838) tried it at Charenton in every way, and under the most favourable circumstances, but with little success. "Sometimes," he reports, "it rendered the patients furious, often it appeared to divert them, but I cannot affirm that it contributed to their recovery. To the convalescent, however, it proved advantageous." A more recent writer (Dr. Conolly) also observes,[2] that "little regard is probably due to music as a remedial means, its effects being usually only temporary. Violent patients often become silent, and then moved to weeping, when the piano is played to them."—As, in the therapeutical employment of music in insanity, our object is to create agreeable emotions, by recalling the happy events of by-gone times, and by restoring old associations and trains of thought, particular attention should be paid to adapt the character of the music to the peculiarities of each case; for it is obvious that what may prove beneficial to one patient, may be injurious to another.

4. Vision.—α. Sleep is promoted by "the sight of any thing waving; as of a field of standing corn, or of the hand drawn up and down before the face by a mesmeriser, attracting attention much more than an object at rest." (Dr. Elliotson's *Human Physiology*, p. 608, 5th ed. 1840.)

[1] Consult Dr. Thomas Brown's *Lectures on the Philosophy of the Human Mind*, vol. i. p. 341., 2d ed. 1824.

[2] *The Report of the Resident Physician of the Hanwell Lunatic Asylum, presented to the Court of Quarter Sessions for Middlesex, at the Middlesex Sessions*, 1840.

β. Absence of light is one of the circumstances which usually dispose to sleep.

5. Touch.—α. Gentle friction[1] with the fingers, on some part of the body, disposes to sleep. Its soothing and lulling effects I have repeatedly experienced when suffering with severe headach. "I knew a lady," says Dr. Elliotson, (p. 609) "who often remains awake, in spite of every thing, till her husband very gently rubs her foot: and, by asserting to a patient my conviction that the secret of an advertising *hypnologist*, whom I allowed to try his art upon the sleepless individual, and which he did for a time successfully, was to make him rub some part of his body till he slept, he confessed this to be the fact."

β. "Gentle friction acts on the same sense; and a combination is still more effective: whence experience has taught nurses to rock, and otherwise agitate infants, while they hum them to sleep." (Ibid.)

γ. Freedom from pain and uneasiness of any kind favours sleep.

δ. In some soporose affections, as poisoning by opium, apoplexy, &c., remedies are resorted to which, by exciting the sensibility of the body, are calculated to rouse the patient. Various methods of causing pain have been devised: one of the oldest is *urtication*, or flagellation by a bunch of nettles (*Urtica dioica.*) This practice is mentioned by Celsus. (Lib. iii. cap. 2.)

Class 2. Internal Affections of the Mind.—This class includes the *intellectual states of the mind* and our *emotions*. But, as the observations which I have to make on the therapeutic employment of this class, are rather general than specific, it will be unnecessary to attempt any systematic division of the internal affections.

α. An important part of the treatment of mental affections, as well as of many corporal derangements, is *the removal of all moral or mental circumstances which either have produced or keep up the morbid condition*. This, however, cannot be effected in many cases, or only with extreme difficulty. In a considerable number of nervous and hypochondriacal affections, *appeals to the reasoning faculties* are not only useless, but, in many instances, absolutely injurious, "by exciting irritation in the mind of the sufferer, who thinks his counsellors are either unfeeling or incredulous towards his complaints."[2] In such cases no remedy is equal to *travelling*, especially in a mountainous country; for it combines the salutary influence of abstraction of mind from painful reflections, change of scene, respiration of pure air, and employment of bodily exercise. If the extent of the mental disorder, or the circumstances of the patient, preclude the trial of this remedy, *removal from home* is calculated to act beneficially, by withdrawing the patient from the influence of domestic circumstances calculated to add to, or at least to keep up, the morbid condition, and by presenting new objects to his view, which arrest his attention, and excite new trains of ideas. (Consult Esquirol, *op. supra cit.* tom. ii. p. 743.) In lunatic asylums, *seclusion* proves a simple but most valuable means of tranquillizing violent maniacs.[3] *Amusement* and *employment* are powerful psychical remedies in the treatment of the insane.[4]

β. Emotions and passions of the mind have a most powerful influence upon the disorders of the body.[5] Much of the evidence, however, which establishes the truth of this statement, is rather curious than practically useful, and as the general fact is well known and admitted, I shall confine myself to a few practical illustrations. *Hope* is a mildly stimulating or tonic passion, which may be beneficially employed in all diseases, and which proves injurious in few, if in any cases. Most patients receive with satisfaction and benefit assurances of the prospect of recovery from their medical attendant. Even in diseases of a mortal character, life may be sometimes prolonged by concealing from the sufferer the fatal nature of his malady.[6] *Faith* in the beneficial agency of the remedies employed, and *confidence* in the skill of the medical attendant, are important adjuvants in the treatment of most diseases. To them both physician and empiric owe part of their success; and it is, therefore, the duty of the practitioner to encourage these feelings in his patient by every legitimate and honourable

[1] The friction above referred to should be very light and gentle.—Strong or violent friction by the hand or horse hair gloves is used for other purposes; as, for allaying itching and irritation of skin, and promoting cutaneous circulation. Dinneford's "*Patent improved Electrical Horse-hair Renovators*" are, for these purposes, a great improvement over the ordinary horse-hair gloves.—On the subject of Friction as a remedial agent, consult Celsus, lib. ii. cap. 14.

[2] *Change of Air, or the Pursuit of Health and Recreation; illustrating the beneficial influence of bodily exercise, change of scene, pure air, and temporary relaxation, in sickness and in health.* By James Johnson, M. D. 4th ed. 1838.

[3] See Dr. Conolly's *Report* before referred to, p. 53.—*Bodily coercion* is now no longer resorted to at the Hanwell Lunatic Asylum. Farther experience, however, is still required to establish the propriety or even humanity of omitting it in *all* cases.

[4] Consult Sir W. C. Ellis's *Treatise on the Nature, Symptoms, Causes, and Treatment of Insanity*, 1838; and Dr. Conolly's *Report* before quoted, p. 51.

[5] See Dr. Wm. Falconer's *Dissertation on the Influence of the Passions upon Disorders of the Body.* 2d ed. London, 1791.

[6] For some judicious remarks, by Sir H. Halford, on the duty of the physician, in withholding from, or communicating to, a patient the probable issue of a disease displaying mortal symptoms, see *London Medical Gazette*, vol. vii. p. 602. I fully agree with the learned President of the College of Physicians, that the first duty of the physician is "to protract the life of his patient by all practical means."

means. The influence of the *imagination* on disease has long been known, and is a fruitful source of fallacy in therapeutics. Extraordinary cures have frequently been ascribed to inert and useless means, when, in fact, they were referrible to the influence of the imagination.[1] *Fear* is a depressing and debilitating passion, of whose power over disease the practitioner has sometimes availed himself. Thus, Boerhaave prevented the recurrence of epileptic attacks (brought on by a person falling down in a fit in the sight of the hospital patients,) by directing a red-hot iron to be applied to the person who should next be affected. (Falconer's *Dissert.* before quoted, p. 100.)

2. REMEDIA SOMATICA.—SOMATICAL OR CORPORAL REMEDIES.

Those remedies which act on the body directly, and which we have denominated Somatical or Corporal, admit of arrangement into four classes, as follows:

I. *Physical but Imponderable Agents*, as Light, Heat, Electricity, and Magnetism.
II. *Hygienic Agents*, as Diet, Exercise, and Climate.
III. *Mechanical and Surgical Agents.*
IV. *Pharmacological Agents* or *Medicines.*

I. AGENTIA PHYSICA.—PHYSICAL BUT IMPONDERABLE AGENTS.

1. Lux.—Light.

(Lumen.)

Physiological Effects.—Light acts as a vivifying or vital stimulus[2] to living beings. It promotes the nutritive processes of vegetables, and its absence is the cause of that curious phenomenon denominated the *sleep of plants*. A morbid condition, called *etiolation*, or *blanching*, is induced in vegetables by growing them in obscure places.[3] On animals, light operates in a two-fold manner: it promotes their development and nutrition, and it acts as a specific stimulus to the eye, as the organ of vision.[4] Privation of light disposes to inactivity and sleep. The disease, called *Anæmia* or *Hypæmia* in man, is analogous to the condition termed etiolation in vegetables; and, like the latter, is sometimes referrible to deprivation of light, combined, however, with other deleterious causes.[5] Blindness (retinitis?) occasionally results from the exposure of the eye to strong light. The effect of the sun-stroke (*coup de soleil* or *ictus solaris*,) in inducing inflammation of the brain, may be, in part, perhaps, owing to the influence of the light of the solar rays.

Uses.—In maladies characterized by imperfect nutrition and sanguification, as scrofula, rickets, and anæmia, and in weakly subjects with œdematous limbs,

[1] See Dr. Haygarth's *Of the Imagination, as a Cause and a Cure of Disorders of the Body; exemplified by fictitious Tractors and epidemical Convulsions;* in the *London Medical Review*, vol. iii. p. 28, 1800. Also, Dr. Lind's *Treatise on the Scurvy*, p. 343, et. seq.; and p. 535. 3d ed. 1772.

[2] The phrase *vivifying* or *vital stimuli* is used to designate those external conditions necessary to the maintenance of life in organized beings; such as heat, air, water, and nutriment. They are to be distinguished from the *alterative* or *medicinal stimuli*, which, while they cause temporary excitement, ultimately exhaust. (See Müller's *Elements of Physiology*, by Baly, vol. i. pp. 28 and 57.)

[3] For details respecting the influence of light on vegetation, consult J. C. Ebermaier, *Versuch einer Geschichte des Lichtes*, Osnabrück, 1799; Landgrebe, *Ueber das Licht vorzugsweise über die chemischen und physiologischen Wirkungen desselben*, p. 187, Marburg, 1834.—Also, De Candolle, *Physiologie végétale*, t. iii. p. 1069, Paris, 1832.

[4] On the influence of light on animals, see J. C. Ebermaier, *op. supra cit*; E. Horn, *Ueber die Wirkungen des Lichts auf den lebenden menschlichen Körper*, Königsberg, 1799; Landgrebe, *op. supra cit.* p. 370; and W. F. Edwards, *De l'Influence des Agens physiques sur la Vie*, Paris, 1824, p. 394.

[5] See the case of the workmen employed in a French coal-mine, detailed in the *Dictionnaire de Médecine*, art. *Anémie;* and M. Andral's *Treatise on Pathological Anatomy*, translated by Drs. Townsend and West, vol. i. p. 97.—"When a gardener wishes to etiolate, that is, to blanch, soften, and render juicy, a vegetable, as lettuce, celery, &c., he binds the leaves together, so that the light may have as little access as possible to their surfaces. In like manner, if we wish to etiolate men and women, we have only to congregate them in cities, where they are pretty securely kept out of the sun, and where they become as white, tender, and watery, as the finest celery. For the more exquisite specimens of this human etiolation, we must survey the inhabitants of mines, dungeons, and other subterraneous abodes; and for complete contrasts to these, we have only to examine the complexions of stage-coachmen, shepherds, and the sailor 'on the high and giddy mast.'" (Dr. James Johnson, *Change of Air*, p. 7, 4th ed. 1838.)

&c., free exposure to solar light is indicated. Its use is sometimes attended with very happy effects. Open and elevated situations probably owe part of their healthy qualities to their position with regard to solar light. The observations of Dr. Edwards, on the influence of light in promoting the perfect development of animals, led him to conclude, that in climates, where nudity is not incompatible with health, exposure of the whole surface of the body to light is favourable to the regular conformation of the body; and he, therefore, has suggested insolation in the open air as a means calculated to restore healthy conformation in children affected with scrofula, whose deviations of form do not appear to be incurable. (*Op. supra cit.* p. 401.)

As in bright solar light we feel more active, cheerful, and happy,—while obscurity and darkness give rise to a gloomy and depressed condition of mind,—so we employ insolation in the open air as a mental stimulus in melancholy, lowness of spirits, and despondency.

In amaurosis, supposed to depend on, or be connected with, a languid condition of the vital actions going on in the tunics of the eye, exposure to strong solar light (concentrated by a lens) has been proposed as a remedy. But notwithstanding that Hufeland (quoted by Sundelin, *Handbuch der speciellen Heilmittellehre*, Bd. ii. S. 72. 3tte. Aufl. 1833) reports a case said to have been cured by it, its value is exceedingly doubtful, and its use requires extreme caution.

a. Darkness.

In many maladies light acts injuriously on the system, and its exclusion is attended with benefit to the patient.

In all diseases of the eye attended with local, vascular or nervous excitement, darkness or obscurity should be employed. In inflammatory conditions of the brain, in fever, and in mental irritation, whether attended or not with vascular excitement, the stimulus of light proves injurious, and in such, darkness of the chamber should be enjoined. After parturition, severe wounds, and surgical operations, and in all inflammatory conditions, the exclusion of light contributes to the well-doing of the patient. Lastly, darkness is employed to promote sleep. (See p. 43.) In most cases where obscurity is indicated, rest and quietude are to be enjoined.

b. Dioptric Instruments.

When vision is imperfect, from defect of focal distance, the remedy consists in the use of dioptric or refracting instruments (*eye-glasses; spectacles.*) In *Myopia*, (i. e. *Short-* or *Near-sightedness*) doubly concave lenses (whose focal lengths vary from about $2\frac{1}{2}$ to 48 inches) are usually employed to counteract the over refractive power of the humours; while, in *Presbyopia*, (*Long-* or *Far-sightedness*) doubly convex lenses (whose focal lengths vary from about 6 to 48 inches) are generally used to obviate the diminished refractive power of the humours of the eye.[1] Lenses, for the above purposes, are commonly made either of flint-glass or of Brazilian quartz.[2] The latter, called *pebble*, has the advantage of greater hardness, and its surface, therefore, is not so readily scratched. (Lenses made of amber are readily scratched and soon lose their polish.) The diathermancy of quartz is about the same as that of mirror-glass.[3]

[1] In opticians' shops two *trial boxes*, or *frames of sight*, are kept; the one comprises the range of doubly convex—the other, of the doubly concave lenses. These are used for trying myopic or presbyopic eyes.

[2] Quartz presents some remarkable optical phenomena. It possesses the property of double refraction in the direction of its axis. In this it differs from every other known uniaxial crystal. Moreover, when a plane polarized ray is transmitted through a prism of quartz, the two pencils, into which the ray is divided, are, at their emergence, elliptically polarized (Airy, in *The Transactions of the Cambridge Philosophical Society*, vol. iv. 1833.)

[3] Melloni, *Taylor's Scientific Memoirs*, vol. i. p. 1. The transcalency or diathermancy of several transparent solids is as follows:—Of 100 rays of heat proceeding from the flame of an Argand lamp, there were transmitted by

	Rays transmitted.		*Rays transmitted.*
Rock Salt	92	Mirror Glass	62
Iceland Spar	62	Alum	12
Quartz	62	Sulphate of Copper (diaphanous)	0

In another series of experiments Melloni ascertained the relative diathermancy of Flint-Glass, Mirror (Plate) Glass, and Crown Glass, to be respectively, 65, 62, and 49.

Occasionally lenses of other forms, than those above enumerated, are employed; but the only one deserving of special notice is the *periscopic* or *meniscus* (concavo-convex) lens, recommended by Dr. Wollaston (*Nicholson's Journal*, vols. vii. and viii.) for enlarging the field of vision.[1]

c. Chromatic Instruments.

In some affections of the eye (popularly known as *weakness of sight*,) coloured glasses are employed, with occasional relief, to diminish the intensity of the light. Those with a neutral tint (or twilight tinge) prove the most agreeable to the eye.

White light is most fatiguing and hurtful to the eye.[2] The disease, called snow-blindness, which sometimes results from the long contemplation of a country covered with snow, is probably retinitis. (Mackenzie, *op. cit.* p. 501.—Xenophon (*Anabasis*, lib. iv.) speaks of snow-blindness.) Both *red* and *yellow* light (Hence amber lenses are objectionable) are injurious to the eye. To the excess of the yellow and red rays, in common artificial light, may be in part ascribed the baneful influence of this light in causing impaired vision. Two modes of preventing its ill effects have been suggested; viz. the addition, by reflection, of the blue rays that are deficient (as by the use of conical blue shades or reflectors around the flame,) or the substraction, by absorption, of the red or yellow rays that are in excess (as by passing the light through some transparent medium of a blue tint.)[3] *Green*, *blue*, *indigo*, and *violet* lights, are much less injurious than either red or yellow. Spectacles of these colours have been made for the use of those suffering with sensitive eyes, but they are inferior to the neutral tint before mentioned, since after their removal from the eyes every object sometimes presents for a short period complimentary tints; showing that these colours have fatigued the retinæ. All dark-coloured glasses, however, and especially black crape spectacles, are objectionable, on account of their greater power of absorbing and radiating caloric, by which they prove heating to the eyes.[4]

2. Calor.—Heat.

Physiological Effects.—All living beings, but especially the animals denominated *warm-blooded*, generate heat. To all a certain temperature (which differs in different individuals) is essential to the maintenance of life; and hence caloric or heat is a vital stimulus. (See foot-note at p. 44.) Increased beyond a certain degree, it ceases to be vivifying: it may cause inflammation or apoplexy; it may exhaust by its prolonged stimulant operation; or, when its action is very violent, it may decompose the organized tissues by its chemical influence.

There are three modes of promoting or raising the temperature of warm-blooded animals, viz:—

1. The communication from without of sensible heat, either by the application of heated substances to the body, or by the introduction of radiant heat.
2. By augmenting the generation of heat within the body; as by the use of stimulant foods and drinks.
3. By diminishing the cooling influence of surrounding bodies; as by the use of clothing made of substances which are bad conductors of caloric.

The effects of caloric communicated from without, on living beings, are threefold, viz:—

1. Physical; including *expansion* or *dilatation*, and *fluidity*.
2. Chemical; comprising *increased tendency to changes of composition* and *decomposition*.
3. Dynamical, physiological, or vital; comprehending all *changes in the condition of the vital properties* produced by heat. These changes are of two kinds:—
   α. Primary; excitement, or augmentation, of vital action.
   β. Secondary; exhaustion, or diminution, of vital action.

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[1] For farther information respecting spectacles, consult Mackenzie's *Practical Treatise on Diseases of the Eye*, 3d edit., London, 1840, pp 784 and 792; Kitchener's *Economy of the Eyes*, Part I. (Spectacles,) London, 1824; and Cox's *Spectacle Secrets*, London, 1838.

[2] The intense light caused by the ignition of charcoal and the combustion of the metals effected by the Voltaic Battery constructed by Professor Groves, has produced on myself, as well as on some friends, temporary blindness. The symptoms (which lasted two days in my case) were those of retinitis, with profuse lachrymation.

[3] See Dr. James Hunter's work, *On the Influence of Artificial Light in causing Impaired Vision*. Edinburgh, 1840.

[4] Melloni (*op. supra cit.*) ascertained the diathermanous properties of coloured glasses to be as follows:—Of 100 incident rays, there are transmitted by

Coloured glass.	*Rays transmitted.*	*Coloured glass.*	*Rays transmitted.*
Deep violet	53	Bright yellow	34
Vivid red	47	Mineral green	23
Clear blue	42	Very deep blue	19

a. On Vegetables.—A certain degree of heat promotes all the vital processes of plants. It accelerates germination, the growth and development of all vegetable organs, inflorescence, fecundation, and the ripening of the fruit; and it quickens the movements of parts susceptible of motion. Too elevated a temperature, accompanied with dryness, deranges the health of plants. (Decandolle, *Physiologie Végétale*, tom. iii. p. 1098.) An intense heat decomposes the vegetable tissues.

b. On Man and other Animals.—A certain degree of external heat (different in different beings) promotes the vital manifestations of animals, and hence we denominate it an excitant or stimulant. Its prolonged operation, however, is followed by debility and exhaustion proportionate to the previous excitement.

The influence of tropical heat on the human species furnishes an illustrative example of the effects just mentioned. It is well known that the mental powers of children are sooner developed, and the sexes arrive earlier at puberty, in warm than in cold countries. Moreover, the languor, indolence, and relaxed fibres, so commonly observed in the inhabitants of tropical climates, are probably to be ascribed, in a great measure, to the exhausting and enervating influence of external heat.

The effects of topical heat are first, a sensation of warmth, redness, turgescence, and a slight augmentation of temperature of the part heated. The diameters of the minute capillary vessels expand under the influence of caloric, and thus the red blood-disks are enabled to enter tubes previously impervious to them. The augmented volume of the part arises, therefore, in a great measure from the presence of an increased quantity of blood; but in part also from the dilatation of the solids and fluids caused by their augmented temperature. The living tissues become more relaxed, soft, and flexible, under the influence of a moderate heat, and admit of a more rapid transpiration.

A more violent degree of heat causes burning pain, redness, and vesication. A still more intense heat destroys vitality and organization. Whenever a large portion of the surface of the body is destroyed (as in burns and scalds,) great constitutional disturbance, or even death, results from the shock given to the nervous system.

If the whole body be subjected to an elevated temperature, not incompatible with prolonged life, its effects are manifested first in the vascular system, and in the organs connected therewith. The superficial vessels enlarge; the skin becomes redder; and the pulse quicker and fuller: respiration more frequent; the animal heat is augmented; and the expired air is hotter, and more loaded with vapour.

The exciting influence of heat, on the vascular system, points out the impropriety of employing this agent in inflammation or congestion of the organs (heart and lungs) engaged in the circulation of the blood; in dilatations of the heart; in aneurism; in apoplexy; and many other cases which will readily suggest themselves.

Increased exhalation (first of insensible and vaporous matter, then of visible and liquid sweat) and augmented secretion of the periphery soon succeed. The rapid conversion of a liquid into an aeriform fluid (insensible perspiration) is attended with the production of cold; and thus animals are enabled to counteract external heat, and to maintain nearly their original temperature, when exposed to a temperature considerably higher than that of their own bodies, by the increased perspiration which they suffer under these circumstances. The determination to the surface, and the increased transpiration and secretion of the skin, are attended with a contemporaneous diminution of activity in some of the internal organs. Thus, the secretions of the kidneys and the mucous membranes are diminished in consequence of the increased secretion and exhalation of the skin.

The mutually antagonizing influence of determinations of blood to different parts—as well as of the secretions of different tissues—is a circumstance the knowledge of which is of great

practical value in therapeutics.[1] We avail ourselves of this influence, and employ external heat to produce determination of blood to, and augmented secretion of, the skin on various occasions; as when an internal malady is attended with coldness of surface, or appears to be connected with the sudden disappearance of a cutaneous eruption. The benefit obtained by the use of external heat in gastritis, enteritis, cystitis, and nephritis, is in part referrible to the same antagonizing influence. External heat is also an important adjuvant in the treatment of diabetes: it checks the excessive secretion of urine, and relieves the dry and unperspirable state of the skin. Whenever we exhibit sudorific medicines, we promote their operation by keeping the surface warm; while when we employ diuretics, the skin should be kept cool. The agency of tropical heat in weakening the digestive organs, and the efficacy of spices, taken as condiments, in counteracting this effect, are clearly referrible to the principle of antagonism above explained.

The augmented secretion of bile, and the tendency to hepatic diseases, so commonly observed in Europeans when they become residents in warm climates, are other effects of the continued operation of heat on the body.

That heat, aided by inactivity, abundance of solid food, and little or no drink, is capable of inducing hepatic disease, is well shown on the goose. The celebrated *pâtés de foies gras*, prepared at Strasburg and Metz, are made from the livers of geese artificially enlarged. These animals are crammed with food, kept from drink, nailed to a plank by the webs of their feet, and placed quite close to a fire: and, in due time, their livers become greatly enlarged.

Relaxation of the living tissues is another consequence of the employment of moderate heat. This effect, which is best observed when moisture is conjoined with caloric, commences first in the part to which heat is applied: and, when the whole surface of the body has been subjected to an increased temperature, its relaxing influence soon extends to internal parts: hence arise atony, diminution of muscular power, a feeling of languor or fatigue, and an indisposition to corporal exertion.

We take advantage of this relaxing influence of heat in the treatment of spasmodic diseases, in the reduction of dislocations, in the application of the taxis in hernia, and on many other occasions where our object is to relax or soften muscular or other tissues. On the other hand, we avoid the employment of heat where preternatural relaxation or atony of the general system, but especially of the surface, exists.

The primary effect of moderate heat on the nervous system is excitation; the secondary effect, exhaustion. In the first instance sensibility is agreeably promoted, the action of the voluntary muscles assisted, and the intellect somewhat exalted. But to these effects succeed languor, relaxation, listlessness, indisposition to corporal and mental labour, and tendency to sleep.

Lastly, the prevailing maladies of hot climates may be referred to as farther illustrations of the effect of continued heat on the body. Fevers, diarrhœa, dysentery, cholera, and liver diseases, may be regarded as the special maladies of the burning equatorial regions.

The exhaustion, which follows the excitation caused by heat and other stimuli, would seem, to use the words of Müller, (*Op. cit.* vol. i. p. 52.) to "show that the organic force is consumed, as it were, by the exercise of the functions;" and to employ a simile of Dr. Priestley,[2] we may say, that as a candle burns out much faster in oxygen gas than in air, so we may be said to live out too fast when under the exciting influence of an elevated temperature.

Uses.—Heat is employed as a remedial agent for various purposes, of which the following are the principal:—

1. To cause an afflux of blood to a part; by which,—
   - *a.* Healthy circulation and temperature may be restored.
   - *b.* The equalization of the distribution of blood may be effected; and thereby a preternatural afflux to other organs checked.
   - *c.* The secretions and exhalations of a part may be re-established or increased.
2. To promote the general circulation of blood.

[1] See some valuable remarks on the "*antagonism*" of the secretions, in Müller's *Elements of Physiology*, by Dr. Baly, vol. i. p. 473.

[2] *Experiments and Observations on different kinds of Air*, vol. ii. p. 169. Birmingham, 1790.

3. To relax tense, rigid, or spasmodically contracted tissues.
4. To alleviate pain.
5. To hasten organic changes; as the termination (resolution or suppuration) of inflammation.
6. To destroy the vitality and organization of a part.

The most important circumstances which contra-indicate its employment, are—

1. Great vascular excitement, plethora, aneurism, hemorrhage, &c.
2. Great relaxation and flabbiness, especially in the superficial organs.
3. Profuse secretion and exhalation.
4. Great nervous excitability, with little power.

Heat is communicated to the body in two ways; viz. by *radiation* and by *conduction*.

α. Radiant Heat.

Radiant heat proceeds from the sun and terrestrial bodies, in straight lines or rays. Therapeutically it has been employed as a stimulant or excitant, to promote circulation and warmth in the old, the debilitated, and the paralytic; and as a cautery.

a. **Solar Heat.**—The rays, which proceed from the sun, are of three kinds—illuminating, heat-making, and chemical. Their important influence—as illuminating rays—have been already alluded to. (See p. 44.)

The ancients[1] were well acquainted with the salutary influence of solar heat on the human frame, and frequently employed it for therapeutical purposes.

Insolation (*insolatio*, *apricatio*, *solicatio*, *heliosis*, ἡλίωσις) may be employed as a stimulant for the purposes already mentioned. It is also valuable in scrofula, and as a restorative after lingering and painful maladies. Whenever it is used the head should be carefully guarded from the direct influence of the sun, in order to prevent the occurrence of the *sun-stroke*, or *ictus solaris*, before referred to. (Page 44.) Occasionally erythema or erysipelas is produced by the direct action of the sun on the naked skin.

Faure concentrated the solar rays by a burning-glass, and employed them to stimulate indolent ulcers, especially those which follow frost-bites. Formerly cauterization was effected in the same way.[2]

2. **Artificial Radiant Heat.**—Exposure to the rays of a common fire is resorted to, as a stimulant and calefacient, in old paralytic and other cases attended with coldness and blueness of the extremities, and other symptoms of insufficient circulation of the blood.

The heat radiating from a burning body, (as a candle) or ignited iron, is sometimes employed as a stimulant to produce rubefaction in the tract of the vertebral column, in paralytic and neuralgic affections of the spinal cord. "A much more durable impression of heat," observes Müller, (vol. i. p. 59.) "better than moxa or the actual cautery, is produced by holding a burning candle near to the affected part for a long time, so as to produce pain; by which means all the beneficial effect of heat is obtained, without the formation of an eschar and the subsequent suppuration, which is often of no service. The mode in which the caloric acts in these cases is not evident."

The radiant heat from a red-hot iron or burning coal has been employed as a

[1] Hippocrates, *De Morbis*, lib. ii. 66 and 68; Celsus, lib. i. cap. 2 and 3; Cœlius Aurelianus, *Morb. Chronic.* lib. iv. cap 2.

[2] Marjolin, in *Dict. de Médecine*, art. *Cautérisation*. Most, in his *Encyklopädie der gesammten medicin. u. chirurg Praxis*, Leipzig. 1837, art. *Insolatio*, quotes two authors on insolation, whom I have had no opportunity of consulting: they are Dresig, *De solicatione vulgo insolatione veterum*, Lips. 1737; and Richter, *Diss. Insolatio, seu potestas solis in corpus humanum*, Götting. 1747.

cautery to check hemorrhages, and to promote the reduction of prolapsus of the rectum and uterus, and of hernia. This practice constitutes the *cautérisation objective* of the French writers.

β. Conducted Heat.

1. *Calor siccus.—Dry Heat.*

This includes hot air, bottles filled with hot water, hot sand, &c.

1. **Hot-Air Bath.**—Air, at a temperature of from 100° to 130° F., is a powerful stimulant and calefacient, but is less relaxing and soothing than moist vapour. When required to operate as sudorific, a temperature of from 90° to 100° F. (Dr. Gower says 85°) is found most advantageous. The hot-air bath is principally valuable as a remedial agent when the blood has receded from the superficial parts of the body, and the internal organs are in a state of congestion; as in some forms of fever, and in spasmodic cholera. In asphyxia from drowning, and from some other causes, it is also highly useful. Furthermore, in chronic rheumatism, stiffness of the joints, and chronic skin diseases (especially the dry scaly eruptions,) it also proves beneficial.[1]

The *medicated hot-air bath* is prepared by impregnating the hot air with some gas or vapour; as with sulphurous acid gas or chlorine. (See *Chlorine* and *Sulphurous Acid.*)

2. **Solid Substances, heated not beyond 100°.**—*Bottles filled with hot water* are applied to the feet to excite the circulation and augment the animal heat, in various diseases attended with cold extremities. The same remedy is conveniently applied to the abdomen, to relieve spasmodic pain. *Hot sand* (*arena calida,*) enclosed in a bag or bladder, may be employed for similar purposes. Sometimes hot sand is used as a bath.[2] It is rarely resorted to in this country, but is had recourse to in the maritime departments of the South of France. (Schwilgue, *Traité de Matière Médicale*, t. ii. p. 324.) A sand-bath operates as a stimulant and sudorific; and is employed in rheumatism, spasm, paralysis, &c.[3] *Hot ashes* or *bran* have been applied to similar uses; as also *hot bricks*. *The leaves of the common birch* (*Betula alba*) are employed in Sweden. (Bergius, *Materia Medica*, t. ii. 778, ed. 2nda, Stockh. 1782.)

3. **Metal heated to 212°.**—The late Sir Anthony Carlisle (*Lancet*, 1826–27, vol. xi. p. 315 and 384.) proposed to excite speedy vesication by the application to the skin of a polished plate of metal, heated to 212° by immersion in boiling water. He recommended it as a substitute for cantharides, than which he declared it to be less painful. Moreover, it is not liable to cause strangury.

4. **The Actual Cautery** (*Cauterium actuale.*)—The term *actual cautery* is used to indicate a heated substance, employed to burn or disorganize a portion of the living body, to which it is applied.

A *potential cautery* disorganizes by its affinity for the constituents of the living tissues.

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[1] For farther information respecting the hot-air bath, consult the *Cyclopædia of Practical Medicine*, vol. i. p. 266. art. *Warm-Air Bath*, by Dr. Forbes.—Also, Dr. Gower's *Auxiliaries to Medicine*, Lond. 1819, Tract 1, *An Account of the Sudatorium.*

Various simple and ready modes of making a hot-air bath have been suggested. A very simple method is that recommended by Mr. Alcock (*Lancet*, 1825–6, vol. ix. p. 862.) It consists in burning spirit in a cup or saucer under a blanket; the patient lying on the bed with his head and face outside the blanket, as the air is not fit for respiration. The blanket is supported over the bed by a cord.

[2] The phrase *balneum arenæ* is incorrect. Celsus (lib. ii. cap 17.) limits the term *balneum* to a water-bath artificially heated in a private house.

[3] The therapeutical use of sand is denominated *arenatio* or *psammismus* (ψαμμισμος, from ψαμμος, *sand.*) See Quiring. *De balneis arte parandis Diss. Inaug.* Berol. 1837.—"*Saburration* was a species of bathing in ancient use. The body was buried in sand, and exposed to the sun." (Sutherland's *Attempts to revive Ancient Medical Doctrines*, vol. i. p. 48. Lond. 1763.)—Sand is employed therapeutically for other purposes than to communicate heat. Thus, a bag of sand has been applied to the abdomen, to compress, by its weight, the uterus, and thereby to restrain uterine hæmorrhage after the removal of the placenta; but incomplete inversion of the uterus is said to have been produced by it (see Most, *Encyklopädie der gesammt. med. u. chir. Praxis*, Bd. i. S. 175. Leipzig, 1836.) Sand has also been used as a mechanical support in fractures of the leg.

Several agents have been employed as actual cauteries, viz. *red-hot iron*, *moxa*, and the *flame of hydrogen*. The first, however, is the one generally used, and commonly meant, when we speak of the actual cautery. The latter two will be noticed in subsequent parts of the work. (See *Hydrogen*, and *Artemisia Moxa*.)

I have excluded *boiling water*, *steam*, and *metal heated* to 212°, from the list of cauteries. These agents coagulate and harden the albuminous and fibrinous portions of the living tissues, and excite acute inflammation; that is, they *scald*. They neither decompose nor effect any chemical change in the organic principles; and, therefore, chemically speaking, they do not *burn* the living tissues.

In this country the actual cautery (red-hot iron) is seldom used. It is sometimes resorted to as a styptic, where the hemorrhage is from a great number of small vessels, or from a vessel so situated that the ligature cannot be applied. It is also used to destroy morbid growths, which cannot be reached by the knife—as fungus of the antrum. Lastly, it has been applied to stop caries, to excite an artificial ulcer, to open abscesses, to close fistulous ulcers, in bites by poisonous animals, and in some affections of the brain—as epilepsy, to destroy the part from whence the aura epileptica sets out.[1]

2. *Calor humidus.—Moist Heat.*

a. Aqueous Vapour.

The practice of bathing is of great antiquity, and precedes the date of our earliest records. It was adopted sometimes for the purpose of cleanliness, sometimes for the preservation of health, and frequently as a recreation and luxury. The ancient Hebrews (*Leviticus*, xiv. 8.—2 *Kings*, v. 10.) practised ablutions. Josephus (*Bell. Jud.* lib. i. cap. 33, § 5.) mentions that Herod was let down into a bath of oil. The Greeks employed bathing. Homer,[2] on various occasions, mentions hot baths and ablutions. In the writings ascribed to Hippocrates, (*De diæta*, lib. ii. § 35. *De affectionibus*, § 47.) baths are mentioned, and their effects described. Baths are also noticed by Celsus, (Lib. i. cap. 3; and lib. ii. cap. 17.) Pliny, (*Hist. Nat.* lib. xxix. cap. 8; lib. xxxi. cap. 2, et seq. Ed. Valp.) and other Roman writers. Prosper Alpinus (*Medicina Ægyptiorum*, lib. iii. cap. 14—19.) says, that the Egyptians employed hot baths for cleanliness and health; and Freind states, that when Alexandria was plundered, in A. D. 640, there were 4000 baths in that city. (*History of Physick*, part i. p. 7. 3d ed. Lond. 1727.) Among the Persians, baths were in use.[3] The Arabians also were acquainted with hot baths, as we learn from Avicenna. (*Canon*, lib. iii. fen. xvi. tract. iv. cap. 10.) The ancient Hindoos employed baths and aspersions with water. (Royle's *Essay on the Antiquity of Hindoo Medicine*, p. 53. Lond. 1837.)

These examples sufficiently establish the great antiquity of the practice of bathing.[4]

The following is a sketch of the baths of the Romans, copied from a painting found at the *Thermæ* of Titus. (De Montfaucon, *L'Antiquité expliquée et representée en Figures*, tom. iii. part. ii. p. 204, 2nde éd. Paris, 1722.

[1] For farther details respecting the actual cautery and cauterization, I must refer the reader to Percy's *Pyrotechnie chirurgicale pratique*, Paris, 1811; Marjolin, art. *Cautère* and *Cautérisation*, in the *Dict. de Médecine*; and Sanson, in the *Dict. de Méd. et Chir. pratiques*.

[2] *Iliad*, xxii. 444. *Odyss* viii. 451.—It would appear from Homer, that the offices of the baths were performed by females; though, from a passage in Herodotus (*Erato*, xix.,) we may infer that this custom was not peculiar to the Greeks.

[3] Xenophon, *Cyropædia*, lib. viii.—Plutarch, in his life of Alexander the Great, mentions that this celebrated conqueror was astonished at the sight of the baths of Darius

[4] For farther information respecting ancient baths, consult an *An Account of the Ancient Baths, and their Use in Physic*, by Thos. Glass, M. D. Lond. 1752.—*Attempts to revive Ancient Medical Doctrines*, by Alexander Sutherland, M. D. Vol. i. p. 12, et. seq. Lond. 1763.—Also, *De Balneis omnia quæ extant apud Græcos, Latinos et Arabas*. Venet. 1553.

Fig. 1.

Ancient Baths.

a. The *Strigil* (a scraper or currycomb, used at baths to scrape the skin.)

On the right is the *eleotherium* (ἀλειπτήριον) where the oils and perfumes are kept in vases: next to this is the *frigidarium* (ψυχρολουτήριον) or dressing-room: the third apartment is the *tepidarium*: the fourth is the sudatory (*concamerata sudatio*,) in which are seen the *laconicum* (so called from being first used in Laconia,) a brazen furnace to heat the room, and persons sitting on the steps: the fifth is the *balneum*, with its huge basin (*labrum*,) supplied by pipes, communicating with three large bronze vases, called *milliaria*, from their capaciousness; the lower one contained hot, the upper one cold, and the middle one tepid water. The bathers returned back to the frigidarium, which sometimes contained a cold bath. The subterranean portion of the building, where the fires were placed for heating the baths, was called the *hypocaustum*.

1. **The Vapour Bath.**—As aqueous vapour, like air, is a worse conductor of caloric than liquid water, its influence, as a source of either heat or cold, is neither so powerfully nor so speedily felt as that of the latter. Hence, therefore, the temperature of the vapour bath should always exceed that of the water bath. If, however, the whole body be immersed in vapour, which is consequently inhaled, the temperature must be a little less than if the trunk and limbs alone were subjected to the influence of vapour; because the inhalation of vapour stops the cooling process of evaporation from the lungs. The following is a comparative view of the heating powers of water and of vapour, distinguishing the latter according as it is or is not breathed. (Dr. Forbes, *Cyclopædia of Practical Medicine*, art. *Bathing*, vol. i. p. 265.)

	Water.	*Vapour.*	
		Not breathed.	Breathed.
Tepid bath	85° — 92°	96° — 106°	90° — 100°
Warm bath	92° — 98°	106° — 120°	100° — 110°
Hot bath	98° — 106°	120° — 160°	110° — 130°

The general effects of the vapour bath are those of a powerful stimulant and sudorific. It softens and relaxes the cutaneous tissue, expands the superficial vessels, accelerates the circulation of blood, augments the frequency of the pulse and respiration, and produces copious perspiration. These effects are succeeded by a feeling of languor and a tendency to sleep.

The vapour bath is distinguished from the hot-air bath by its soothing, relaxing, and greater sudorific influence; from the hot-water bath, by its inferior power of communicating heat, by its greater sudorific tendency, and by its causing scarcely any superficial compression of the body, whereby it does not occasion the præcordial oppression experienced on entering the water bath.

The vapour bath, like the hot-air bath, may be employed when the blood has receded from superficial parts, and congestion of internal organs has in consequence occurred;—as during the cold stage of intermittent fever, in malignant cholera, and during the stage of chilliness which ushers in various febrile complaints. But its great value is experienced when our object is to relax the skin,

and to produce profuse sweating. Thus in chronic rheumatism and gout, in slight colds from checked perspiration, and in chronic skin diseases, accompanied with a dry state of the cutaneous surface, it often proves highly serviceable. In old paralytic cases, unaccompanied with signs of vascular excitement of the brain, it sometimes gives relief. In some uterine affections, as chlorosis, amenorrhœa, and irritation of the womb; in dropsy of old debilitated subjects; in old liver complaints; and in some scrofulous affections, the vapour bath is occasionally employed with advantage.[1]

In this country the vapour bath is employed for therapeutic purposes only. In Egypt, Turkey, Persia, and some other parts of the East, and in Russia, however, it is in common use as a hygienic agent and luxury; and is accompanied by a process of friction, kneading, and extension of the muscles, tendons, and ligaments, constituting the *massing*[2] of the Egyptians, and the *shampooing* (Mahomed's *Treatise on Shampooing*.—I have not met with this work.) of the East Indians. This process is thus described by Dr. Gibney:—(*Op. supra cit.* p. 84.) "After exposure to the bath, while the body is yet warm from the effects of the vapour, the shampooman proceeds, according to the circumstances of the case, from gentle friction gradually increased to pressure, along the fleshy and tendinous parts of the limb;—he kneads and grasps the muscle repeatedly, presses with the points of his fingers along its course, and then follows friction, in a greater or less degree, alternating one with the other, while the hand is smeared with a medicated oil, in the specific influence of which the operator has considerable confidence. This process is continued for a shorter or longer space of time, and, according to circumstances, is either succeeded or preceded by an extension of the capsular ligament of each joint, from the larger to the smaller, causing each to crack, so as to be distinctly heard, which also succeeds from the process being extended to each connecting ligament of the vertebræ of the back and loins. The sensation at the moment is far from agreeable, but is succeeded by effects not dissimilar to what arise from brisk electrical sparks, taken from the joints in quick succession."

In rigidity and stiffness of joints this process of massing or shampooing may prove of considerable service.

The *Russian Vapour Baths* have long been celebrated. The vapour is produced by throwing water over red-hot stones. Its temperature, according to Lyall, (*Character of the Russians*, p. 112, Lond. 1823.) is from 122° to 144-5° F. Besides being exposed to the influence of this vapour, the bathers are subjected to a system of friction, flogging with the leafy branches of the birch, and affusions of warm or cold water. It is customary with them to issue from the bathing-houses while quite hot, and, in the summer, to plunge into cold water,—in the winter, to roll themselves naked in the snow, without sustaining injury or ever catching cold. (Dr. E. D. Clarke's *Travels in various Countries of Europe*, part i. p. 143, et seq.) Bremner (*Excursions in the Interior of Russia*, vol. i. p. 185. Lond. 1829.) describes the supposed bracing effects as being all imaginary; and declares that the practice of bathing, followed by the Russians, rapidly enervates and undermines the constitution. Several medical writers (Dr. Granville's *St. Petersburgh*, vol. i. p. 509. Lond. 1828.) have borne testimony to the efficacy of the baths in alleviating rheumatism.

The *Egyptian Vapour Baths* are in constant and general use. The bathers having been subjected to the operation of *massing*, already described, are then rubbed, and afterwards washed.[3] The *Turkish*[4] as well as the *Persian* (Fowler's *Three Years in Persia*, vol. i. p. 269. Loud. 1841.) *Baths* are somewhat similar.

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[1] For a more detailed account of the uses of the vapour bath, the reader is referred to Dr. Gibney's *Treatise on the Properties and Medical Application of the Vapour Bath*. Lond. 1825.

[2] *Masser*, from the Arabic verb *masses*, to touch lightly. See Savary's *Letters on Egypt*, vol. i. p. 130, 2d. ed. Lond. 1787.

[3] For a description and representation of the Egyptian baths, consult *Description de l'Egypte*. Etat Moderne, t. ii., (2de partie) p. 683. Vol. i. planche 49; and vol. ii. planche 94.—Also, Lane's *Account of the Manners and Customs of the Modern Egyptians*, vol. ii. p. 35, Lond. 1837.—Sir J. G. Wilkinson, in his *Manners and Customs of the Ancient Egyptians*, vol. iii. p. 388, Lond. 1837, has given a sketch, from a painting in a tomb at Thebes, representing a lady in a bath, with four attendants.

[4] D'Ohsson's *Tableau Général de l'Empire Ottoman*, tom. i. p. 160, Paris, 1787.—An engraving of a bath is given.

Topical or *local vapour baths* are sometimes employed in the treatment of local diseases, as affections of the joints. Dr. Macartney (*A Treatise on Inflammation*, p. 176. Lond. 1838.) recommends the topical use of vapour, as a soothing and anodyne application, in painful wounds, contusions, and fractures, and has invented an apparatus for generating and applying it, which is sold by Mr. Stoddart, 401, Strand, London.

The *vapour douche* may be regarded as a topical vapour bath. It is a jet of aqueous vapour (whose temperature does not exceed that of a general vapour bath) directed on some part of the body, and its action depends principally on the temperature of the fluid; for its mechanical effects are comparatively trifling. In some affections of the ear, as otitis, otorrhœa, and otalgia, a stream of warm aqueous vapour is sometimes introduced into the meatus auditorius externus with considerable relief; and the most ready means of effecting it is by a funnel inverted over a vessel of hot water, the meatus being applied to the orifice of the funnel.

The *medicated vapour bath* is prepared by impregnating aqueous vapour with the odour of medicinal plants. There is no good reason, however, for supposing that it possesses any advantage over the simple vapour bath.

Sulphur vapour, *sulphurous acid gas*, *chlorine gas*, and *the vapour of camphor*, are sometimes employed in conjunction with aqueous vapour. Their effects will be described hereafter.

The application of vapour to particular parts of the body has been accompanied with the simultaneous removal of atmospheric pressure, constituting the *air-pump vapour bath*. It has been employed in gout, rheumatism, and paralysis.[1]

2. **Inhalation of Warm Vapour.**—The inhalation of warm aqueous vapour proves highly serviceable, as an emollient remedy, in irritation or inflammation of the tonsils, or of the membrane lining the larynx, trachea, or bronchial tubes. It may be employed by Mudge's inhaler, or by inspiring the vapour arising from warm water. Various narcotic and emollient substances are frequently added to the water, but without adding much (if any thing) to its therapeutical power. Dr. Paris (*Pharmacologia*, vol. i. pp. 198 and 379, ed. 6th. Lond. 1825.) states that, in some pulmonary complaints, he has been long in the habit of recommending 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 north-east winds, which so frequently infest this island during the months of spring; and the most marked advantage has attended the practice. In rooms artificially heated by hot-air stoves, the necessity for this proceeding is still more obvious.

The benefit which pulmonary invalids are said to have derived from a *residence in cow-houses*[2] is in part referrible to the moist warm air with which such places are filled, though something, perhaps, may be ascribed to the carbonic acid gas which is present.[3]

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[1] *Facts and Observations respecting the Air-Pump Vapour Bath in Gout, Rheumatism, Palsy, and other Diseases.* By Ralph Blegborough, M. D. Lond. 1803.—La Beaume, *Observations on the Air-Pump Vapour Bath.* Lond.

[2] See Dr. Beddoes's *Observations on the Medical and Domestic Management of the Consumptive, on the Digitalis purpurea, and on the Cure of Scrophula.* Lond. 1801.

[3] See Vogt's *Lehrbuch der Pharmakodynamik*, 2er Band. S. 32; 2te Aufl. Giessen, 1828.—I am indebted to Mr. Steinhaeuser (a very intelligent pupil of mine,) a native of Saxony, for the following note on residence in cow-houses, as a remedial agent in diseases of the lungs:—"In Germany the balsamic air of cow-sheds is commonly recommended as a preventive in suspected pulmonary disease, or as a means of prolonging life in a confirmed phthisis. Although this latter disease is comparatively of rare occurrence in Saxony, yet several cases have fallen under my own observation, in which this plan of treatment was adopted. The mode of effecting it has varied according to circumstances: in some cases the patient has merely retired from a crowded town to a farm-house; in others, the sitting and bed-rooms have actually been converted into residences for cows. Of the former I have known several instances where patients have been greatly benefited by sleeping in apartments built over cow-stalls; and this, I should say, is the most usual plan adopted. Of the latter I can only record one case, which is somewhat remarkable. It is that of the late Prince Putiati, a Russian exile, resident in the vicinity of Dresden, and well known there on account of his eccentricities. His young, beautiful, and only daughter, the Countess ———, being affected with this destructive malady (phthisis,) to which she eventually fell a victim, the warm air of cow-sheds was recommended by her physicians, as a mode of prolonging her life. The Prince ordered the lower part of a wing of his magnificent but curiously-constructed mansion (Schachwitz) to be converted into a cow-stable; and the elegantly furnished sitting and sleeping apartments of his daughter were so arranged, that she was actually in the same room with the cattle, from which she was separated merely by a low partition.

3. Steam.—Steam (*i. e.* aqueous vapour heated at least to 212° F.) is sometimes employed as a powerful rubefacient and caustic. It contains more specific and latent heat than boiling water, but its conducting power is less. It is applied by a small copper or tin boiler (called an *eolipile*) furnished with a tubular mouth and stop-cock, and heated by a spirit-lamp. Its action on the body is limited by a perforated piece of pasteboard. If applied sufficiently long, it causes an extensive and deep eschar. In this respect its action is similar to that of boiling water, from which it principally differs in the circumstance of having a much larger quantity of specific heat, and in the greater facility with which we can limit its effects. It greatly resembles moxa, but its action is less readily localized, and the wound which it causes is less manageable. It has been used as a powerful counter-irritant in diseases of the hip-joint, neuralgic pains, chronic rheumatism, &c. The objections to its employment are the great pain which it causes, and the danger of its effects.

b. Water.

Hot, but not scalding water, augments the temperature, volume, and redness of living parts, relaxes the tissues, and increases the vital actions.

1. Tepid, Warm, and Hot Baths.—*a.* The *Tepid Bath* has a temperature of from 85° to 92° F. It gives rise to a sensation of either heat or cold, according to the temperature of the body at the time of immersion. It cleanses the skin, promotes perspiration, and allays thirst. It is sometimes employed as a preparative to the temperate, cool, or cold bath. When there is a tendency to apoplexy, the simultaneous immersion in the tepid bath, and affusion of cold water over the head, have been recommended.

b. The *Warm Bath* has a temperature of from 92° to 98° F.:—that is, about that of the body, or a little below it. In general it causes a sensation of warmth, which is more obvious when the body has been previously cooled. It renders the pulse fuller and more frequent, accelerates respiration, and augments perspiration. It causes languor, diminution of muscular power, faintness, and a tendency to sleep. As a relaxant, it is employed to assist reduction in dislocations of the larger joints, and in hernia. In the passage of calculi, whether urinary or biliary, it is used with the greatest advantage: it relaxes the ducts, and thereby alleviates the pain, and facilitates the passage of the concretion. In gastritis, enteritis, cystitis, and nephritis, it proves a valuable and powerful agent. In exanthematous diseases, when the eruption has receded from the skin, in chronic cutaneous diseases, rheumatism, amenorrhœa, and dysmenorrhœa, it is highly serviceable.

The *coxæluvium*, or *hip-bath*, is resorted to in inflammatory or spasmodic affections of the abdominal and pelvic viscera, and in amenorrhœa, and in dysmenorrhœa. It is also sometimes employed as a substitute for the general bath, where some affection of the lungs, heart, or great vessels, prohibits the use of the latter. The *bidet* is employed in piles, prolapsed rectum, strangury, ischuria, &c. The *pediluvium*, or *foot-bath*, is used as a revulsive or counter-irritant in slight colds; to promote the menstrual and hemorrhoidal discharges; and for various topical purposes. The *brachiluvium*, or *arm-bath*, and *manuluvium*, or *hand-bath*, are principally applied in topical affections of the upper extremities.

c. The *Hot Bath* has a temperature of from 98° to 112° F. It causes a sensation of heat, renders the pulse fuller and stronger, accelerates respiration, occasions intense redness of the skin, and subsequently copious perspiration; gives rise to violent throbbing, and a sensation of distention of the vessels of the head, with a feeling of suffocation and anxiety. Long immersion may cause apoplexy. Being a powerful excitant, its use requires considerable caution. It is principally employed in paralysis, rheumatism, and some other chronic diseases.

The above remarks apply to common or fresh water-baths. But *Sea Water*, *Mineral Waters*, and various *Medicated Waters*, are employed for general or topical baths. Of the

medicated water baths, those in most frequent use are the *nitro-muriatic*, the *ioduretted*, the *salt water*, the *alkaline*, and the *alkaline sulphuretted*. These will be described hereafter. A *decoction or infusion of bran*, and *a solution of bichloride of mercury*, are used as pediluvia. *Milk* and *gelatinous liquids* are employed as nourishing baths. *Blood*, and *the soft parts of recently killed animals*, were formerly used as baths. (See Quiring, *op. supra cit.*)

Mud-bathing (*illutatio*, from *in*, upon; and *lutum*, mud) is a very ancient practice. The slime of the Nile was formerly in great request for this purpose.[1] The saline mud found on the sea-shore has been employed, in very hot weather, as a bath, by the inhabitants of Crimea, and especially by the Tartars, against hypochondriasis, scurvy, scrofula, &c. It operates as an excitant and sudorific. (*Bull. des Sc. Méd. de Ferussac*, xiii. 179.) *Hot dung* is used in France, as a kind of bath against rheumatism, and in Poland against syphilis. (Merat and De Lens, *Dict. de Mat. Méd.* art. *Bain.*) *The husk of the grape*, and *the refuse of the olive*, from which the oil has been drawn, undergo fermentation, and, in this state, have been successfully employed in Paris against acute rheumatism. (Merat and De Lens, *Dict. de Mat Méd.* art. *Bain.*)

2. **Warm Affusion.**—Warm affusion excites very pleasant sensation, followed by chilliness, and often by pulmonary affections. It has, however, been used in mania. It reduces the frequency of the pulse and of respiration, and occasions a tendency to repose; but its effects are much more temporary than those of the warm bath. (For farther details respecting *Affusion*, see p. 61.)

3. **Warm Fomentations and Poultices.**—*Warm fomentations* are employed to relieve inflammation, pain, tension, and spasm. In inflammation of the abdominal and pelvic viscera, and in strangury, they are highly serviceable. My friend and colleague, Mr. Luke, has employed, for several years, warm water as an emollient application to burns and scalds, and his account of its effects is as follows:—"After several years' experience in the use of warm water as an application in the first treatment of scalds and burns admitted into the London Hospital, I am enabled to say, that the general result has been very satisfactory. It has, almost in every instance, appeared to soothe and mitigate pain; and, in many instances, to facilitate the recovery of the patient from the great constitutional depression so frequently attendant upon cases of severity. In these respects I think it exceeds in value all other means which I have seen used. It appears also to me to have exerted a beneficial influence in mitigating the consecutive inflammation, rendering the after consequences less severe locally, and the reparative process more speedy, than under other modes of treatment. The most striking exemplifications of its value have been seen in the treatment of the scalds and burns of young children, and of those cases where the vitality of the skin has not been completely destroyed. The water has generally been used in the form of fomentations; repeatedly changing the flannels, and taking care that the surface of the skin was exposed as little as possible. The occasional use of poultices has also been adopted, and with much benefit; although their weight, when large, has rendered them not so convenient as fomentations: they obviate, however, the evil arising from the frequent renewal of the latter, and the consequent mechanical irritation. Inability to continue the warm bath, for the requisite length of time, has been the reason for its not being used in these cases."

Emollient poultices act as a kind of local bath. They are employed to relieve pain, spasm, and tension, and to promote the termination of inflammation by resolution or suppuration.

4. **Warm Aqueous Drinks and Injections.**—Tepid or warm water is *taken into the stomach* to promote vomiting; to dilute the contents of the stomach, in cases of poisoning by acrid substances; to excite diaphoresis in rheumatism, catarrh, gout, &c.; and to allay troublesome cough, especially when dependent on irritation at the top of the larynx. Warm water is *injected into the rectum* to excite alvine evacuations; to promote the hemorrhoidal flux; to diminish irritation in the large intestine, or in some neighbouring organs, as the uterus, bladder, prostate gland, &c.; and to bring on the menstrual secretion. *Thrown into the vagina*, it is

[1] Aetii, *Serm.* i. cap. 1 and 3.—Sunderland, *Attempts to revive Ancient Medical Doctrines*, vol. i p. 45. Lond. 1763.

used to allay uterine irritation and pain, and to promote the lochial discharge. *Injected into the bladder*, it is sometimes employed to relieve vesical irritation, or to distend the bladder previously to the operation of lithotrity. It has also been *injected into the urethra* to allay pain, irritation, inflammation, and spasm.

Lastly, Magendie *injected warm water into the veins* in hydrophobia, but without saving the life of the patients. I have repeated the experiment, but without any successful result. The same remedy has been employed by Vernière (Christison's *Treatise on Poisons*, p. 35, 3d ed., 1835.) to distend the venous system, and thereby to check or stop absorption in cases of poisoning by those substances (opium, for example,) which operate by getting into the blood. Moreover, warm water is sometimes used as a medium for the introduction of more powerful agents (as emetic tartar) into the circulating system.

5. **Boiling Water.**—Water at the temperature of 212° F. is a powerful irritant, vesicant, and cautery. Its effects are similar to those of steam before mentioned. It has been applied to the skin as a powerful counter-irritant in maladies of internal organs, and as a speedy vesicant when the object is to introduce medicinal substances (morphia, for example) into the system by the cutis vera. But the excessive pain which it gives rise to, the uncertainty of its effects, and the difficulty of localizing its action, are great and almost insuperable objections to its use.

Frigus.—Cold.

Physiological Effects.—The general effect of cold on living bodies is a diminution of vital activity; which terminates, if the cold be intense and its application continued, in death; but, if moderate and temporary, in increased activity of the vital powers, *i. e.* in reaction. Hence, then, we distinguish two orders of effects:—

1. The *direct*, *primary*, or *immediate*.
2. The *indirect*, *secondary*, or *mediate*.

In the warm-blooded animals there are two modes of checking or diminishing their temperature:—

1. The abstraction of caloric, by the application of cold substances to the body.
2. The diminution of the generation of heat within the body, by use of refrigerants or sedatives.

The influence of cold is threefold:—

1. Physical; including *diminution of volume*, *of temperature*, and *of fluidity*.
2. Chemical; comprising *a diminished tendency to changes of composition*, and *to decomposition*.
3. Dynamical, Physiological, or Vital; comprehending *changes in the condition of the vital properties*, induced by cold. These changes are of two kinds:—
   α. Primary; sedation, or a diminution of vital activity.
   β. Secondary; reaction.

a. On Vegetables.—The effects of cold on plants are greater in proportion to the combined humidity. The first effect is a certain state of languor or torpor manifested in germination, the growth and development of all the vegetable organs, inflorescence, fecundation, and maturition of the fruit. Cold also favours the disarticulation of articulated parts. Lastly, by an intense frost the aqueous juices freeze,—an effect which is often attended with the death of part or the whole of a plant. (De Candolle, *Physiologie Végétale*, t. 3me, p. 1117. Paris, 1832.)

b. On Man, and other Animals.—The first effect of diminished temperature is that which we denominate a sensation of cold. Its intensity depends not merely on the actual degree of cold to which the living surface is exposed, but is in proportion to the conducting power of the cooling agent, as well as to the previous heat of the living surface.

"If, in winter, a person, with bare feet, were to step from the carpet to the wooden floor, from this to the hearth-stone, and from the stone to the steel-fender, his sensation would deem each of these in succession colder than the preceding. Now the truth being that all had the same temperature, only a temperature inferior to that of the living body, the best conductor,

when in contact with the body, would carry off heat the fastest, and would, therefore, be deemed the coldest." (Arnott's *Elements of Physics*, Philda. ed.)

A substance, having a temperature of 60° F., will feel warm to the hand or other living part previously exposed to a temperature of 32° F., but cold to a part which immediately before was exposed to a heat of 96° or 98° F.

The sensation of cold is soon followed by a reduction of temperature and a diminution of volume of the part. This last effect is partly physical, partly vital. Of course the solids and fluids of the body, in common with inorganized substances, must have their bulk reduced when their temperature is diminished. But a living part lessens in size from a vital manifestation—viz. the contraction of the living tissues. This contraction, or astriction, is especially manifested in the skin when exposed to a cooling influence. The cutaneous tissue becomes dry and shrivelled, while the bulbs of the hairs become elevated and manifested; constituting the state called goose-skin (*cutis anserina.*) In muscular tissues, spasmodic contraction results from cold. Moreover, this effect extends by sympathy to other muscular parts beyond those to which the cold is applied. The blood-vessels, in common with all other living parts, suffer contraction; and the quantity of blood circulating in them is thereby lessened, while its motion is retarded. The secretions and exhalations are checked or stopped; partly as a consequence of the effect on the circulation of the part, partly by the contraction of the secreting and exhaling vessels. If the cold be excessive, or its action prolonged, the part, after suffering more or less uneasiness, loses its sensibility. This state of torpefaction, or benumbing, when fully established, is denominated *frost-bite;* and, unless speedily relieved, will be soon followed by the death of the part.

"I perceived one day on a journey," says Beaupré, (*A Treatise on the Effects and Properties of Cold*, p. 132. Translated by Dr. Clendinning, Edinb. 1826.) "that two officers, prisoners of war, and my companions in misfortune, had the points of their noses of a horn white, the colour of old wax. I warned them, and frictions with snow were sufficient to remove this first stage of congelation, which they had not suspected. But what appeared to them very singular was, that, while I gave them advice, I myself needed the same—my nose was in the same condition; *sibi non cavere et aliis consiliam dare.* From that moment we were on the alert; we kept on our guard; and, that we might not fall victims to a security alike fatal and involuntary, each begged his neighbour, on terms of reciprocal service, to watch over his nose and ears."

"After entire cessation of pain, the part remains cold and insensible; sometimes phlyctenæ arise; sometimes the change of colour in the skin, which is livid and blackish, evinces from the commencement that there is mortification." (*A Treatise on the Effects and Properties of Cold*, p. 132. Translated by Dr. Clendinning, Edinb. 1826.)

Such is a sketch of the primary topical action of continued intense cold. When, however, it is either moderate or only temporarily applied, reaction is readily induced. The disagreeable feeling of cold is succeeded by an agreeable sensation of warmth; the natural temperature returns, relaxation takes place, and the parts acquire their usual volume, colour, and sensibility. When the cold to which the part has been exposed is excessive, and the heat subsequently employed to excite reaction be too suddenly applied, inflammation and gangrene ensue.

Pernio, or *chilblain*, is the effect of inflammation caused by cold.

That gangrene and death readily result from the sudden application of warmth to a frozen part, was known to Hippocrates, (*De usu liquidorum*, p. 425, ed. Fæsii.) who states that a man having had his feet frozen, lost them by the application of warm water.

The true method of recovering frost bitten parts consists in very gradually restoring their natural temperature by the use, first, of snow or ice frictions, then of cold water, and subsequently of luke-warm water.

Hitherto I have considered the effects of cold used topically: I must now notice its effects when employed generally.

Temporary exposure to moderately cold air (from 30° to 45° F.) is agreeable, and, by the reaction which it establishes, exciting to the young and the vigorous.

The coldness of surface and diminished capillary circulation, which it at first occasions, are soon followed by reaction, especially if exercise be conjoined. Perspiration is checked and urine promoted. A more intense or a longer continued cold causes shivering, goose-skin, determination of blood to internal organs, coldness of surface, and a kind of spasmodic stiffness. These effects are much more severely experienced by the old, the debilitated, and the paralytic.

When the degree of cold is excessive, or its application too prolonged, it causes torpor, irresistible tendency to sleep, apoplexy, asphyxia, and death.

A remarkable and well-known instance of the strong tendency to sleep induced by cold occurred in one of Captain Cook's voyages[1]. Sir Joseph Banks, Dr. Solander, and some others, landed on Terra del Fuego, and were overtaken by night on the hills. Dr. Solander warned the party against giving way to sleep. "Whoever sits down," he observed, "will sleep, and whoever sleeps will wake no more." Yet he was the first who experienced this irresistible desire to sleep, and he insisted upon being suffered to lie down. He was, however, dragged along. Nevertheless, he slept for five minutes, and it was discovered that the muscles of his feet were so contracted that his shoes dropped off.

In both ancient and modern times, military expeditions have furnished dreadful and notorious illustrations of the disastrous effects of cold on the human frame. The Greeks under the command of Xenophon, (*Cyropædia*, lib. iv.) in their retreat from Persia, and on two occasions under the command of Alexander the Great,[2] suffered severely from cold. In more modern times, we have examples of much greater military disasters from cold. In 1719, the Swedes lost, by cold, 5200 out of 7300 men in their retreat from Norway. (*Historical Register* for 1719, vol. iv. p. 308–310.) In 1742, in the retreat of Prague, 4000 Frenchmen perished from cold and misery in ten days. (Beaupré, *op. supra cit.* p. 96.) The dreadful sufferings of the French army, in 1812, on its return from Moscow, are too well known to need much notice on the present occasion.[3] Buonaparte invaded Russia with an army of 400,000 men. He left Moscow with only 120,000; and by the time he arrived at Smolensko, great difficulty was experienced in assembling 40,000 men in fighting order. About 10,000 Frenchmen, and 25,000 auxiliaries, alone remained to return to their native country.

The diseases produced by cold are numerous. (See Dr. Clendinning, in the *Lond. Med. and Phys. Jour.* for June, July, and Sept. 1832.) Chilblains and frost-bites have been already referred to. Pulmonary affections are by far the most common of the internal maladies induced by cold. Scrofula is a disease of cold and moist climates. Rheumatism is another malady brought on by cold and moisture conjoined. Apoplexy and paralysis, especially in the aged, are occasioned by cold. (*Dict. of Pract. Medicine*, art. *Cold*. By J. Copland, M. D.) In addition to the diseases now mentioned, there are many others the progress of which are more or less promoted by cold.

On examining the bodies of persons killed by cold, congestion of the cerebral vessels, and effusion into the ventricles of the brain, (Kellie, *Trans. of the Medico-chirurgical Society of Edinburgh*, vol. i. p. 84.) have always been found.

Therapeutical Uses.—We employ cold for the purpose of obtaining its primary, its secondary, or its total effects. (Gallot, *Diss. Inaug. De Frigoris Usu Therapeutico.* Berol. 1838.) When our object is to procure the first of these effects, we use a more intense degree of cold, and continue it for a longer period than if we are desirous of obtaining the secondary effects only.

The following are the principal purposes for which we use cold:—

1. To lessen preternatural heat; as in ardent fever.
2. To reduce excessive vascular action; as in inflammation.
3. To allay exalted sensibility and pain; as in burns.
4. To constringe the living tissues; as when we apply cold to arrest hemorrhage, to relieve congestion, to check profuse exhalation or secretion, to counteract relaxation, and to reduce the volume of enlarged or displaced parts.
5. To make a sudden and powerful impression on the nervous system; as when we use aspersion of cold water to relieve syncope, and immersion in cold water to allay spasm.

[1] Hawkesworth's *Account of the Voyages for making Discoveries in the Southern Hemisphere*, vol. ii. p. 46. Lond. 1773.

[2] Pratt's Translation of Quintus Curtius's *History of Alexander the Great*, vol. ii. pp. 157 and 233. Revised ed. 1821.

[3] Count Segur's *History of the Expedition to Russia, undertaken by the Emperor Napoleon in* 1812. Lond. 1825.—Beaupré, *op. supra cit.* p. 93.—Sir H. Halford, *Lond. Med. Gaz.* vol. xix. p. 903.

6. To strengthen or give tone to a part or the whole of the body; as in the ordinary hygienic uses of the cold plunge-bath and the cold shower bath.

As cold is thus adapted to produce several objects, so it frequently happens in practice that it is employed to fulfil, simultaneously, several indications.

a. Cool Air.

In febrile diseases, accompanied with preternatural heat, exposure to moderately cool air (from 50° to 60° F.) is both grateful and efficacious. It diminishes the temperature of the body, and reduces excessive vascular action. In the admission of fresh and cool air to patients affected with febrile disorders, consists one of the most important features of the modern improved methods of treating fevers.

b. Cold Water.

1. **Cold, Cool, and Temperate Baths.**—*a. Cold Bath.* The temperature of this ranges from 33° to about 60° F. When below 50° F., the bath is considered very cold. Its primary effects constitute the *shock*,—its secondary effects, the *reaction* or *glow*.

The sudden abstraction of heat from the surface of the body, and the pressure of the water, produce a powerful effect on the system: a sensation of cold (speedily followed by one of warmth,) contraction of the cutaneous vessels, paleness of the skin, diminution of perspiration, and reduction of the volume of the body, are the immediate effects. Shivering, and, as the water rises to the chest, a kind of convulsive sobbing, are also experienced. Continued immersion renders the pulse small, and, ultimately, imperceptible, and the respiration difficult and irregular; a feeling of inactivity succeeds; the joints become rigid and inflexible; pain in the head, drowsiness, and cramps, are experienced; the temperature of the body falls rapidly; and faintness, followed by death, comes on. Many of these symptoms are readily accounted for: the contracted state of the superficial vessels produced by the cold, and the pressure of the water, together cause the blood to accumulate in the internal vessels. The palpitations arise from the efforts made by the heart to rid itself of the increased quantity of blood thrown on it; but the pulse continues small, because the arteries remain contracted. The internal veins becoming gorged, the functions of the brain necessarily suffer:—and hence arise headach, drowsiness, cramps, and, in some cases, apoplexy. The difficult respiration depends on the accumulation of blood in the lungs. The contracted state of the superficial vessels accounts for the diminished perspiration; while the increased secretion of urine is referrible to the blood being driven towards the internal organs.

In general, the immersion being only temporary, reaction quickly takes place; a sensation of warmth soon returns; the cutaneous circulation is speedily re-established; a glow is felt; perspiration comes on; the pulse becomes full and frequent; and the body feels invigorated. In weakly and debilitated subjects, however, this stage of reaction may not occur, or at least may be imperfectly effected; and usually, in such cases, the cold bath will be found to act injuriously.

The cold bath is employed with the view of obtaining the nervous impression or shock,—the refrigeration,—or the reaction or glow. (*Cyclopædia of Practical Medicine*, art. *Bathing*, by Dr. J. Forbes.) It is evident that it ought not to be applied unless there be a sufficient degree of tone and vigour in the system to cause a perfect state of reaction; and, therefore, in weak subjects, its use should be prohibited. So, also, in visceral inflammation, more especially peripneumonia, it is a dangerous remedy; since the determination of blood to the internal organs is increased by the cold, and it seems even within the range of probability that death might be the immediate result. Apoplectic subjects, who are unaccustomed to cold bathing, had also, for a similar reason, better avoid trying it. In some affections of the nervous system it has been found highly useful; for example, in tetanus and insanity. In many cases, where it is desirable to increase the

tone and vigour of the body, and where the before-mentioned objections do not exist, the cold bath may be used advantageously. It is a common opinion that immersion in cold water is dangerous when the body is heated by exercise, or other exertion; and hence it is customary with bathers to wait until they become cool. Dr. Currie[1] has strongly combated both the opinion and the practice: the first, he says, is erroneous, the second injurious.

b. The Cool Bath (whose temperature is from 60° to about 75°) is analogous in its operation to the cold bath, but is less powerful. It is commonly used as a luxury, and for cleanliness; but it may be employed, therapeutically, in the same diseases as the cold bath, where we are in doubt as to the power of the patient's constitution to establish full reaction, after the cold bath. It is frequently resorted to as a preparative to the cold bath.

c. The *Temperate Bath* ranges from 75° to 85° F. Its effects and uses are similar to the cool bath.

2. **Affusion** (*Perfusio;* Καταχυτις.) Affusion was employed, as a hygienic agent and luxury, by the Greeks and Orientalists at a very early period. Homer (*Odyssey*, x. 362.) makes some allusions to it; Hippocrates (*Aphorismi*, sect v. aph. 21; and sect. vii. aph. 42.) used it in medicine; and Celsus (Lib. i. cap. 4.) recommends it in some affections of the head. The last-mentioned writer also states, that Cleophantus (a physician who lived about 300 years before Christ) employed hot affusion in intermittents. (Lib. iii. cap. 14.)

The affusion on the head is thus effected:—The water is to be poured on the head (inclined over a pan or tub,) by means of an ewer or pitcher, from a height of two or three feet. If the patient be confined to his couch, the head should be inclined over the side of the bed. In children, it is sufficient to squeeze a large sponge (previously soaked in water) at some height above the head, as recommended by Dr. Copland. (*London Medical Gazette*, vol. x.) When the object is to apply affusion to the whole body, the patient is placed in a large tub or pan (*e. g.* a bathing tub or washing pan,) and then an attendant, standing on a chair, may readily effect it. The time that the affusion should be continued varies, according to circumstances, from a quarter of a minute to two or three minutes; but in some cases it has been employed for twenty minutes. After the affusion the body should be carefully wiped dry, the patient wrapped up warm, and placed in bed.

The effects of affusion depend partly on the temperature of the liquid, and partly also on the sudden and violent shock given to the system by the mechanical impulse; hence the reason why the effects vary, according to the height from which the water is poured.

a. Cold affusion.—When water whose temperature is between 32° and 60° F. is used, we denominate the affusion *cold*. To a certain extent the effect of cold affusion is analogous to that of the cold bath, but modified by two circumstances, namely, the short period during which the cold is applied, and the mechanical influence of the stream: hence, its primary effects are very transient, and reaction speedily follows. By a long continuance of affusion, however, the heat of the body is considerably reduced, and the same diminution of vital action occurs as when the cold bath is employed. The sensation of cold, the constriction of the skin, and the contraction of the superficial vessels, first experienced in the part to which the water is applied, are very speedily communicated to the rest of the system by sympathy; and the effects are perceived in the nervous, vascular, secreting, and cutaneous systems. The temperature of the whole body falls, the pulse is reduced in fulness and frequency, the respiration becomes irregular, convulsive shiverings take place, faintness; and, in fact, all the previously described effects of the cold bath are produced. During this condition the excretions are suspended. "When," says Dr. Copland, "the stream of water is considerable,

[1] *Medical Reports on the effects of Water, cold and warm, as a Remedy in Fever and other Diseases*, vol. i. p. 112.

and falls from some height upon the head, the effect on the nervous system is often very remarkable, and approaches more nearly than any other phenomenon with which I am acquainted to electro-motive or galvanic agency."

After affusion, reaction is soon set up, the heat of the body is re-established, the pulse becomes full and regular, though sometimes reduced in frequency, the thirst is diminished, and frequently perspiration and tendency to sleep are observed.

Cold affusion is used principally in those cases where it is considered desirable to make a powerful and sudden impression on the system: for as a mere cooling agent it is inferior to some other modes of applying water. It is objectionable in visceral inflammation, on account of the determination of blood which it produces to the internal parts. It has been employed with great benefit in *fevers*, both continued and intermittent. It may be used with safety, according to Dr. Currie (*Op. supra cit.*) and others, "when there is no sense of chilliness present, when the heat of the surface is steadily above what is natural, and when there is no general or profuse perspiration." It is inadmissible during either the cold or the sweating stage of fever, as also in the hot stage, when the heat is not greater than ordinary. In some instances it seems to act by the shock it communicates to the system; for the effect is almost immediate, the disease being at once cut short. The patient has fallen asleep immediately afterwards, profuse perspiration has succeeded, and from that time recovery commenced. This plan of extinguishing a fever, however, frequently fails; and in that event the patient may be in a worse condition: hence the practice is not often adopted. I think the cases best adapted for the use of cold affusion are those in which there is great cerebral disorder,—either violent delirium or a soporose condition. My friend, Dr. Clutterbuck, (*Inquiry into the Seat and Nature of Fever*, 2d ed. p. 451.) says he has seen pulmonic inflammation and rheumatism brought on by cold affusion in typhus; but he adds, "I have not, in general, observed that the situation of the patient was rendered materially worse by the combination."

In the *exanthemata*, cold affusion has been applied during the fever which precedes the eruption, as also after this has been established; it has been used in scarlet fever, and also in small-pox; likewise in measles; but its employment in the latter disease is objectionable, on account of the tendency to pulmonary inflammation, in which affection cold affusion is prejudicial.

Croup is another disease in which cold affusion has been used with advantage, principally with the view of removing the spasm of the glottis, which endangers the life of the patient.

In *inflammatory affections of the brain*, especially of children, after proper evacuations have been made, it is useful. In many cases of *narcotic poisoning*, cold affusion is of the greatest service; as in poisoning by hydrocyanic acid, and in asphyxia caused by the inhalation of carbonic acid; so also in poisoning by opium, belladonna, and other narcotic substances; in intoxication; (*Lond. Med. Gaz.* vol. ix. p. 502.*) in asphyxia from the inhalation of sulphuretted hydrogen gas, or of the vapours of burning charcoal, it is most advantageous. In *hysteria* and *epilepsy* it is oftentimes serviceable: it diminishes the duration of the paroxysms, and relieves the comatose symptoms. In *puerperal convulsions* Dr. Copland relies on cold affusion and blood-letting. In *mania* it is oftentimes serviceable; as also in *tetanus*. In *malignant cholera* it sometimes proved valuable; (*Lond. Med. Gaz.* vol. ix. pp. 452, 502, and 505.) principally, however, in mild cases. In severe attacks the power of reaction was insufficient.

b. Cool affusion has been employed instead of the cold; and in weak irritable subjects it is always preferable. Dr. Currie regards it as a milder form of the cold affusion, as a preparatory means to which it is sometimes used. It has been applied in febrile diseases and paralysis.

c. Tepid affusion.—The affusion of tepid water is frequently resorted to as a substitute for that of cold water, where great dread is entertained of the latter

agent, or where there is doubt as to the production of a perfect reaction after the application of cold water, or where there is some pulmonary disease. It may be regarded as a safer, though less powerful means. Thus it is very useful in febrile complaints, especially of children. It is very beneficial in scarlet fever, as I have seen on several occasions. Dr. Currie thinks that it reduces the temperature more than cold affusion; first, because the evaporation is greater; secondly, because it does not excite that reaction by which heat is evolved. It diminishes the frequency of the pulse and of respiration, and causes a tendency to sleep. The same writer tells us that he has not found its effects so permanent as those of the cold affusion; and that he never saw it followed by the total cessation of regular fever. In other words, it produces a much less powerful shock to the system, and, therefore, is less influential over disease. In hectic fever, however, the paroxysm is sometimes completely extinguished by the affusion of tepid water at the commencement of the hot stage.

Warm affusion has been already noticed. (See p. 56.)

3. The Shower-Bath (*Impluvium.*)—The shower-bath is very similar in its effects to, but milder than, affusion. It is frequently employed as a hygienic agent. In insanity it is used with the greatest benefit to allay mental excitement. In violent cases, "the application of the shower-bath, the patient being up to the middle in warm water, seldom fails to subdue the paroxysms." (Dr. Conolly's *Report* before quoted, p. 66.) The period during which it should be continued is a circumstance of some moment. Dr. Conolly observes that it "should be suspended when the patient appears overcome, and instantly renewed when symptoms of violence recur. A strong shower continued even for a minute, has sometimes considerable effect;" and it should never be "many minutes prolonged without careful observation of the patient's state. After four or five applications of this kind, the patient becomes entirely subdued, and should then be taken out of the bath, rapidly dried, warmly covered up, and put into bed; with every possible demonstration of kind attention. Calmness and sleep are the usual results; and more permanent effects frequently follow. A bath of this kind appears to produce a moral as well as a physical impression; being succeeded, in recent cases, by tranquillity for a few days, and in chronic cases by quietness and improved behaviour for many weeks, and sometimes even for months."

The shower-bath is sometimes a valuable substitute for the cold bath or cold affusion, than which it is less likely to occasion cramp or other disorder of the nervous system. Tepid or even warm water may be used where we wish to reduce the violence of the shock.

An extemporaneous shower-bath may be produced by the aid of a cullender. It may be used to allay the violent delirium of fever; and is rendered more beneficial if the patient can be persuaded to sit in a semicupium of warm water. (Dr. Lendrick, *Lond. Med. Gaz.* vol. ii. N. S. p. 104.)

4. The Douche (*Duccia.*) The term *Douche* is applied to a column or current of fluid directed to, or made to fall on, some part of the body. It is uncertain at what time it came into use. Cælius Aurelianus, (*Morbor. Chronicor.* lib. ii. cap. 1.) has been supposed by some to refer to it in the following passage:—"Item *aquarum ruinis* partes in passione constitutæ sunt subjiciendæ, quas *Græci* καταχλυσμούς appellant, plurimum etenim earum percussiones corporum, faciunt mutationem."

The fluid employed is either water or aqueous vapour: hence we have the *liquid douche* and the *vapour douche*. According to the direction in which the fluid is applied, we have *the descending*, *the lateral*, and *the ascending douche*.

The effect of the liquid douche depends in part on mechanical action or percussion, which, by continuance, excites topical pain and inflammation; and in part on the temperature of the liquid. The local excitement more speedily occurs from hot than cold water; indeed the long continued action of a stream of cold

water may act as a sedative, and cause the primary effects of cold before described. The effect of the douche is not wholly local, since the neighbouring parts, and even the whole animal economy, soon become affected. A column of water twelve feet high, made to fall perpendicularly on the top of the head, excites such a painful sensation, that, it is said, the most furious maniacs, who have once tried it, may sometimes be awed merely by the threat of its application; and hence one of its uses in madness, as a means of controlling the unfortunate patient. "At this moment a controversy is proceeding among certain French physicians concerning the application of the douche; which some are disposed to use as a specific against delusive notions. The patient is kept under the douche until he entirely recants. The principle is extremely doubtful; and it should be remembered of every severe application, that lunatics are seldom able to make their real sufferings distinctly known. M. Esquirol subjected himself to the douche; and he describes the sensation as very painful; resembling the continued breaking of a column of ice on the head, followed by a feeling of stupefaction, which lasted an hour afterward." (Dr. Conolly's *Report* before cited, p. 68.) Probably all the good effects of the douche may be obtained by the shower-bath, the application of which is much less distressing to the patient.

The cold douche is applicable to some cases of local diseases requiring a powerful stimulus; as old chronic affections of the joints, whether rheumatic, gouty, or otherwise;[1] paralytic affections; sciatica; old glandular swellings; chronic headach; deafness, &c. (Dr. Butzke, *London Medical Gazette*, N. S. for 1839, 1840, vol. i. p. 893.) has recently employed it with good effect in old ulcers of the feet. In some of the preceding cases a warm, is used instead of the cold, douche.

The operation of *pumping* practised at Bath, may be regarded as a kind of douche, and is used in the same cases. The degree or extent of the application is determined by the number of times the handle of the pump is raised or depressed. From 20 to 200 strokes of the pump is the number generally directed to be taken at one time, which, however, may be increased or diminished according to the age, sex, strength, or other circumstances of the patient.[2] The water does not issue in gushes, but in a continuous stream.

5. **Lavation, Washing, or Sponging.**—Cold, cool, or tepid washing or sponging, may be used in febrile diseases, with great advantage, in many cases where affusion is not admissible, or where timidity on the part of the patient or practitioner prevents the employment of the latter. (Dr. Currie, *Reports*, vol. i. p. 72, 4th ed.) remarks, that in all cases of fever where the burning heat of the palms of the hands and soles of the feet is present, this method of cooling them should be resorted to. A little vinegar is frequently mixed with the water, to make the effect more refreshing. Washing or sponging must be effected under precisely the same regulations as those already laid down for affusion.

6. **Cold Lotions.**—Aqueous and spirituous liquors are employed as lotions to generate cold by evaporation, and thereby to relieve local irritation and inflammation. They should be applied by means of a single layer of thin muslin or linen, and not by a compress. The cold is considerably increased by blowing on the part. Evaporating lotions are applied to the head with great relief in cephalalgia, phrenitis, fever with disorder of the cerebral faculties, and poisoning by opium. In ophthalmia, fractures of the bones of the extremities, severe bruises, and erysipelatous inflammation, cold lotions are used with benefit. Dr. Kinglake, (*A Dissertation on the Gout*. Lond. 1804.—*Additional Cases of Gout*. Lond. 1807.) recommended the application of cold water to parts affected with gout, but the practice is somewhat hazardous. One method of treating burns is by the application of cold water to the injured part. In modern times, Sir James Earle,[3]

[1] See some observations of Lisfranc on the use of the Douche in White Swelling, in the *Lancet*, vol. ii. 1834–5. p. 337.

[2] *A Practical Dissertation on the Medicinal Effects of the Bath Waters*, by William Falconer, M. D. 1790.

[3] *An Essay on the means of lessening the Effects of Fire on the Human Body*. Lond. 1799.

was the great advocate for this plan, which proves more successful in scalds and slight burns. The burnt part should be covered with rags, and kept constantly wetted with water, in which ice is placed from time to time; "care being taken never to remove the rags from the burnt surface."[1]

If the cold fluid be continually renewed, the practice has been called *irrigation*. (Macartney, *Treatise on Inflammation*, p. 158. London, 1838.) It is effected either by allowing cold water to drop on the affected part, from a stopcock inserted in the side of a bucket of water, or by conducting a stream of water from a vessel by means of a strip of cloth, on the principle of a syphon.

7. **Cold Drinks.**—Hippocrates, (*De usu liquidorum.*) Celsus, (Lib. iii. cap. 7.) and other ancient writers, employed cold water as a drink in ardent fever. In modern times also it has been extensively used in the same malady. Dr. Hancocke[2] called it the *febrifugum magnum*. Its employment, however, has not been limited to fever. From its supposed great efficacy in gouty complaints, Heyden[3] termed it the *arthritifugum magnum*. Within the last ten years, thirteen or fourteen establishments have been set up in Germany, for the cure of diseases by cold water. This mode of treatment is denominated *Wasserheilkunst*, or *Wasserkur* (Water-cure.[4])

We are indebted to Dr. Currie for the examination of the circumstances under which the employment of cold water in fever is proper. According to him, it is inadmissible during the cold or sweating stage, but may be employed with safety and advantage when the skin is dry and burning: in other words, the regulations for its administration are precisely the same as for cold affusion. When exhibited under proper circumstances, it operates as a real refrigerant, reducing preternatural heat, lowering the pulse, and disposing to sweating. Occasionally, however, serious and even fatal consequences have resulted from the employment of large quantities of cold water by persons who have been rendered warm by exercise and fatigue.

Besides fever, there are several other affections in which cold water is a useful remedy. For example, to facilitate recovery from epilepsy, hysteria, and fainting; and to alleviate gastric pain and spasm. Large draughts of cold water have sometimes caused the expulsion of intestinal worms, (*Tænia* and *Ascaris vermicularis.*)

8. **Cold Injections.**—*a.* Cold water is thrown into *the rectum* to check hemorrhage, to expel worms, to allay local pain, to rouse the patient in poisoning by opium, to stop hemorrhage, and to diminish vascular action in enteritis.

b. Dr. A. T. Thomson[5] speaks very favourably of the effects of cold water introduced into the *vagina*, by means of the stomach-pump, in uterine hemorrhage.

3. Ice and Snow.

The temperature of these agents does not exceed 32° F. They are employed both internally and externally.

1. **Employed externally.**—The topical effects (primary and secondary) of cold agents have been already described. (See page 58.) Ice, snow, and ice-cold water, are employed externally to obtain sometimes the primary, at other times the secondary, effects of cold.

a. For the Primary Effects.—Ice is used to check hemorrhage, more especially when the bleeding vessel cannot be easily got at and tied. Thus, after operations about the rectum, (more especially for piles and fistulæ) bleeding sometimes occurs to a most alarming extent; and, in such cases, our principal reliance must be on cold. In two instances that have fallen under my own

[1] *Two Lectures on the Primary and Secondary Treatment of Burns*, by H. Earle. Lond. 1832.
[2] *Febrifugum magnum; or Common Water the best cure for Fevers, and probably for the Plague.* 5th ed. Lond. 1723.
[3] *Arthritifugum Magnum: A Physical Discourse on the Wonderful Virtues of Cold Water.* Lond. 1724.
[4] I must refer the reader to the article *Aqua*, for a short notice of this mode of treatment.
[5] *Elements of Materia Medica and Therapeutics*, vol. ii. p. 78. Lond. 1833.

observation, I believe the lives of the patients were preserved by the introduction of ice within the rectum. In many other cases of hemorrhage, the external application of cold (either in the form of ice or ice-cold water) is exceedingly useful. Thus, applied to the chest in dangerous hemoptysis, and to the abdomen in violent floodings, it is oftentimes very beneficial. In some of these cases, especially in uterine hemorrhage, more benefit is obtained by pouring cold water from a height, (*cold affusion* or *douche*) than by the mere use of ice.

A bladder, containing pounded ice, has been applied to hernial tumours, to diminish their size and facilitate their reduction; but notwithstanding that the practice has the sanction and recommendation of Sir Astley Cooper,[1] it is, I believe, rarely followed, not having been found successful; while, if too long continued, it may cause gangrene. In this, as well as in other cases, where ice or snow cannot be procured, a freezing mixture may be substituted. For this purpose, five ounces of muriate of ammonia, five ounces of nitre, and a pint of water, are to be placed in a bladder, and applied to the part. Ice has also been applied in prolapsus of the rectum or vagina, when inflammation has come on, which threatens to terminate in mortification.

In inflammation of the brain, the *ice-cap* (*i. e.* a bladder containing pounded ice) is applied to the head with great benefit. In fever, also, where there is great cerebral excitement, with a hot dry skin, I have seen it advantageously employed. In apoplexy, likewise, it might be useful; as also in mania, with great mental excitement. In the retention of urine, to which old persons are liable, ice-cold water applied to the hypogastrium is sometimes very effective, causing the evacuation of this secretion.

b. For the Secondary Effects.—Friction with ice or snow is employed to produce the secondary effects of cold in diminished sensibility of the skin, and in the rheumatism or gout of old and enfeebled persons; but its most common use is as an application to frost-bitten parts. The feet, hands, tip of the nose, and pinna of the ear, are the organs most frequently attacked. In order to guard against mortification, and other ill effects arising from a too rapid change of temperature, the vital properties must be slowly and gradually recalled. In order to effect this, the frost-bitten part should be rubbed with snow or pounded ice, or bathed in ice-cold water, very gradually raising the temperature of the applications until the part acquires its natural heat.

2. **Employed internally.**—When ice or ice-cold water is swallowed, the sensation of cold which it produces is neither so acute as that occasioned by the application of ice to the skin, nor so prolonged. For the sensibility of the alimentary tube is less than that of the external integument, while its temperature is higher; so that the ice is sooner melted, and the liquid quickly raised to the temperature of the body. But when swallowed in considerable quantity, the effects of ice are of the same kind as those already described for cold generally. A sensation of cold at the epigastrium is experienced, and sometimes shivering occurs. The pulse is diminished in frequency. Temporary contraction of the alimentary canal, and diminution of irritability and secretion, are produced. When ice is taken in small quantity only, these primary effects are very slight or scarcely noticed, and the stage of re-action quickly succeeds. A feeling of warmth follows that of cold at the epigastrium, and quickly extends over the whole body; the circulation is somewhat accelerated; and the secretions of the alimentary canal, of the kidneys, and of the skin, are promoted. If the re-action be excessive, gastric inflammation may be induced.

Ice, or ice-cold water, is swallowed for the purpose of obtaining either the primary or secondary effects of cold. Thus it is taken to cause contraction of the gastric vessels, and thereby to check or stop sanguineous exhalation from the mucous membrane of the stomach. It has also been found beneficial in nasal,

[1] *The Anatomy and Surgical Treatment of Inguinal and Congenital Hernia*, p. 25. Lond. 1804.

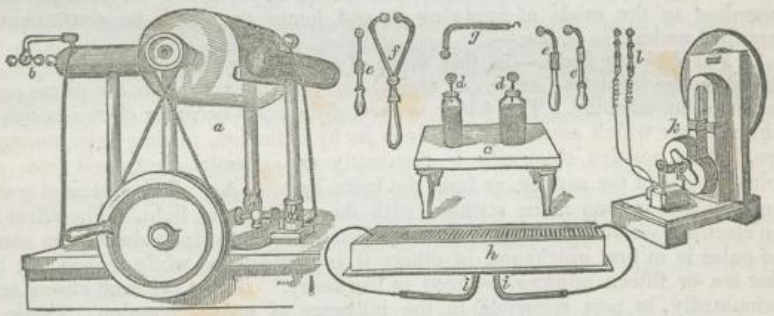
bronchial, and uterine hemorrhage. In the latter cases, the constriction of the bleeding vessels must be effected through sympathetic relations which exist between the stomach and other organs. Ice is also employed to relieve cardialgia, vomiting, and spasmodic pain of the stomach. In the latter stage of typhus fever, the internal use of ice is sometimes beneficial.

3. Electricitas.—Electricity.

Physiologists[1] have long suspected that electricity was the cause of some vital phenomena; and various circumstances lend support to this notion. Among these may be mentioned the extensive agency of this force in the production of the physical and chemical phenomena of the external world;—its well-known remarkable influence on the animal economy;—and, lastly, its development by some fishes, as the *Torpedo vulgaris* and *Gymnotus electricus*. Hitherto, however, no one has succeeded in establishing the identity of electricity and the cause of vital phenomena.

Electricity may be obtained from various sources; but the quantity and condition of this agent, as procured by different methods, are by no means uniform. *The common electric machine* yields, by the friction of its glass cylinder or plate on the rubber, a small quantity of electricity whose tension or elasticity is great, and which, therefore, is capable of exerting attractive and repulsive forces not merely at sensible, but at considerable, distances. We denominate this, *friction*, *ordinary*, *common*, or *Franklinic electricity*. The electricity procured from *the atmosphere*, by *the cleavage of crystals*, and by *pressure*, is of the same kind. By chemical action, however, we put in motion an immense quantity of electricity, whose tension is very low, and we distinguish it by the name of *Voltaic electricity* or *Galvanism*. The electricity obtained by a *magneto-electric machine* is of the latter kind.

Fig. 2.



Electrical Apparatus for Medical Purposes.

FRICTION ELECTRICITY.

a. Cylinder Machine.
b. Medical Electrometer.
c. Insulating Stool.
d d. Leyden Jars.
e e e. Insulated Directors.
f. Discharging Rod.
g. Glass Tube traversed by a wire, which terminates at one end by a loop, at the other by a brass ball.

VOLTAIC ELECTRICITY.

h. Cruickshank's Wooden Trough.
i i. Directors, each consisting of a glass tube traversed by a wire, an extremity of which is connected with one end of the trough—while the other extremity is surmounted by sponge or flannel moistened with salt and water.

MAGNETIC ELECTRICITY.

k. Clarke's Magneto-electric Machine.
l. Directors.

[1] Mr. Abernethy, (*Inquiry into the Probability and Rationality of Mr. Hunter's Theory of Life*, Lond. 1814,) adopting the notion of several preceding physiologists, that life depended on an internal principle distinct from the body,—suggested that this principle was electricity; or if not electricity, "at least we have reason to believe," he says, that "it is of a similar nature, and has the power of regulating electrical operations."—In 1809, Dr. Wollaston (*Phil. Mag.* vol. xxxiii. p. 488) suggested that the products of secretion might be due to electricity of low tension; and the accuracy of this opinion Dr. Wilson Philip (*An Experimental Inquiry into the Laws of the Vital Functions*) has endeavoured to prove experimentally. Meissner has carried the

a. Friction Electricity.

(Common of Franklinic Electricity.)

The apparatus, requisite for the medical application of friction electricity, consists of the following instruments:—

1. A cylindrical or a plate machine. If a cylinder, the diameter should be at least from 8 to 14 inches; if a plate, from 18 to 24 inches. The amalgam used for the rubber is composed of one part tin, two parts zinc, and six parts mercury.
2. A medical electrometer, to regulate the force of the spark or shock.
3. One or two Leyden jars.
4. An insulating stool or chair.
5. A discharging rod.
6. Two or three insulated directors. The brass ball which surmounts each director may be occasionally unscrewed and removed, and a point brought into view.
7. Flexible metallic wire or chain. A brass chain is generally employed; but the spiral brass wire employed for braces is more convenient: it may be enclosed by a silk riband.

Physiological Effects. *a. On Vegetables.*—It is a popular opinion, perhaps founded in fact, that atmospheric electricity promotes vegetation; but the arguments adduced to prove it are somewhat vague. It is said that those years in which the greatest number of thunder-storms occur, are the most productive; and that hops, barley, wheat, vines, &c., shoot up much more rapidly after a storm. These statements may, however, be true, without the inference which has been drawn from them being correct. Mushrooms form, it has been said, an exception to this statement; their growth being retarded by electricity. (De Candolle, *Physiol. Vég.* t. iii. p. 1091.) Some electricians have affirmed that artificial electricity promotes the germination of seeds as well as the growth and green colour of plants; but the accuracy of the statement is exceedingly doubtful. De Candolle says he has observed transpiration increased by it. The movements of the sensitive plant and of the stamina of the barberry may be excited by electricity.

b. On man and other animals.—The effects of electricity on animals vary according to the mode of applying it; and hence they may be conveniently described under five heads:—

1. *The Electric Bath.*—In this mode of employing electricity the patient is placed on the insulating stool, (or chair,) and in connexion with the prime conductor of the machine. The whole surface of the body becomes electro-positive, while the air which surrounds the body is, by induction, rendered electro-negative. The positive electricity is constantly and silently discharged from all pointed parts of the surface, as from the hairs, fingers, &c. In a darkened room the discharge is seen to be attended with the evolution of light. The effect of the electric bath does not appear to be uniform on different individuals. In some the pulse is at first quickened, in others it is unchanged; while in some it is, after ten or fifteen minutes, reduced in frequency.[1] These different effects are, undoubtedly, in part referrible to the influence of mental emotion. Copious perspiration sometimes breaks out while the patient is on the insulating stool.

2. *Electric Aura.*—This is produced by the action of a current of electrified air on the skin. It is applied by means of an insulated pointed director, connected with the prime conductor by a wire or chain; its point being turned to the part intended to be electrified. In this way a current or breeze of highly excited air is directed towards the part. Or the aura may be drawn from the

hypothesis of electricity being the cause of vital phenomena to a most extravagant length (see Müller's *Elem. of Phys.* trans. by Baly, vol. i. p. 73.) That the active principle of the nerves is electricity has long been a favourite opinion. Though many objections have been raised to it, (see Müller, *op. supra cit.* pp. 72 and 633.) yet it has recently received additional support from Prof. Zantedeschi and Favio (*Lond. Ed and Dubl. Phil. Mag.* for April, 1841.) who assert, that independent of *common electro chemical* and *thermo-electric currents*, there exist in animals two *electro-vital* or *neuro-electric currents*—one external or cutaneous, moving from the extremities to the cerebro-spinal axis; the other internal, going from the cerebro-spinal axis to the internal organs situated beneath the skin. Pain, it is said, weakens or suspends the current, while the voluntary or convulsive automatic movements give a very strong current, which may be named discharge of current.

[1] See Mr. Smith's experiments, in Dr. Hodgkin's Translation of Edwards' work, *On the Influence of Physical Agents on Life*, p. 335. Lond. 1832.

patient while placed on the insulating stool, by means of an uninsulated metallic point. The electric aura operates as a mild stimulant, and is occasionally used when we are desirous of electrifying delicate parts—as the eye, ulcers, excoriated surfaces, the testicles, &c.

3. *The Electric Spark.*—This is one form of the disruptive discharge. It may be communicated by presenting to the part to be electrified, the ball or knob of an insulated director connected with the prime conductor. Or it may be drawn from the patient by placing him on the insulating stool, (or chair,) and bringing the knuckle or the ball of an uninsulated director near him. The opposed surfaces, between which the spark passes, are in oppositely electrified conditions. The nearer they are together, and the smaller the ball, the weaker is the force of the spark. A succession of very small sparks is obtained by substituting a wooden point for the metallic ball.

The spark occasions a sharp, painful, pungent sensation, redness, and sometimes a small circumscribed spot or wheal, which, however, in general quickly disappears.

For internal parts, as the bottom of the meatus auditorius externus, a glass tube is used to insulate the conducting wire, the end of which terminates in a very small knob, contained within, or placed at the end of, the tube. (*Fig. 2, g.*)

A favourite mode of employing electric sparks is *to draw them through flannel*, as recommended by Cavallo, (*Complete Treatise on Electricity*, vol. ii. p. 136, 3d ed. Lond. 1786.) and since practised with great success by my friend, Mr. Charles Woodward. This method is called by some electricians *electric friction*. The patient being placed on the insulating stool, takes hold of the chain communicating with the prime conductor, by the hand opposite to the side to be electrified. Over the naked part is then placed a piece of flannel, and, the machine being turned, the operator places the knob of an uninsulated director in close contact with the flannel, and moves it steadily but rapidly so as to draw a vast number of very small sparks. Mr. Woodward says it is essential, for the success of the practice, that the motion of the ball should be down the part affected; that is, in the direction of the ramifications of the nerves. The operation is to be continued for twenty or thirty minutes. It excites an agreeable warmth, but no very disagreeable sensations. When an uneven surface (as of the face and hands) is to be electrified, the ball of the director should be covered with flannel.

4. *The Electric Shock.*—This is a violent effect of the disruptive discharge, and is thus effected. Charge a Leyden jar: then connect its outside by a chain or wire with the ball of an insulated director, which is applied to one extremity of the part through which the electricity is intended to pass. The knob of the jar is then applied to the other extremity of the part, and the discharge instantaneously takes place.

The force or the strength of the charge is graduated by interposing in the circuit a medical electrometer, which is employed thus:—Place the Leyden jar so that its interior may be in communication with the prime conductor, while its exterior is connected with the patient by a chain and insulated director. One of the knobs of the electrometer is then put in communication with the opposite side of the patient by a second chain and director. If the machine be now turned, the jar charges, and, when the tension is sufficiently high, a spark passes from the prime conductor to the ball of the electrometer, and the discharge takes place, the patient experiencing the shock. To increase or diminish the force or strength of the shock, we augment or lessen the space between the prime conductor and the ball of the electrometer.

Sometimes a coated glass tube is substituted for the Leyden phial in the above arrangement, the medical electrometer being employed. The patient then receives a rapid succession of slight shocks, constituting what some electricians denominate *electrical vibration*.

When a portion of the body makes part of the circuit through which the discharge of a Leyden phial is effected, a sudden, instantaneous, and painful sensation is produced, which is denominated *the shock*. If the charge be passed through the arms, the effects are principally experienced in the wrists, elbows, and across the breast. "If the charge is passed through the spine, it produces a degree of incapacity in the lower extremities; so that if a person be standing at the time, he sometimes drops on his knees, or falls prostrate on the floor." (Singer, *Elements of Electricity*, p. 296. Lond. 1814.) If the diaphragm form part of the circuit, it is immediately thrown into a temporary state of contraction. Mr. Singer "once accidentally received a considerable charge from a battery through the head; the sensation was that of a violent but universal blow, followed by a transient loss of memory and indistinctness of vision, but no permanent injury ensued." If a strong charge of a battery be passed through the head of a rabbit, temporary blindness or death ensues. In persons killed by lightning, red streaks are frequently observed on the skin. It is said that marks are often observed indicating the passage of the electric fluid along the spine. The blood is usually fluid, and the muscles flaccid; though occasionally rigidity of muscles has been found.

The greater or less violence of the shock depends not on the quantity merely, but on the intensity of the charge. Thus a small jar highly charged will produce a greater effect than a large battery feebly charged. But of course if the intensities be equal, the greatest shock is perceived when the largest quantity is employed.

5. *The Electric Current.*—To cause a current to pass through a patient to the ground, connect some part of the body directly, or indirectly by a chain or wire, with the prime conductor of the machine; the patient standing on the ground. By this means the current passes into the body at the point of connexion, and escapes by the feet. Its effects are exceedingly slight, and scarcely, if at all, obvious.

Uses.—The uses of electricity are partly rational, partly empirical. When the indications are to excite a nerve of sensation or of motion, or to produce a temporary contraction of muscles, or to promote transpiration and secretion, its employment may be regarded as rational. But it is used, sometimes beneficially, in several diseases in which these indications are by no means obvious. In such, its *methodus medendi* is unknown, and its use may be regarded as empirical.

1. *To stimulate the nerves of sensation.*—In nervous *deafness* electricity is sometimes employed. Sparks are thrown on, or drawn from, the mastoid process, the parts around the meatus auditorius externus, or the bottom of the meatus. In some cases slight temporary relief is obtained. In *amaurosis*, the current, the aura, and sometimes slight sparks and shocks have been tried, but rarely with success.[1] In *topical numbness* unconnected with lesion of the nervous centres, electric friction, sparks, or very slight shocks, are occasionally serviceable.

2. *To excite the motor nerves.*—In partial *paralysis*, benefit is at times obtained by the use of electric friction and slight shocks. When the disease depends on some lesion of the cerebro-spinal centre, relief by electricity is not to be expected. Electricity is calculated to be serviceable when the malady arises from some functional disorder of the nerves. It may also contribute to restore the use of parts originally paralyzed by effusion in some part of the cerebro-spinal centre, but which has been gradually absorbed, leaving the limb paralyzed from desuetude. These cases, however, are comparatively rare. Notwithstanding the favourable account of its efficacy given by Dr. Golding Bird, (*Guy's Hospi-*

[1] Mr. Hey published several successful cases of its use in amaurosis. He never saw the least benefit from its employment when the disease had existed for two years. (*Med. Observ. and Inq.* vol. v. p. 1. Lond. 1795, 2d ed.)

tal Reports, vol. vi. p. 98.) my own experience of its use leads me to give an unfavourable report of it in cases of paralysis properly so called. *In chronic rheumatism* I have occasionally seen benefit from the use of electricity. *In stiffness and rigidity*, after sprains and bruises, when all inflammation and tenderness have subsided, it has also been employed.

3. *To promote secretion.*—In *amenorrhœa*, considerable benefit is obtained by passing shocks through the pelvis (from the sacrum to the pubis.) I have, on several occasions, found the practice successful. Electric friction, or slight shocks, are sometimes employed *to promote the biliary secretion*. My friend, Mr. Woodward, is very sanguine as to its efficacy for this purpose; but I have had no experience of it.

4. *To promote absorption.*—*In indolent tumours*, electricity in the form of sparks, slight shocks, and friction, has been employed, and, it is said, with occasional benefit. In enlarged cervical glands I have tried it in several cases, but without observing that any benefit resulted therefrom.

5. *In chorea* and some other allied convulsive disorders, considerable benefit is occasionally obtained from the employment of electricity, in the form of friction or slight shocks in the course of the spine and limbs. I am acquainted with several remarkably successful cases of its use. Dr. Addison (*Guy's Hospital Reports*, vol. ii. p. 493.) and Dr. Golding Bird (*Guy's Hospital Reports*, vol. vi. p. 84.) have also found it beneficial. Its *methodus medendi* is quite inexplicable.

β. Voltaic Electricity.

(Galvanism; Voltaism.)

The apparatus usually employed for the medical application of voltaic electricity consists of—

1. Two wooden troughs (devised by Mr. Cruickshanks,) each containing 50 pairs of copper and zinc plates, 2 or 2½ inches square. These may be charged with a solution of common salt, or with a weak acid liquor. Some electricians employ 1 part of common muriatic acid, and 16 or 20 parts of water. Singer thinks that $\frac{1}{300}$ of muriatic acid will be found the most useful. In some cases where the skin was very susceptible I have used water only.
2. A pair of insulated directors, each consisting of a glass tube traversed by a copper wire. One extremity of the wire is in communication with one end of the trough; the other extremity is covered with sponge or flannel, moistened with a solution of common salt.
3. Copper wire to connect the directors with the ends of the troughs.

Harrington's electrizers are plates of copper and zinc, or silver and zinc, made in various forms. Thus for the toothache a plate of copper is soldered edgeways to one of zinc, and worn in the mouth; the saliva serves to excite the apparatus. In another contrivance an hexagonal plate of zinc is connected by its face to a plate of silver; and a series of these compound plates are connected together by wire, so as to move on each other like hinges. These are worn next the skin for the relief of rheumatism. The perspiration serves to excite the plates. Silver and zinc spangles also have been employed, instead of the plates just mentioned.

Physiological Effects.—The physiological effects of voltaic electricity are threefold; viz.—

1. The production of certain sensations.
2. The contraction of muscular fibres.
3. An influence over secreting organs.

1. *Production of certain sensations.*—Although electricity acts on all the organs of sense, yet the nerve of each sense is affected in a manner peculiar to itself. Thus, by acting on *the nerves of touch*, we produce pain, the shock, and other disagreeable sensations: by affecting *the optic nerve*, we occasion a sensation of light: by influencing *the gustatory nerve*, a remarkable taste is excited: by affecting *the auditory nerve*, a peculiar sound is excited. (Volta, *Phil. Trans.* for 1800, p. 403.) *The olfactory nerve* is influenced by electricity with more difficulty. Volta could not succeed in producing an effect on the sense of smell; which he ascribes to the circumstance of the electric effluvia not being expanded in and conveyed by the air, which, it is thought, is the proper vehicle for exciting sensations in the olfactory nerves. Cavallo (Wilkinson's *Elements of Galvanism*, vol. i. p. 223. Lond. 1804.) and Ritter (Müller's

Elements of Physiology, translated by Baly, vol. i. p. 623. Lond. 1838.) each assert, however, that they have produced peculiar smells by electricity.[1]

The sensations excited by the passage of the voltaic current through the sensitive nerves may be owing to the mechanical or chemical influence of the current; and not any thing peculiar to the electricity. Thus the nerves of touch, the optic nerve, and the auditory nerves, have each their special sensations excited by mechanical violence. The acid, or the alkaline taste produced by electricity, may be referred to the electrolysis of the salts of the saliva, and the development of an acid and an alkali at the opposite electrodes; and the metallic taste may be owing to the chemical action of the constituents of the saliva on the electrode, by which a soluble metallic compound is produced.

2. *Contraction of Muscular fibre.*—Voltaic electricity excites muscular contractions when applied to the motor nerves, or to the central organs of the nervous system. The effect is produced not only on living, but on recently killed, animals; and is more powerful on the voluntary, than on the involuntary, muscles.

MM. Prevost and Dumas (Edwards, *De l'Influence des Agens Physiques*, p. 531. Paris, 1824.) have proposed an electrical theory of muscular contraction, which appears to me to be disproved by anatomical and physiological, as well as by physical, considerations. They assert that the nervous fibres run transversely across the muscular fasciculi; that when the muscular fibres become shorter by contraction, they do so by assuming a zig-zag inflexion; that the nervous fibres are conductors of a voltaic current; and, lastly, that zig-zag inflexion is produced by the mutual attraction of the parallel rectilineal currents in the nerves, the muscular fibre itself being passive. But not one of these assumptions can be admitted. Schwann, (Müller, *op. supra cit.* p. 900.) has shown that Prevost and Dumas mistook entire nervous fasciculi for primitive nervous fibres. Prof. Owen and Dr. A. Thompson, (Ibid. p. 887.) doubt whether the zig-zag inflexion exists during contraction. Prof. Owen says that the fibres become shorter and thicker, and only assume a wavy or zig-zag arrangement after contraction has ceased. Lastly, we have yet to learn how the voltaic current is insulated in the nerves, and prevented passing off laterally; for the neurilemma, and the other soft tissues, are excellent conductors of electricity. (Ibid. p. 635.)

3. *Influence over the secreting organs.*—Of the great influence exercised by the nerves in the process of secretion, no doubt can be entertained. Now it appears highly probable, that as the voltaic current excites the functions of the sensitive and motor nerves, it also may exercise a similar influence over those nerves which are distributed to the organs of secretion. Dr. Wilson Philip[2] has endeavoured to establish the truth of this opinion in the case of the secretion of the gastric juice. He divided the nervi vagi in a rabbit, and found, as he supposed, that the digestive process was stopped. In another experiment he restored, as he tells us, the functions of these nerves by the voltaic influence. But subsequent experiments have shown that the division of the nervi vagi does not wholly stop the digestive process, and that electricity cannot restore it to its original state. (Müller, *op. ante cit.* p. 549.)

Uses.—The therapeutic uses of voltaic electricity, like those of common electricity, are partly rational, partly empirical.

1. *To stimulate the sensitive nerves.*—In cases of nervous *deafness*, voltaic electricity has been used to stimulate the auditory nerve. For this purpose, one wire (pole or electrode) is introduced into one ear, and the other wire (pole or electrode) into the opposite ear. The circuit is then to be rapidly broken and completed a number of times. In *amaurosis*, the same remedy has been used empirically, to stimulate the retina, when other remedies have failed. It must, however, be employed with great caution, as its mechanical effect is calculated in many cases to aggravate the malady.

2. *To excite the motor nerves.*—In *paralysis*, voltaic electricity is occasionally resorted to, but, for the most part, empirically. It can, of course, be of no avail if the disease arise from organic changes in the nervous centres. But when the

[1] The peculiar smell evolved by working the ordinary electric machine in the atmosphere,—by electric sparks, and in some electro-chemical decompositions, is ascribed by Schönbein to a new elementary substance, which he terms *ozone* (from ὀζω, *I smell*,) and which is evolved at the anode or positive surface. He supposes it to be a constituent of an electrolyte, small quantities of which exist in both air and water. (*Athenæum* for 1840, p. 742.)

[2] An Experimental Inquiry into the Laws of the Vital Functions, pp. 111, 213, 256, &c. 3d edit. Lond. 1825.

malady appears to be functional only, or when there is reason to suppose that the blood effused in the brain has been absorbed, and that the paralysis remains from desuetude only, stimulating the motor nerves by electricity may perhaps prove serviceable. In *asphyxia* from drowning, hanging, the inhalation of noxious gases, &c., voltaic electricity is occasionally employed to excite the muscles of respiration. It appears to be a very plausible remedy, but in the cases in which it has hitherto been tried on the human subject, it has mostly failed to effect resuscitation.[1] In *sanguineous apoplexy*, Dr. W. Philip suggests that it might be used to enable the lungs "to perform their functions for a longer time than without this aid," and that by it the life of the patient may be prolonged. In the asphyxia produced by *concussion*, galvanism has been suggested by M. Goudret.

3. *In Asthma and Dyspepsia.*—Dr. Wilson Philip, having observed that withdrawing a considerable part of the nervous influence from the stomach and lungs deranges the digestive powers, and produces great difficulty of breathing; was led to expect relief from galvanism in indigestion and habitual asthma. He describes the benefit obtained as greatly exceeding his expectations. The positive pole (*anelectrode*) is applied to the nape of the neck,—the negative pole (*cathelectrode*) to the pit of the stomach. A weak power should be commenced with, and the strength gradually increased until some uneasiness is experienced. In some instances perfect cures were obtained; in others relief was gained.[2]

4. *To electrolyze urinary calculi.*—Prévost and Dumas (*Journal de Physiologie*, t. iii. p. 217.) have proposed voltaic electricity as a means of destroying some kinds of urinary calculi. They state that a fusible calculus, in one case contained in a basin of water, in another introduced into the bladder of a dog previously distended with water, was completely disintegrated by voltaic electricity, from a battery of 120 pairs. The wires were introduced through a canula into the bladder. The operation, it is said, did not occasion the least apparent uneasiness to the animal. During the action of the battery on the calculus, the bases and phosphoric acid first arrived at their respective poles, then re-entered into combination, forming a pulverulent salt. Bonnet proposed to inject the bladder with a solution of nitrate of potash, and to galvanize the calculus in this liquor. The nitrate will be decomposed; the phosphates dissolve in the liberated nitric acid,—and uric acid, or urate of ammonia, in the disengaged potash. These propositions are ingenious, but at present no practical use has been made of them.

5. *To coagulate the blood within an aneurismal tumour.*—If the electrodes of a voltaic apparatus be immersed in an albuminous liquor, the albumen is coagulated. It has, therefore, been suggested "that galvanism might be applied to the important purpose of coagulating the blood within an aneurismal tumour, and thus removing the disease without resorting to the ligature." (Apjohn, *Cyclopædia of Practical Medicine*, art. *Galvanism.*) For this purpose two needles are to be introduced into the tumour, and their projecting extremities connected with the opposite electrodes of the battery.

6. *To cauterize.*—Pravaz (*Revue Médicale*, Dec. 1830.) has proposed to cauterize the bites inflicted by rabid animals, by introducing the electrodes of a battery into the wound. Fabre-Palaprat (*Du Galvanisme appliqué à la Médecine*, p. 57. Paris, 1828.) has proposed to produce the cauterizing effects of the moxa by voltaic electricity; this kind of therapeutical agent he calls a *galvanic moxa.*

7. *To promote the absorption of medicinal substances.*—In 1832, Dr. Costor,

[1] The Professors of the Irish College of Surgeons, in 1829, failed to restore by it the respiratory movements in a person who had been hung (Dr. Apjohn, in *Cyclopædia of Practical Medicine*, art. *Galvanism.*)—Electricity, in conjunction with other means, was tried, but without success, in the case of Scott, the American diver, who had been accidentally hung for five or six minutes (see *Times*, Jan. 13, 1841.)

[2] See *Phil. Trans.* 1817, p. 22; and Dr. Wilson Philip's *Treatise on Indigestion.*—Also, La Beaume, *On the Medical Effects of Electricity and Galvanism in Nervous and Chronic Disorders.* 1820.

(*Archives Générales de Médecine*, t. ii. p. 432.) and in 1833, M. Fabré-Palaprat, (Ibid. II^me^ série, t. ii.—Also, Becquerel, *Traité de l'Electricité*, t. iv. p. 321.) employed voltaic electricity to assist the introduction of certain medicinal substances into the blood. They adopted Sir H. Davy's (*Phil. Trans.* 1807, p. 1.) opinion, (subsequently shown by Mr. Faraday (Ibid. 1838 and 1834,) to be erroneous,) that the poles (*electrodes*) of a voltaic battery have attractive and repulsive powers for certain substances: the positive pole (*anelectrode*) for oxygen, chlorine, and iodine,—the negative pole (*cathelectrode*) for hydrogen and the metals. M. Fabré-Palaprat asserts, that by the aid of galvanism he has caused certain chemical agents to traverse the body, and appear at some distant part. He bound on one arm a compress, moistened with a solution of iodide of potassium, and covered by a platinum disk, connected with the negative pole (*cathelectrode*) of a voltaic battery of thirty pairs of plates. On the other arm was placed a compress, moistened with a solution of starch, and covered by a platinum disk, connected with the positive pole (*anelectrode*) of the battery. In a few minutes the starch acquired a blue tinge, showing that the iodine had been transported from one arm to the other. But Davy's idea that the poles (*electrodes*) possess attractive and repulsive properties is not correct, as I have before remarked. That electricity may promote absorption, either by increasing endosmosis or by acting as a stimulus to the blood-vessels and lymphatics, is not improbable; but that the poles (*electrodes*) can draw medicinal substances either into or out of the body is not true. I have twice repeated Fabré-Palaprat's experiment; but, though I employed fifty pairs of plates for fifteen minutes, I was unable to obtain the slightest evidence of the passage of iodine through the body.

A mode of employing galvanism is practised in this country, which was first suggested by *Mansford, in his Treatise on Epilepsy*. Two plates of convenient size, one of silver, the other of zinc, are connected together by means of a silver wire of sufficient length to reach between the points of application that may be desirable, and to favour the adjustment a portion of it should have the spiral form. By this apparatus a galvanic circuit is established through the parts into apposition with which the plates are brought, by the wire on one side, and their nervous communication on the other. To prepare the parts for the galvanic impression, the cuticle should be removed by a blister the size of the plates, and strips of adhesive plaster may be used to keep them in their situation. The galvanic action is favoured by placing beneath the plates a piece of moistened buckskin, parchment, sponge, or fresh muscle. The latter is most efficient, but inconvenient from the speedy decomposition which takes place, requiring to be changed oftener. The plates should be removed and cleansed of the oxide deposited on their surfaces twice in the twenty-four hours. In the treatment of Epilepsy, MANSFORD directs the location of the silver plate upon a blistered surface on the back of the neck at the base of the brain, and the zinc plate upon a similarly prepared surface on the leg just below the knee; the wire descending the back till it reaches a belt of chamois leather buttoned round the waist, following the course of the belt to which it is attached until it arrives opposite the groin, then passing down the inside of the thigh until it reaches its position. Other points, however, may be selected. For an account of several interesting cases of Neuralgia treated in this manner, see Paper, by Dr. Thomas Harris, in American Journ. of Med. Sciences, No. xxviii. p. 384. August, 1834.—J. C.]

Electro-Puncture.

(Galvano-Puncture.)

The operation of electro-puncture was proposed by Sarlandière, (*Mémoires sur l'Electro-Puncture*. Paris.) in 1825. It consists in introducing two acupuncture needles in the usual way, and connecting them with the poles of a weak voltaic battery; the contact being occasionally suspended and renewed, in order to produce a succession of shocks. This practice has been successfully adopted for the relief of rheumatism, neuralgia, local paralysis, sciatica, spasmodic affections, and other maladies in which the operation of simple acupuncture has been used, than which it has been thought, by some, to be more efficacious. In neuralgia and in rheumatism it should be employed only in the interval of the paroxysms. (Trousseau and Pidoux, *Traité de Thérapeutique*, t. i. p. 579. Paris, 1836.) M. Bourgeois[1] proposed to employ the operation of electro-puncture of the heart, to promote resuscitation, in cases of asphyxia.

[1] Quoted by Merat and De Lens, in the *Dict. Univ. de Mat. Méd.* art. *Electro-Puncture*.

γ. Magnetic Electricity.

The apparatus required for the medical application of magnetic electricity consists of—

1. A magneto-electric machine.
2. A pair of directors.

The most convenient, simple, and powerful magneto-electric machine is that devised by Mr. E. M. Clarke, of the Strand. It consists of a battery of six curved permanent magnets, and an intensity armature, around whose cylinders 1500 yards of fine insulated copper wire are coiled. The ends of this wire communicate respectively with a pair of directors, each holding a piece of sponge (dipped in vinegar or a solution of common salt.) When the armature is rotated, and a portion of the living body interposed between the directors, a succession of shocks is received.

A magneto-electric machine is not affected by the moist state of the atmosphere: this gives it an advantage over the common electric machine; and as acids are not required to excite it, one inconvenience of the voltaic battery is obviated.

It is employed in medicine as a convenient substitute for the ordinary voltaic battery.

4. Magnetismus.—Magnetism.

(Mineral Magnetism.)

Ætius, (*Sermo* ii. p. cap. 25.) who lived about A. D. 550, is the oldest author who mentions the application of magnetism to the cure of diseases; for, although Hippocrates (*Opera; De intern. affect.* p. 543; and *De his quæ uterum non gerunt*, p. 686, ed. Fœsii.) speaks of the magnet as a remedial agent, he refers to its internal use only. About the end of the 17th century, magnetic tooth-picks and ear-picks were made as secret preventives against pains in the teeth, eyes, and ears. (Beckmann, *History of Inventions and Discoveries*, vol. i. p. 74.)

The power of a magnet to affect the vital functions is not generally admitted in this country; but it must be remembered that the experience which British practitioners have had of its use is exceedingly limited. Becker says that the sensations which his patients experienced from the use of the magnet were, *cold* (probably from the coldness of the steel;) *heat* (this is the most frequent effect, especially in the ears, and it often amounts to unpleasant burning;) *traction* (from the slightest degree, when it is an agreeable feeling, to the strongest, when it is almost painful, like that of a cupping-glass;) *an indefinite sensation* (in the ear, called a working or roaring;) *throbbing*; *pain*; and *numbness* or *loss of feeling in the magnetized part*. Some years ago, Mr. Faraday allowed Dr. Keil to try his magnets, in every way he thought proper, on himself (Mr. F.,) but without any effect resulting. (*Lancet* for 1835–36, vol. i. p. 716.) In some instances it has appeared to exercise a most remarkable influence over neuralgic pains and spasmodic affections; at one time apparently curing, at another palliating, and occasionally augmenting all the patient's sufferings. But, in a large proportion of cases, it fails to produce any obvious effect. The employment of magnetic plates is sometimes attended with itching and an eruption of pimples. Toothach, neuralgia, painful affections of the stomach, rheumatic pains, spasmodic asthma, angina pectoris, and palpitation of the heart, are the maladies which have occasionally appeared to be relieved by the magnet.

It is said that, in some cases, neuralgic pain is alleviated by the application of the north pole of the magnet, but is augmented by the south pole. (Ibid. 1832–33, vol. ii. p. 312.) Laennec[1] speaks highly of the efficacy of magnetized plates in neuralgia of the lungs and in angina pectoris. He applied two strongly magnetized oval steel plates, one to the left precordial region, the other exactly opposite on the back, so that their poles were opposed. He says the relief is increased if a blister be applied under the anterior plate. The late Dr. Thomas

[1] *A Treatise on the Diseases of the Chest*, translated by Dr. Forbes, pp. 402 and 693. Lond. 1827.

Davies (*Lectures on the Diseases of the Lungs and Heart*, p. 497. Lond. 1835.) tried this plan, and with good effect.

There are several modes of using magnets. For toothach, a *simple straight* or *bar magnet*, sometimes called *a magnetic staff*, is used. It is first made warm, and its north pole applied to the tooth: if the pain be not relieved, the south pole should then be substituted. Or the poles are applied to, or passed over, the gums or cheeks. In neuralgic pains, *a compound magnet*, called *a magnetic battery*, is commonly employed. This consists of several curved (horse-shoe, lyre-shaped, or U-shaped) magnets, placed one over the other, with all their poles similarly disposed, and fastened firmly together. Dr. Schmidt (*Lancet* for 1835–36, vol. i. p. 338.) employed a battery of five magnets of unequal length, the centre one being the longest and thickest. This kind of battery is usually called by workmen *a magnetic magazine*. *Magnetic collars*, *girdles*, *bracelets*, &c., are made of several artificial magnets, with their opposite poles in contact, enclosed in linen or silk. *Magnetized steel plates*, (*magnetic plates*) of various forms, are fitted to any part of the body. They are applied to the naked skin, and worn by the aid of a bandage.[1]

To attempt to explain the *methodus medendi* of an agent whose therapeutical influence is not generally admitted, appears to me somewhat premature. I may remark, however, that should the existence of *electro-vital* or *neuro-electric* currents in the animal body, as announced by Prof. Zantedeschi and Dr. Favio,[2] be hereafter fully established, we shall have a ready explanation of the medicinal power of magnetism in the well-known influence of a magnet over a voltaic current.[3]

II. AGENTIA HYGIENICA.—HYGIENIC AGENTS.

(Non-Naturals.)

Under the absurd name of the *Non-Naturals*, (*Non-Naturalia*) the ancients included six things necessary to health, but which, by accident or abuse, often became the cause of disease;—viz: *Air*, *Aliment*, *Exercise*, *Excretions*, *Sleep*, and *Affections of the Mind*.[4] These are now denominated *Hygienic Agents*.[5]

I propose very briefly to consider, as therapeutic agents, *Food*, *Climate*, and *Exercise*. *Affections of the Mind* have been already noticed. (See p. 41.)

1. Cibus.—Food.

The substances employed as Food (*Cibus*) may be conveniently arranged in three groups, respectively denominated Aliments, (*Alimenta*) Drinks, (*Potulenta*) and Condiments (*Condimenta*.)

a. Alimenta.—Aliments.

It will be convenient to consider aliments under the two heads of *Alimentary Principles* and *Compound Aliments*.[6]

1. Alimentary Principles.

Dr. Prout[7] has divided the alimentary principles into three great classes or

[1] Figures of the different forms of magnetic instruments here referred to, are given by MM. Andry and Thouret, in their very elaborate and able article on Medical Magnetism, in the *Memoires de la Société Royale de Médecine*, Année 1779. p. 531.

[2] *Report on the Memoir on Electric Currents in Warm blooded Animals*, by Prof. Zantedeschi and Dr. Favio, presented to the Royal Academy of Sciences of Brussels on the 4th April, 1840. By M. Cantraine. In *Lond. Edinb. and Dubl. Mag.* for April, 1841.

[3] For farther information respecting Magnetism as a therapeutical agent, I must refer to Andry and Thouret's Memoir before quoted; as also to Dr. Becker's *Der mineralische Magnetismus und seine Anwendung in der Heilkunst*, Mühlhausen, 1829; Dr. Bulmerincq's *Beiträge zur ärztlichen Behandlung mittelst des mineralischen Magnetismus*, Berlin, 1835; and Dr. Schnitzer's *Ueber die rationelle Anwendung des mineralischen Magnetismus*, Berlin, 1837.—Also, Most's *Encyklopädie der gesammten medicinischen und chirurgischen Praxis*; art. *Magnetismus mineralis*, 2er Band. S. 394. Leipzig, 1837.

[4] For an account of the Non-Naturals, consult Sutherland's *Attempts to revive Ancient Medical Doctrines*, vol. ii. p. 113. Lond. 1763.—Also, Willich's *Lectures on Diet and Regimen*, 3rd edit. Lond. 1809.

[5] Rostan (*Dict. de Médecine*, art. *Hygiène*) terms them *Matière de l'Hygiène*.—On Hygiène, consult Dunglison, *On the Influence of Atmosphere and Locality; Change of Air and Climate; Seasons; Food; Clothing; Bathing; Exercise; Sleep; Corporeal and Intellectual Pursuits, &c. &c. on Human Health; constituting Elements of Hygiene*. Philadelphia, 1835.

[6] See Tiedemann's *Untersuchungen über das Nahrungs-Bedürfniss, den Nahrungs-Trieb, und die Nahrungs-Mittel des Menschen*. Darmstadt, 1836.

[7] *Phil. Trans.* for 1827, p. 355. Also, *On the Nature and Treatment of Stomach and Urinary Diseases*, 3d edit. Lond. 1840. In the latter work he admits a fourth alimentary principle, which he calls *aqueous*.

groups—the *saccharine*, the *oleaginous*, and the *albuminous*. He was led to this division by observing that milk, the only article actually furnished and intended by nature as food, always contains a saccharine principle, a butyraceous or oily principle, and a caseous, or, more correctly speaking, an albuminous principle. This arrangement of alimentary principles appears to me to be superior to any hitherto devised; and I shall, therefore, adopt it.

Class 1. Saccharine Principles.

The principles contained in this class are Sugar, Gum, Vegetable Jelly, Starch, and Lignin. These agree in being of vegetable origin, and in consisting of carbon, hydrogen, and oxygen. With the exception of pectin or vegetable jelly, they contain oxygen and hydrogen in the ratio to form water; and might, therefore, be termed *hydrates of carbon*. The following table is principally drawn up from Dr. Prout's paper in the Philosophical Transactions before referred to :—

	Carbon.	*Water.*
Sugar,		
Pure Sugar Candy..	42·85	57·15
Impure ditto.....	41·5 to 42·5	58·5 to 57·5
East India ditto....	41·9	58·1
English refined	41·5 to 42·5	58·5 to 57·5
East India refined..	42·2	57·8
Maple	42·1	57·9
Beet-root	42·1	57·9
East India moist...	40·88	59·12
Diabetic	36 to 40?	64 to 60?
Of Narbonne Honey	36·36	63·63
Of Starch.....	36·2	63·8
Of Milk.....	40·0	60·0
Gum,		
Arabic.....	36·3	63·7
Ditto, dried at 212°.	41·4	58·6

	Carbon	*Water.*	
Starch,			
Fine Wheaten.....	37·5	62·5	
Ditto, dried at 212°.....	42·8	57·2	
Ditto, highly dried at 350°.	44·0	56·0	
Arrow-root.....	36·4	63·6	
Ditto, dried at 212°.....	42·8	57·2	
Ditto, highly dried at 212°.	44·4	55·6	
Lignin,			
From Box	42·7	57·3	
Ditto, dried	50·0	50·0	
From Willow	42·6	57·4	
Ditto, dried	49·8	50·2	
Pectin or Vegetable Jelly,		*Hydr*	*Oxyg.*
From sweet apples (Mulder[1])	45·198	5·352	49·450
Ditto, sour ditto (ditto)....	45·853	5·479	48·668
In pectinate of lead (ditto)	45·608	5·370	49·022
In pectinate of lead (Fremy[2])	43·5	5·2	51·4

Those varieties of each principle which contain the smallest quantity of water, Dr. Prout terms *strong* or *high;* while those containing the largest proportion of water, he denominates *weak* or *low*. Thus, sugar-candy is a high or strong sugar,—sugar of starch, a weak or low one.

Sugar is the only one of the above five principles capable of crystallizing; and is, therefore, the farthest removed from organization and life. Gum, though incapable of crystallizing, is not organized: it may be denominated an organizable substance. Starch and lignin are organized substances.

In *Diabetes*, abstinence from all the alimentary principles of this class is attended with a considerable diminution of the saccharine secretion. Farinaceous matter, though less objectionable than common sugar, is readily convertible into sugar.

1. Saccharina. *Saccharine Substances.*—Under this head are placed several sweet organic principles, capable, for the most part, of undergoing vinous fermentation when mixed with yeast and a due proportion of water.

a. Sugars susceptible of Vinous Fermentation.

1. *Crystallizable.* This division includes *common sugars*, (viz. *cane*, *maple*, and *beet-root sugars*) *granular sugars*, (viz. *grape*, *honey*, *starch*, and *diabetic sugars*) and *sugar of milk*.
2. *Uncrystallizable.* Called *liquid* or *mucous sugars*, as *treacle*.

b. Sugars unsusceptible of Vinous Fermentation.[3]

1. *Crystallizable. Mannite.*
2. *Uncrystallizable. Glycyrrhizin*, *Glycerin*, and *Sarcocollin*.

[1] *Pharm. Central-Blatt für* 1838. p. 338. [2] *Journ. de Pharm.* xxvi. 373.

[3] Liebig (Turner's *Elements of Chemistry*, 7th ed. p. 914, Lond. 1840) regards those substances only as saccharine which are susceptible of the vinous fermentation.

Sugar is a highly nutritious substance, and by the healthy stomach is readily digested. It does not agree, however, with some dyspeptics. Flatulency and preternatural acidity of stomach are frequently ascribed to it; but, in many cases, these conditions are referrible rather to the substances taken with the sugar, than to the saccharine matter itself. In diabetes the power of assimilating sugar is in a great measure lost, and the dietetical use of saccharine matter must be rigorously prohibited.

Sugar appears to contribute directly to the nutrition of plants: for the saccharine juices of the sugar-cane, of the maple, of the beet root, &c., must be regarded as nutritive. Yet, it is somewhat remarkable, and apparently inconsistent with this statement, that saccharine matter is found in the excretions of plants; as those formed by the nectariferous glands. Sugar appears to be especially adapted for the food of young plants; hence we find it generated in many seeds (as peas, barley, &c.) during germination.

It is nutritive to animals. Thus it is an important constituent of milk;—a liquid intended for the nourishment of mammals during the first period of their existence. Many insects (especially the *Lepidoptera*, *Hymenoptera*, and *Diptera*) feed on sugar or saccharine liquids. Its asserted poisonous action on some *Annelida*, birds, and frogs, is improbable, and wants confirmation. (Vide Murray, *App. Med.* vol. v. p. 411. Goett. 1790.) That a diet of sugar only is incapable of supporting the life of mammals and birds, has been fully proved by the experiments of Magendie (*Ann. de Chim.* iii. 66. 1816.) and of Tiedemann and Gmelin. (Müller's *Elem. of Phys.* by Baly, p. 482.) Dogs and geese die, when confined and fed solely on sugar and water, with all the symptoms of starvation. Change or alteration of diet, with the use of a certain portion of nitrogenous food, seems, therefore, to be essential to the vitality of these animals.

Sugar is employed by man on account of its agreeable taste, rather than as a direct source of nourishment; yet, of its nutritive qualities, few entertain any doubt. During the sugar season of the West India Islands, "every negro on the plantations, and every animal, even the dogs, grow fat." (Wright, *Med. Plants of Jamaica.*) The injurious effects, which have been ascribed to sugar, are more imaginary than real. Some individuals have consumed large quantities of it, for a long series of years, without suffering any ill consequences. (Slare, *Vindication of Sugars*, Lond. 1715.) Stark's experiments (Stark's *Work*, ed. by J. C. Smith, pp. 160 and 115. Lond. 1788.) hardly admit of any legitimate conclusions being drawn therefrom, as to the action of sugar. The fondness of children for sugar may be regarded as a natural instinct; since nature, by placing it in milk, evidently intended it to form a part of their nourishment during the first period of their life. The popular notion of its having a tendency to injure the teeth seems most absurd, as Dr. Slare (*Op. cit.*) has shown. "It has been alleged, that the eating of sugar spoils the colour of and corrupts the teeth: this, however, proves to be a mistake, for no people on the earth have finer teeth than the negroes in Jamaica." (Wright, *op. cit.*)

The principal use of sugar, considered *dietetically*, is for sweetening various articles of food, whose nutritive qualities also it promotes. In diabetes, and the oxalate of lime diathesis, sugar and sweet foods should be rigorously excluded. In dyspepsia, its effects are to be carefully examined; and, if found to be injurious, its use ought to be prohibited. The copious use of unrefined sugar is likely to prove injurious in some nephritic disorders, as the phosphatic diathesis, on account of the lime contained in it.

2. Mucilaginosa. *Gummata.*—The gummy principles, called Arabin, Tragacanthin or Adraganthin, Cerasin or Prunin, Cydonin, and Bassorin, belong to this group. They possess nutritive properties; but are somewhat difficult of digestion, and apt to disagree with dyspeptics.

Magendie (*Ann. de Chim. et Phys.* t. iii. p. 66.) has shown that dogs, fed on gum alone, languish and die in two or three weeks; and Tiedemann and Gmelin (Müller's *Physiology*, by Baly, vol. i. p. 482.) found that a goose, fed with gum, died on the sixteenth day. These, as well as other experiments, merely show, however, that animals require more than one kind of aliment.

The nutritive property of gum is shown by several facts. In the first place it constitutes a portion of several well-known articles of food; secondly, it sometimes forms the principal or only food of man. Hasselquist (*Voyages and Travels in the Levant*, p. 298. Lond. 1766.) tells us, that a caravan, of more than a thousand persons, travelling from Abyssinia to Cairo, and whose provisions were exhausted, supported themselves for two months on the gum they were carrying as merchandize. The Moors and the Negroes near the Niger, employ it as a common kind of food. The Hottentots also each are well aware of its nutritive properties. (Murray, *App. Medicam.* vol. ii. p. 535. Ed. alt. Goett. 1794.) Six or eight ounces daily for an adult are said to be sufficient to sustain life.

3. Vegeto-Gelatinosa. *Vegetable Jelly.*—To this head are referred Pectin or Grossulin, and Carrageenin. These are nutritive and digestible. Whether the tendency of some fruits to disorder the *primæ viæ* is fairly ascribable to the vegetable jelly, or to some other principle associated with it, has not been clearly made out.

Pectin, under the influence of an alkali, is readily converted into pectic acid. The latter has been recommended for the formation of jellies, gelatinous conserves, &c. (Dumas, *Traité de Chimie*, t. v. p. 404. Paris, 1835.)

4. Farinosa. *Amylaceous, farinaceous, or starchy substances.*—Under this division are included Wheat-starch, Sago, Tapioca, Arrow-root, (West Indian, East Indian, South Sea, and Portland,) Potato-starch, Tous les Mois, Salop, &c. Amylaceous matter is found in various parts of plants. The albumen of the seeds of grasses abound in it, and from this organ wheaten and rice-starch are obtained. The fleshy cotyledons of the leguminous seeds—as peas and beans—likewise contain it. In the roots, subterranean stems, and tubers of many plants, it is also found; and from these sources are procured Tapioca, Arrow-root, (West Indian, East Indian, and Portland,) Salop, Potato-starch, and Tous les Mois. The interior of some monocotyledonous stems abound in farinaceous matter; and from this source Sago is obtained. Farthermore, a feculoid substance, called *lichenin*, is found in some Lichens—as in Cetraria islandica.

The amylaceous substances are organized. Examined by a microscope they are seen to consist of small grains, which are usually rounded, or elliptical, or mullar-shaped, or polyhedral. The polyhedral form probably arises from the mutual compression of numerous grains in the same or neighbouring cells. On some part of the surface of each grain is a round spot, called the hilum: very rarely, two or even three of these spots are observed on the same grain. The grains of most, if not of all, feculas, have a laminated texture. To the concentric layers is owing the appearance of concentric rings on the surface of most feculas.[1] The organic principle (*amidon*,) of which these layers consist, seems to be uniform in its composition and properties, excepting in some slight differences of cohesion.[2]

When cooked, amylaceous matter is a nutritious and easily digestible substance. Directly or indirectly, observes Dr. Prout, (*On the Nature and Treatment of Stomach and Urinary Diseases*, p. x. Lond. 1840.) "it forms a constituent of the food of most of the higher animals, as well as of man. It differs, therefore, from sugar, in being a *necessary* article of food, without which animals could not exist; while sugar is not. Hence a much larger quantity of amylaceous matter than of sugar, can be taken; and what is a still more decisive fact, the use of this larger quantity of amylaceous matter may be persisted in for an unlimited period, which, it appears, is not the case with a large proportion of sugar."

Farinaceous food is, perhaps, the least irritating of all kinds of aliments. It is, therefore, well adapted for the use of persons affected with morbidly sensible conditions of the primæ viæ. It will sometimes remain on the stomach when every other kind of nutriment is immediately rejected. Being totally devoid of all stimulating properties, it is a useful and valuable article of food in febrile and inflammatory diseases. In diabetes it is the only kind of vegetable aliment admissible.

To render amylaceous matter digestible, it requires to be cooked in order to break or split the grains; for, of the different laminæ of which each grain consists, the outer ones are the most cohesive, and present the greatest resistance to the digestive power of the stomach, while the internal ones are the least so. Hence farinaceous substances are boiled in milk or water,—or they are panified with gluten, by which the grains are completely broken up,[3]—or they are made into puddings and tarts.

5. Lignin. *Woody Fibre.*—The substance, called lignin, constitutes the basis

[1] Figures of the different starchy bodies, drawn to the same scale, will be given in subsequent parts of this work (see *Index*.)

[2] For an elaborate account of the structure and chemical properties of starchy substances, see Payen's *Mémoire sur l'Amidon*, in the *Annales des Sciences Naturelles*. 2nde Série, t. x; Botanique. Paris, 1838.

[3] Good bread gives not the slightest trace of entire grains of starch.

of woody fibre, vessels, ducts, and cellular tissues of plants. Its composition is probably similar in all plants.[1] It "forms the appropriate food of numerous insects and of some of the lower animals, but of few of the higher classes of animals. The reason of this is probably to be sought for, in their not being furnished with organs proper for comminuting and reducing it; for when lignin is comminuted and reduced by artificial processes, it is said to form a substance analogous to the amylaceous principle, and to be highly nutritious." (Prout, *op. ante cit.* p. xii.)

The Laplanders, according to Linnæus, (*Flora Lapponica.*) eat bark-bread (*barkbröd*) during a great part of the winter, and sometimes even during the whole year. It is prepared from the inner bark of the *Pinus sylvestris.* (See Von Buch in *The Scots Magazine*, vol. lxxx. p. 315. Edinb. 1817.)

Professor Autenrieth, (*Phil. Trans.* 1827, p. 355.—Also, *The Scots Mag.* vol. lxxx. p. 313.) of Tubingen, states, that when wood is deprived of every thing soluble, reduced to powder, repeatedly subjected to the heat of an oven, and then ground in the manner of corn, it yields, boiled with water, a flour, which forms a jelly, like that of wheat-starch, and, when fermented with leaven, makes a perfectly uniform and spongy bread.

Class 2.—Oleaginous Alimentary Principles.

This class comprehends the substances denominated Fats, Fixed Oils, and Butters.

Dr. Prout (*Op. supra cit.* p. xiv.) includes also the volatile oils. But, though volatile oil is a constituent of several substances employed as aliments or condiments, yet I am unacquainted with any evidence of its being alimentary. When received into the stomach, it is absorbed, and taken into the system; but is subsequently thrown out again, without having undergone much, if any, change. Alcohol, which Dr. Prout ranks with the volatile oils, is neither oleaginous nor alimentary.

The ultimate constituents or the elementary principles of the oleaginous substances are Carbon, Hydrogen, and Oxygen. The proportions are as follow:—

	Carbon.	*Hydrogen.*	*Oxygen.*	*Loss.*
Almond Oil (Saussure[2])	77·403	11·481	10.828	0·288
Olive Oil { Elaine (Saussure) . .	76 034	11·545	12·068	0·353
Olive Oil { Margarine (Saussure)	82·170	11·232	6·302	0·296
Butter (Bérard[3])	65·6	17·6	16·8	—
Hog's Lard (Chevreul[4])	79·098	11·146	9·756	—
Mutton Suet (Chevreul)	78·996	11.700	9·304	—

The fats and fixed oils, as presented to us by nature are separable into two or three or more fatty principles; of which stearine, margarine, elaine, and butyrin, are the most important. By subjecting solid or congealed fats to pressure, Braconnot[5] separated several of them into two parts,—the one liquid (elaine,) the other solid (stearine and margarine.)

	Stearine.	*Elaine.*
Butter	40	60
Hog's Lard	38	62
Beef Marrow . .	76	24
Mutton Marrow .	26	74
Goose Fat	32	68
Duck Fat	28	72
Turkey Fat . . .	26	74

	Margarine.	*Elaine.*
Olive Oil	28	72
Almond Oil	24	76
Oil of Colza[6]	46	54

[1] According to the Rev. J. B. Reade (*Lond. and Edin. Phil. Mag.* vol. xi. p. 421) a very remarkable difference exists between the chemical composition of cellular membrane and of spiral vessels in the same plant. But his "results are in many respects so remarkably at variance with all that we are as yet acquainted with respecting similar subjects, that we must at the outset doubt their correctness." (Meyen's *Report on the Progress of Vegetable Physiology, during the year* 1837. Translated by William Francis. Lond. 1839.)

[2] *Ann. de Chim. et Phys* t. xiii. p. 351. [3] Gmelin, *Hand. d. Chemie*, Bd. ii. S. 439. [4] Ibid.

[5] *Ann. de Chim.* xciii. 225. Braconnot terms all the solid fats, stearine; but Lecanu (*Ann. de Chim. et Phys.* lv. 192) has shown that the solid fat of the vegetable oils is margarine

[6] The Colza is the *Brassica campestris*, which is closely allied to *Brassica Napus*, the seeds of which yield Rape Oil.

Stearine, Margarine, Elaine, and Butyrine, yield, by saponification, fatty acids, a sweet basic principle called glycerine (or the oxide of glycerule,) and water. They are probably, therefore, hydrated salts of glycerine. The acids (stearic, margaric, and oleic) obtained respectively from stearine, margarine, and elaine, are fixed; while those (butyric, capric, and caproic acids) procured from butyrin, are volatile and odorous.

Oleaginous aliments are highly nutritious, but exceedingly difficult and slow of digestion. The last-mentioned circumstance is familiar to every dyspeptic, and has been confirmed by the experiments of Dr. Beaumont,[1] made on a Canadian, who had, two inches below the left nipple, a permanent artificial opening into his stomach, produced by a gun-shot wound. Dr. Beaumont remarks, that the bile is not ordinarily found in the stomach; but that, after the use of oily food, it is often observed there: and, he concludes, that it assists the digestion of the fatty substances. The operation of heat on the fatty bodies is injurious to their digestibility, especially in the case of butter. This appears to be owing to the development of acrid fatty acids, and empyreumatic oil matters. Hence buttered toast, melted butter, substances cooked by frying in oil or butter, and pastry, are highly injurious to dyspeptics.

Oleaginous foods often agree so remarkably well with diabetic patients, "that some have gone so far as to propose them as remedies. When freely taken, they usually cause a flow of saliva, and thus diminish the urgent thirst. When they agree, also, they give a sensation of satisfaction and support to the stomach, which other alimentary substances do not. Perhaps butter is the most agreeable form in which they can be taken, and this, under proper circumstances, may be taken freely. When oleaginous matters disagree, as is sometimes the case, they should be carefully shunned." (Prout, *op. supra cit.* p. 43.)

Sir John Ross (*Narrative of a Second Voyage in search of a North-West Passage*, p. 201. Lond. 1835.) considers, and his opinion is probably correct, that the natives of cold countries seem to require a more fatty diet than the inhabitants of tropical regions, in order to promote the production of animal heat.

Class 3.—Nitrogenous or Azotized Alimentary Principles.

(Albuminous Aliments, *Prout.*)

The most important alimentary principles, containing nitrogen or azote, are Fibrines, Albumen, Caseum, Gelatine, and Gluten. The animal extract, called Osmazome, is also a nitrogenous principle. With one exception (Gluten,) these principles are obtained from the animal kingdom, and they have in consequence, been frequently denominated *animal* aliments. They are composed of carbon, hydrogen, nitrogen, and oxygen, in the following proportions:—

	Carbon.	Hydrog.	Nitrogen.	Oxygen.
Fibrine of a Cow's Arterial Blood (Mulder[2])	53·019	6·828	15·462	24·691
of ditto Venous Blood (Mulder)	53·476	6·952	15·291	24·281
of Muscle of the Ox (Sass & Pfaff[3])	48·30	10.64	15·92	17·64 & fixed salts 7·50
Albumen of Eggs, (Mulder)	53·960	7·052	15·696	23·292
of Arterial Blood (Michaelis[4])	53·009	6·993	15·562	24·436
of Venous Blood (Michaelis)	52·650	7.359	15·505	24·484
Caseum (Jul. Vogel[5])	52·53	7·82	16·20	23·45
Gelatine of Hartshorn (Mulder)	50·048	6·477	18·350	25·125
of Isinglass (Mulder)	50·757	6·44	18·313	24·286
Gluten (Boussingault[6])	54·0	7·50	14·60	23.90

[1] *Experiments and Observations on the Gastric Juice and the Physiology of Digestion.* By Wm. Beaumont, M. D. Reprinted from the Plattsburg edition, with notes by Dr. Combe. Edinb. 1838.
[2] *Pharmaceutisches Central-Blatt für* 1837, S. 325.
[3] Müller's *Elements of Physiology*, by Baly, vol. i. p. 369. I strongly suspect some error in this anslysis.
[4] Berzelius, *Traité de Chimie*, t. vii. p. 75.
[5] *Pharm. Central-Blatt für* 1839, S. 491.
[6] *Ann. de Chim. et Phys.* lxiii. 229.

In *Diabetes*, the diet should be principally of nitrogenous principles. Dr. Rollo[1] advocated the exclusive use of animal substances in this malady, and, of its power to check the secretion of sugar, no doubt seems to be entertained. But the craving for vegetable food which some patients experience is so great, that considerable difficulty is experienced in inducing them to submit to a diet exclusively animal. Moreover, violent fever has been ascribed to it.[2] Hence the recommendation of Dr. Prout, to allow a certain quantity of farinaceous food, has been very generally assented to and followed. More recently, however, Dr. Christison (*Edinb. Monthly Journal of Medical Science* for April, 1841.) has published some cases, showing that a mixed diet of animal and vegetable food is sometimes inadmissible; and "that if a sensible amelioration is to be looked for with any confidence, the injunctions of Rollo and his imitators, to enforce a rigorous animal diet, must often be faithfully followed."

In the *Oxalic Acid Diathesis*, the plan of diet is the same as for Diabetes.

1. Fibrine.—In the liquid form, or in the state of suspension, it exists in the blood. In the solid state it is the principal constituent of the muscles or fleshy parts of animals. It is eminently nutritious, and easy of digestion.

2. Albumen.—This principle constitutes the most important part of animal foods. In the liquid state it exists in eggs (*ovalbumen*) and the serum of the blood (*seralbumen*.) In the solid or coagulated state it is a constituent of the flesh, glands, and viscera of animals. The chemical properties of coagulated albumen are almost identical with those of fibrine. Albumen is highly nutritious, and when either raw or lightly boiled is easy of digestion; but when boiled hard, or especially when fried, its capability of being digested is considerably impaired. (See *Eggs*, p. 86.)

3. Caseum. *Lactalbumen*, or *Curd*.—This is the coagulable matter of milk, and is closely allied to albumen, of which it may be regarded as a modification. Coagulated, dried, somewhat changed in its nature, and more or less mixed with butter, it constitutes *cheese*. It is nutritious, and moderately easy of digestion.

4. Gelatine. *Animal Jelly*.—Gelatine is obtained by boiling certain animal tissues in water: the concentrated decoction forms, on cooling, a tremulous mass, called *jelly*. The bones, antlers, skin, tendons, and aponeuroses of mammals, and the swimming bladder of fishes, are the especial sources of it. It is an exceedingly nutritive principle, though probably somewhat less so than fibrine and albumen. As far as my own observations extend it is readily digestible; but it is said not be suited to the digestive powers of many dyspeptics.

"Gelatine may be considered as the least perfect kind of albuminous matter existing in animal bodies; intermediate, as it were, between the saccharine principles of plants, and thoroughly developed albumen. Indeed, gelatine in animals may be said to be the counterpart of the saccharine principles of plants; it being distinguished from all other animal substances, by its ready convertibility into a sort of sugar, by a process similar to that by which starch may be so converted." (Prout, *On the Nat. and Treatm. of Stomach and Urinary Diseases*, p. xiii.)

Gelatine from Bones is employed in Paris for the preparation of a nutritious soup for hospitals and other pauper habitations.[3]

Hartshorn Jelly is principally used by invalids.

Patent Gelatine is procured from the skins of animals. (See *The Mechanic and Chemist* of July 4th, 1840. Lond.)

Confectioner's Jelly is made from isinglass, calves' feet, and patent gelatine.

Soups and *Broths* owe their nutritive properties principally to gelatine.

Young meats yield more gelatine than old ones.

The *Sounds* of fish and *Isinglass* are gelatinous substances.

5. Osmazome. *Alcoholic Extract of Meat*.—This is an alcoholic extract obtained from the flesh, brain, and other parts of animals. It has a reddish brown colour, and the smell and taste of soup. It is generally mixed with lactic acid, the lactates, and common salt. To this principle broths and soups owe their flavour, smell, and part of their nutritive qualities.

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[1] *An Account of two Cases of Diabetes Mellitus*, Lond. 1797.—*Cases of the Diabetes Mellitus*, Lond. 1798. 2d ed. with large additions, 1806.

[2] See the statements of Dr. Marsh, in the *Dublin Hospital Reports*, vol. iii. Dubl. 1822; and of Dr. Prout, in his *Inquiry into the Nature and Treatment of Diabetes, Calculus and other Affections of the Urinary Organs*, p. 79. Lond. 1825.

[3] D'Arcet *Recherches sur les Substances nutritives que renferment les Os*. Paris, 1829.—Edwards and Balzac, in the *Annals des Sciences Nat.* Juillet 1832, p. 318.—Also, Edwards' *Recherches Statistiques sur l'Emploi de la Gelatine*. Paris, 1835.

6. Gluten.—This substance is found in corn; especially in wheat. By washing wheaten dough with a stream of water, the gum and the sugar are dissolved, the starch is washed away, while the gluten is left in the form of a ductile, tenacious, elastic, gray mass, which, by the action of alcohol, is resolved into *albumen*, *mucin*, and *glutin*.

a. Albumen is insoluble in alcohol, but soluble in water.
b. Mucin is soluble in boiling alcohol, but deposites as the liquid cools.
c. Glutin is soluble in alcohol, but is almost insoluble in water.

Gluten is believed to be highly nutritious, and to confer on wheat flour its well known superior alimentary qualities.

"It is the presence of gluten in wheaten flour that renders it pre-eminently nutritious, and its viscidity or tenacity confers upon that species of flour its peculiar excellence for the manufacture of *macaroni*, *vermicelli*, and similar pastes, which are made by a kind of wire-drawing, and for which the wheat of the south of Europe, (more abundant in gluten than our own) is particularly adapted. The superiority of wheaten over other bread depends upon the greater tenacity of its *dough*, which, in *panary fermentation*, is puffed up by the evolved carbonic acid, and retained in its vesicular texture, so as to form a very light loaf." (Brande's *Manual of Chemistry*, p. 1091, 5th ed. 1841.)

2. Compound Aliments.

These we subdivide into animal and vegetable.

α. Animal Aliments.

We may conveniently arrange these in six classes;—viz.

1. Mammals.	3. Reptiles.	5. Crustaceous animals.
2. Birds.	4. Fishes.	6. Mollusks.

Class 1. Mammalia.—Mammals.

In this country, the mammals employed by man, as food, are the Ox, the Sheep, the Hog, the Deer, the Rabbit, and the Hare.

Herbivorous are generally preferred to carnivorous animals for food; as the flesh of the latter has a somewhat disagreeable odour.

Mammals furnish their flesh, their viscera, their blood, and their milk, as articles of food.

1. Flesh.—This consists principally and essentially of muscle, intermixed, however, with tendons, aponeuroses, nerves, vessels, cellular tissue, blood, serum, and fat. Its chemical constituents are fibrine (principally,) albumen, gelatine, hæmatosin or the colouring matter of the blood, osmazome, fatty matter (stearine and elaine,) creatine,[1] a peculiar nervous matter, and salts. The following are the proportions of the first three principles in the muscles of some kinds of flesh:—(Brande, *op. supra cit.*)

100 *Parts of Muscle of*	*Water.*	*Albumen or Fibrine.*	*Gelatine.*	*Total of Nutritive Matter.*
Beef	74	20	6	26
Veal	75	19	6	25
Mutton	71	22	7	29
Pork	76	19	5	24

The flesh of young animals is more tender than that of old ones. That of castrated males is not only more delicate and finer grained, but has a more agreeable odour and flavour than that of the uncastrated animal. Spaying is said to improve the flavour of the flesh of the female. With regard to digestibility, Dr. Beaumont found that digestion is facilitated by minuteness of division and tenderness of fibre; and retarded by opposite qualities. Venison he ascertained to be one of the most digestible substances; a circumstance which he refers to its

[1] Creatine (from κρεας, *flesh*) is a nitrogenous, crystallizable substance, insoluble in alcohol. It was discovered by Chevreul (*Journ. de Chim. Méd* t. viii. p. 548.)

being easily divisible into shreds or small particles. Beef and mutton are also easy of digestion.

The following table shows the mean time of digestion of several kinds of flesh, according to Dr. Beaumont's experiments:—

	Hours.	*Minutes.*
Venison steak, broiled	1	35
Sucking pig, roasted	2	30
Lamb, fresh, broiled	2	30
Beef steak, broiled	3	0
Mutton, fresh, broiled	3	0
Pork steak, broiled	3	15
Veal, fresh, broiled	4	0
Beef, old, hard, salted, boiled	4	15

By boiling flesh in water, the fibrine is corrugated, the albumen coagulated (though, by a prolonged action of heat and water, it yields a soluble nitrogenous matter;) the hæmatosine is also coagulated; the cellular tissue, the tendons, and the aponeuroses, yield gelatine; the fatty matters melt; while the osmazome and the creatine are dissolved.[1]

2. Viscera.—The brain, the liver, the spleen, the kidneys, the thymus,[2] the lungs, and the alimentary canal of mammals,[3] are employed as food. They abound principally in albumen.

Composition of the Liver of the Ox.[4]

Vascular & Cutaneous Tissues	18·94
Parenchyma (*i. e.* soluble parts)	81·05
Liver	100.00
Brown oil, containing phosphorus	3·89
White fatty flocculi	?
Nitrogenous matter	6·07
Albumen	20·19
Blood	?
Salts	1·21
Water	68.64
Parenchyma of the liver	100.00

Composition of the Thymus of the Calf.[5]

Albumen	14·00
Osmazome	1·65
Gelatine	6·00
Peculiar animal matter	0·30
Margaric acid	0.05
Fibrine	8·00
Water	70·00
Thymus	100·00

The following are the mean times of digestion of several viscera, according to Dr. Beaumont:—

	Hour.	*Minutes.*
Tripe, soused, boiled	1	0
Brains, animal, boiled	1	45
Liver of the ox, fresh, broiled	2	0

Sausages made of the flesh, viscera, or blood of animals, and cured by smoking, have sometimes acquired, by keeping, highly deleterious qualities, which Buchner ascribes to the presence of a peculiar fatty acid, which has been termed *botulinic acid* (Würst-fett-saüre.) (See Christison's *Treatise on Poisons*, p. 585, 3d ed. Edinb. 1835.)

Bacon also sometimes becomes poisonous. (Ibid. p. 592.)

3. Blood.—Among civilized nations, the pig is the only animal whose blood furnishes a distinct article of food. Mixed with fat and aromatics, and enclosed in the prepared intestines, the blood of this animal constitutes the substance sold in the shops under the name of *black pudding* (*apexabo.*)

The deleterious qualities, which blood puddings sometimes acquire, have been above referred to.

4. Milk.—Properly speaking, milk should be considered among Drinks; but,

[1] See some interesting observations on the effects of heat and water on meat, in Soubeiran's *Nouv. Traité de Pharm.* t. i. p. 130. 2nde ed. Paris, 1840.

[2] The thymus of the calf is commonly termed *sweetbread.*

[3] The stomachs of ruminants, when prepared as food, constitute *tripe.*

[4] Braconnot, *Ann. de Chim. et Phys.*, x. 189.

[5] Morin, *Journ. de Chim. Méd.* t. iii. p. 450.

as it contains a large quantity of alimentary matter, and, farthermore, as it yields some solid foods (butter and cheese,) it will be most convenient to consider it here. The composition of several kinds of milk is thus stated by MM. O. Henry and Chevallier. (*Journ. de Pharm.* t. xxv. p. 340.)

Constituents.	*Milk of the*				
	Cow.	*Ass.*	*Woman.*	*Goat.*	*Ewe.*
Caseum	4·48	1·82	1·52	4·02	4·50
Butter	3·13	0.11	3.55	3·32	4·20
Sugar of Milk	4·77	6·08	6·50	5·28	5·00
Various Salts	0·60	0·34	0·45	0·58	0·68
Water	87·02	91·65	87·98	86.80	85·62
Total	100·00	100·00	100·00	100·00	100·00
Solid substances	12.98	8·35	13·00	13·20	14·38

The nutritive principles of milk are (excluding water,)—caseum, butter, and sugar of milk. Perhaps the phosphate of lime, found in milk, ought to be considered as an aliment for young animals; inasmuch as it is necessary to the development of their osseous system. For the most part, milk is readily digestible; but, with adults, this is by no means universally the case. With some dyspeptics, it proves heavy and difficult of digestion. I find that those, with whom it disagrees, are obnoxious to the use of butter; whence I infer, that the injurious qualities of milk are ascribable to the oily constituent; and, with such patients, ass's milk (which contains but little butter) usually agrees.

The quantity of nutritive matter, contained in milk, varies not only with the species, but with the individual,—nay, with the same individual under different circumstances. The quality of the milk is affected by constitution, age, food, period after parturition, mental emotion, disease, the use of medicines, &c.

Dr. Young (Quoted by Cullen, *Mat. Med.*) found, that a bitch, fed on vegetable aliment, yielded an acescent and spontaneously coagulable milk; but, when animal food was substituted, the milk became alkaline, and did not spontaneously coagulate.

Dr. Cullen says, "I allege it to be a matter of experience, that, supposing the quantity of liquid to be the same, nurses living entirely, or for the greater part, upon vegetable aliment, afford a greater quantity of milk, and of a more proper quality, than nurses living upon much animal food. This I venture to assert—from the observations of fifty years."

The influence which many medicines, taken by the mother, have over the sucking infant, is a circumstance known to every nurse, though Cullen denies it. We can modify the *colour* of the milk by mixing saffron or madder with the food; the *odour* may be affected by various cruciferous and alliaceous plants; the *taste* may be altered by the use of bitters, as wormwood; and lastly, the *medicinal effect* may be also influenced. Children may be salivated by sucking nurses under the influence of mercury, or purged by the exhibition of drastics, or narcotized by the administration of opiates to the nurse. These facts are so familiar to every one, that farther evidence of them is scarcely requisite. It is curious, however, that Simon (*Journ. de Pharm.* xxv. 354.) failed to recognise in the milk various salts, which were taken by the mouth, and were found in abundance in the urine. Mental emotions also affect the quality of the milk. I have frequently seen the bowels of the child disordered in consequence of some sudden emotion on the part of the mother. It is also not improbable that diseased conditions of the parent may render the milk unhealthy. Labillardière (*Dict. Mat. Méd.* iv. 23.) states that the milk of a cow, affected with a kind of tuberculous phthisis (*pommelière*,) contained seven times more phosphate of lime than usual. Dupuy[1] also speaks of the large quantity of calcareous matter in the milk of cows, in whose lungs abundant deposites of the same substance were found. Other morbid changes in the milk have been observed by Donné, Robiquet, and Lassaigne. The facts now mentioned, are of the greatest moment, not only in reference to the frequency of disease in cows, and, therefore, to the possible morbific character of their milk, but they are of considerable importance in reference to the milk of the human subject. I think, with this statement before us, it is highly improper to allow a female, with any trace or suspicion of tuberculous disease, to suckle. Not that a few grains, more or less, of phosphate of lime in the milk, can probably do any injury to the child; but the fact once established, that the milk may be thus altered by disease, leads to the suspicion that some other substances not yet recognised by their physical or chemical characters, may be in the milk of diseased nurses, and which may have an injurious influence on the child; and the sus-

[1] Quoted by Andrel, *Treat. on Pathol. Anat.*; by Townshend and West, vol. i. p. 675.

picion does not confine itself to those affected with tuberculous diseases: other hereditary or constitutional affections may also be attended with altered conditions of the milk. This suspicion is strengthened by the common observation, that the milk of nurses will not equally suit different children. A child, quite healthy, and in good condition, will sometimes, without any evident disease, fall off, and get into what is commonly called a bad condition, apparently from a change of the nurse. I am aware that we cannot always refer this to any positively hurtful matter in the milk. The quantity of nutritive matter in the same quantity of milk of two nurses may be very different: according to Payen, (*Journ. de Chim. Méd.* t. iv. p. 118.) milk with too much nutritive matter in it may disagree with the child. Another point worthy of attention is the quantity of milk yielded in a given time. Payen says it varies in different women as much as from one to ten and a half in the same time.

a. **Butter.**—Butter is employed rather as a condiment than as a direct alimentary matter. Its properties have been already noticed (See p. 81.) When rendered rancid by keeping,—or empyreumatic by heat, it is exceedingly injurious to the dyspeptic.

Cream consists principally of butter, but mixed with a certain portion of caseum or whey.

b. **Cheese.**—The basis of this is caseum or curd coagulated, somewhat altered in its nature, and mixed with more or less butter. Its richness is in proportion to the quantity of butter present. *Stilton cheese* is prepared from milk to which cream is added. *Chesire*, and the best *Gloucester cheeses*, are made from unskimmed milk. *Suffolk*, and *Parmesan cheeses*, are prepared from skim-milk. Cheese is nutritious, but difficult of digestion. When old and strong, it is taken as a condiment, to promote the secretion of saliva and gastric juice, and thereby to assist digestion. Toasted cheese is bad for dyspeptics.

Cheese, like sausages and bacon, sometimes acquires poisonous properties by keeping. (Christison, *op. supra cit.*)

Class 2. Aves.—Birds.

The eggs and flesh of these animals are used for food.

1. Eggs.—Both the white or glaire and the yelk are employed as food. The former owes its nutritive property to albumen,—the latter to both albumen and oil.

Albumen	12·0	Albumen	17·47
Mucus	2·7	Yellow oil and fat	28·75
Salts	0·3	Water	53·78
Water	85·0		
White of Egg	100 0[1]	Yelk of Egg	100·00[2]

Eggs are highly nutritive, and, under some circumstances, are readily digested. When beaten up, in tea, or slightly boiled, they are usually easy of digestion, though with some persons they are very apt to disagree. When boiled hard, and especially when fried in butter or oil, they are exceedingly difficult of digestion, and prove highly injurious to the dyspeptic. The following are the mean times of digestion of eggs, as observed by Dr. Beaumont:—

	Hour.	*Minutes.*
Eggs whipped, raw	1	30
Eggs fresh, raw	2	0
Eggs fresh, roasted	2	15
Eggs fresh, soft boiled	3	0
Eggs fresh, hard boiled	3	30
Eggs fresh, fried	3	30

The oil of the yelk renders this part of the egg scarcely so easy of digestion as the white or glaire.

2. Flesh.—The flesh of the common dunghill fowl is white, contains but little osmazome, and, when young, is exceedingly tender. The quantity of nutritive matter, in chicken flesh, is thus stated by Mr. Brande:—

[1] Bostock, quoted by Gmelin.

[2] Prout, *Phil. Trans.* 1822, p. 388.

100 *Parts of Muscle of*	*Water.*	*Albumen or Fibrine.*	*Gelatine.*	*Total of Nutritive Matter.*
Chicken.	73	20	7	27

Chicken flesh is easily digested and nutritious. It is the least irritating or stimulating, perhaps, of all animal foods; and is often retained on the stomachs of invalids when other meats would be immediately rejected. Chicken broth is well adapted for irritable stomachs.

The flesh of wild gallinaceous birds, as the pheasant and the partridge, is darker coloured, firmer, richer in osmazome, somewhat less digestible, and more stimulating than that of chicken.

The flesh of water-fowl, as the goose and duck, is mostly firm, penetrated with fat, and often difficult of digestion. It is scarcely adapted for the invalid.[1]

The employment of the enlarged liver of the goose, in the preparation of the *pâtés de foies gras*, has been already referred to. (See p. 48.) These livers were highly esteemed in the time of Pliny. (*Nat. Hist.* lib. x. cap. 27, ed. Valp.) They contain a quantity of phosphoric oil, which renders them difficult of digestion. Dr. Prout (*Op. supra cit.* p. 244.) suggests, that indolent and dyspeptic individuals, who partake of these diseased productions, "run considerable risk in inoculating and converting their own livers, or other organs, into a similar mass of disease."

Class 3. Reptilia.—Reptiles.

The Green or Edible Turtle (*Chelonia esculenta*, or *C. midas*) is the only reptile used in this country as food. It is highly nutritive, and, probably, when plainly cooked, is easy of digestion; but when taken in the form of the highly esteemed "turtle soup," is very apt to disagree with dyspeptics.

Class 4. Pisces.—Fishes.

The quantity of fibrine, albumen, and gelatine, found in some kinds of fish have been ascertained by Mr. Brande, who states them to be as follows:—

100 *Parts of Muscle of*	*Water.*	*Albumen or Fibrine.*	*Gelatine.*	*Total of Nutritive Matter.*
Cod	79	14	7	21
Haddock	82	13	5	18
Sole	79	15	6	21

Morin (*Journ. de Pharm.* t. viii. p. 61.) analyzed the flesh of the Smelt, and found it to consist of yellow, phosphoric oily matter, osmazome, gelatine, mucus, albumen, fibrine, sal ammoniac, phosphates of potash, lime, iron, and magnesia, chloride of potassium, and carbonate of lime.

Fish are less satisfying to the appetite than either mammals or birds. They are also less nourishing. Those fish (as salmon and eels,) which abound in oily matter, are more nutritive than other kinds, but are proportionably less digestible. The thirst and uneasy feeling at the stomach, frequently experienced after the use of the richer kinds of fish, have led to the use of spirit as a condiment for this kind of food. Hence the vulgar proverb, that "*brandy is Latin for fish.*" (See Dr. George Cheyne's *Essay of Health and Long Life*, p. 41.) Skin diseases are said to be more prevalent among those who live much on fish. (Troil's *Letters on Iceland*, p. 319. Lond. 1780.) By the continued use of fish, the seminal secretion is said to be promoted, and the sexual feelings raised. This effect is ascribed to the phosphoric oil which these animals contain.[2]

The following are the mean times of digestion of several fish, according to Dr. Beaumont's experiments:—

[1] For farther details respecting the properties of the flesh of birds, I must refer the reader to Cullin's *Treatise of the Materia Medica*, vol. i. p. 376, Edin. 1789; and Plenck's *Bromatologia*. Viennæ, 1783.

[2] Foster (*Observations made during a Voyage Round the World*, p 315, Lond. 1778) has endeavoured to prove "that feeding on fish by no means contributes to the increase of numbers in a nation."

	Hours.	Minutes.
Trout (Salmon,) fresh, boiled	1	30
——— fried	1	30
Cod-fish, cured dry, boiled	2	0
Flounder, fresh, fried	3	30
Salmon, salted, boiled	4	0

The white fish, as whiting, haddock, sole, flounder, the cod, and turbot, are the most easily digestible of the fishes in common use, in consequence of containing less oil. They are also less stimulating to the system, and, therefore, are the best adapted for the use of invalids. The whiting and the haddock are the most delicate and tender; the turbot and the cod the least so. It must be remembered, however, that the sauces (melted butter, &c.,) usually taken with these fish, are exceedingly obnoxious to the stomach, and, therefore, must be excluded from the table of the invalid. Salmon, eels, herrings, and sprats, abound in oil; and, in consequence, are difficult of digestion, very apt to disturb the stomach, and are exceedingly injurious to the dyspeptic. By drying, salting, and smoking, the digestibility of fish is diminished.

Some species of fish, especially in tropical climates, possess poisonous properties, either at all times, or at certain seasons. Certain individuals are more susceptible of fish-poison than others. (On the subject of Fish-poison, the reader is referred to Dr. Christison's *Treatise on Poisons*.)

Some of the viscera of fish are prepared and used separately as articles of food. Thus, the swimming-bladder constitutes the well-known *sound* and *isinglass*,—substances of a gelatinous nature, and already noticed. (See p. 82.) The roe or ovary (commonly called the *hard roe*, to distinguish it from the milt or testicle, called the *soft roe*) of most fishes is eaten.) It contains a phosphoric oil. The substance, called *caviare*, is the prepared roe of the sturgeon.

The following is the composition of isinglass and caviare. (Gmelin, *Handb. d. Chem.* ii. 1468 and 1469.)

Isinglass		Fresh unpressed Caviare	
Gelatine	70·0	Yellow odorous fatty oil	4·3
Ozmazome [?]	16·0	Soluble albumen	6·2
Membrane, insoluble in boiling water	2·5	Insoluble albumen	24·8
Free acid and salts	4·0	Chloride of sodium and sulphate of soda	6·7
Water	7·5	Gelatine, with some salts	0·5
		Water	57·5
	100·0		100·0

"The flesh of any fish is always in the highest perfection, or *in season*, as it is called, during the period of the ripening of the milt and the roe. After the fish has deposited the spawn, the flesh becomes soft, and loses a great deal of its peculiar flavour. This is owing to the disappearance of the oil or fat from the flesh, it having been expended in the function of reproduction." (Fleming's *Philosophy of Zoology*, vol. ii. p. 373.)

Class 5. Crustacea.—Crustaceous Animals.

To this class belong Lobsters, Crabs, Cray-fish, Prawns, and Shrimps.—"They have a white, firm flesh, which contains much gelatine. In the membrane, which encloses the calcareous shell, is found a resinous substance, which, in the living animals, is of a brownish-green colour, but becomes red by boiling. From this matter proceeds the peculiar odour and taste of the broth of these animals. The flesh is difficult of digestion; the broth is stimulant. In febrile and inflammatory complaints their use is injurious." (Tiedemann, *op supra cit.* p. 136.) A cutaneous eruption, and even colic, sometimes follow their ingestion. Several of the crustacea are poisonous.

Class 6. Mollusca.—Mollusks.

The Oyster, the Muscle, the Periwinkle, the Cockle, the Whelk, and the

Limpet, belong to this class.[1] The flesh of the Oyster was analyzed by Pasquier, (Gmelin, *Handb. d. Chem.* ii. 1478.) who found it consists of water, 87·4; and of osmazome, mucus, albumen, fibrine, and gelatine, together, 12·6. It furnishes a delicious article of food; and is more digestible in the raw state than when cooked (by roasting, scolloping, or stewing;) for the heat employed coagulates and hardens the albumen, and corrugates the fibrine, which are then less easily soluble in the gastric juice; and the heated butter, generally used as an accompaniment, adds still more to the indigestibility of the oyster. The following are the mean times of digestion of oysters, according to the experiments of Dr. Beaumont:—

	Hours.	*Minutes.*
Oysters, fresh, raw - - -	2 -	55
Oysters, fresh, roasted - - -	3 -	15
Oysters, fresh, stewed - - -	3 -	30
Oyster soup, boiled - - -	3 -	30

As far as my own personal observation extends, the finest raw oysters of the London market, usually called *natives*, rarely disagree even with dyspeptics; and Dr. Cullen declares oysters to be easy of digestion. Very opposite, however, is the experience of some other writers.[2] Poisonous effects even have been ascribed to oysters. (See Christison's *Treatise on Poisons.*) Considering the enormous consumption of these animals, their supposed ill effects must be of extremely rare occurrence. The accuracy of the statement of Dr. Clarke, (*Trans. of the London College of Physicians*, vol. v. p. 109.) that oysters, taken immediately after delivery, are apt to occasion apoplexies or convulsions, appears to me to be improbable. An aphrodisiac property is usually ascribed to oysters. These mollusks have been recommended in phthisis, and in some abdominal affections. The Muscle has on many occasions operated as a poison. (Christison, *op. supra cit.*) The Great or Vineyard Snail (*Helix pomatia*) is a popular remedy for emaciation, with hectic fever and phthisis, on account of its supposed nourishing qualities.

β. *Vegetable Aliments.*

These may be arranged in eight classes:—

1. Seeds.
2. Fleshy Fruits.
3. Roots, Subterranean Stems, and Tubers.
4. Buds and Young Shoots.
5. Leaves and Leafstalks.
6. Receptacles and Bracts.
7. Stems.
8. Cryptogamia, or Flowerless Plants.

Class 1. Semina.—Seeds.

The seeds used as food are of two kinds, farinaceous and oleaginous.

1. Mealy or Farinaceous Seeds.—The most important of these are the Cereal Grains and the Leguminous Seeds. The Chestnut also belongs to this kind of seeds.

The nutritive principles of the *Cereal grains* are Starch, Gluten, Gum, and Sugar. Of these grains none equal *Wheat* in nutritive qualities, which it owes to the large quantity of gluten which it contains. It yields the finest, whitest,

[1] The mollusks just mentioned, and the crustaceous animals used as food, constitute the *Shell Fish* of the shops. Of course, strictly speaking, they are not fish at all.

[2] Pearson, *Pract. Synopsis of the Materia Alimentaria*, Lond. 1808; Paris's *Treatise on Diet*, 5th ed. Lond. 1837.

and most digestible kind of bread. *Oats* are nutritive, but less so than wheat. Oatmeal "is especially the food of the people of Scotland, and was formerly that of the northern parts of England; countries which have always produced as healthy and as vigorous a race of men as any other in Europe." (Cullen's *Materia Medica*, vol. i. p. 278.) Unfermented oat-bread, in those unaccustomed to it, is apt to occasion dyspepsia, with heartburn, and was formerly thought to have a tendency to cause skin diseases, but without just grounds. Gruel is a mild, nutritious, and easily-digested article of food, in fevers and inflammatory affections. It is well adapted for irritable conditions of the stomach. *Barley*, when deprived of the husk (which is slightly acrid and laxative,) is highly nutritious. Count Rumford (*Essay on Feeding the Poor.*) regards barley-meal, when used for soup, as three or four times as nutritious as wheat-flour. Barley-bread is said to be more difficult of digestion than wheaten bread. Barley-water is a mild, easily digestible liquid. *Rye* is nutritive, but less so than wheat. In those unaccustomed to it, rye-bread is apt to occasion diarrhœa, which Cullen ascribes to its readily becoming acescent. *Rice* is the ordinary sustenance of many oriental nations. Being less laxative than the other cereal grains, it is frequently prescribed, by medical men, as a light, digestible, uninjurious article of food, in diarrhœa and dysentery; and, in consequence, it is, with the public, a reputed drying and astringent agent. Various ill effects, such as disordered vision, &c. have been ascribed to its use;[1] but without any just grounds. Neither does there appear to be any real foundation for the assertion of Dr. Tytler, (*Lancet*, 1833–4, vol. i.) that malignant cholera (which he calls *morbus oryzeus!*) is induced by it. *Maize*, or *Indian Corn*, is nutritive; but, being deficient in gluten, is not adapted for manufacture into bread. It is apt to occasion diarrhœa in those unaccustomed to it. (Dunglison, *Elements of Hygiene*, p. 289. Philad. 1835.) In America, Asia, and some parts of Europe, it is used largely for human sustenance.[2] *Millet*, both common and Italian, is cultivated in Italy as an article of food. *Sorghum*, *Durra*, or *Guinea Corn*, is another of the cerealia employed, in some parts of Africa, as an article of food.

Various foods are prepared from the meal or flour of the cerealia. The most important of these is Bread.

1. Bread.—There are two principal kinds of bread,—the one fermented or leavened, the other unfermented or unleavened.

a. Fermented or leavened bread.—The best is that made from wheat, as I have before stated. *Fine bread*, prepared from flour only, is the most nutritive and digestible. That which contains the bran is laxative, and is used by persons troubled with habitual constipation. *Rolls*, and other kinds of *fancy bread*, are less digestible than the common loaf bread. All kinds, when eaten new, are injurious to dyspeptics.

b. Unfermented or unleavened bread.—Biscuit is the best kind of unleavened bread, and sometimes suits the stomach of the dyspeptic when leavened bread disagrees. That which is free from butter is to be preferred.

2. Pastry. (*Baked paste.*)—The action of heat on the butter or lard used in the manufacture of pastry, renders this compound highly injurious to the dyspeptic. "All pastry is an abomination:" justly observes Dr. Paris. "I verily believe," he adds, "that one half, at least, of the cases of indigestion which occur, after dinner-parties, may be traced to this cause."

3. Puddings, Pancakes, &c.—"The most digestible pudding is that made with bread, or biscuit and boiled flour: *batter* pudding is not so easily digested; and *suet* pudding is to be considered as the most mischievous to invalids in the whole catalogue. *Pancake* is objectionable, on account of the process of frying imparting a greasiness, to which the dyspeptic stomach is not often reconciled. (Paris's *Treatise on Diet*, p. 233, 5th ed. 1837.)

Of the *Leguminous Seeds*, peas and beans are the best known. Their composition, as determined by Einhof, is as follows:—

[1] Bontius, *Account of the Diseases, Natural History, &c. of the East Indies.* Translated into English, p. 129. 1769—Bricheteau, in Tortuelle's *Elém. d'Hygiène*, 4me éd.

[2] For farther particulars respecting Maize, consult Cobbett's *Treatise on Cobbett's Corn; Quart. Journ. Agricult.* i.; *Mém. de l'Acad. Roy. de Méd.* t. ii. p. 206, Paris, 1833.

	Peas (*Pisum sativum.*)	*Garden Bean* (*Vicia Faba.*)	*Kidney Bean* (*Phaseolus vulgaris.*)
Starch	32·45	34·17	35·94
Amylaceous fibre	21·88	15·89	11·07
Legumin	14·56	10.86	20.81
Gum	6.37	4·61	19.37
Albumen	1·72	0·81	1·35
Extractive matter	2·11	3·54	3·41
Membrane	—	10·05	7·50
Water	14·06	15·63	(dried)
Salts	6·56	3.46	0·55
Loss	0·29	0·98	—
	100·00	100·00	100·00

Peas and beans are nutritious; but they are apt to disturb the digestive organs, and to occasion flatulence and colic. Their difficult digestibility increases with their age. When young, they are less nourishing, but more digestible. They are usually regarded as being somewhat stimulating and heating, and, therefore, not adapted for febrile and inflammatory affections. Their stimulant influence on horses is well known to veterinarians.

The *Chestnut* possesses considerable nutritive power, and in Lombardy is used as food by the lower classes. Its sweetness, especially when roasted, indicates the presence of sugar. No oil can be obtained from it by pressure. In the raw state, it is very difficult of digestion: it requires to be cooked (roasted) to split the starch grains which it contains, and thereby to render them readily digestible. Dyspetics should carefully avoid chestnuts, even in the cooked state.

2. Oily Seeds.—To this division belong the Almond,[1] the Walnut, the Hazle-nut, the Cashew-nut, the Pistachio-nut, the Stone-Pine-nut, (Pignoli-Pine,) and the Cocoa-nut. These contain a quantity of fixed oil, which, while it confers on them great nutritive qualities, renders them very difficult of digestion. Their use should be carefully avoided by all dyspepties.

Class 2. Fleshy Fruits.

A considerable number of the esculent fleshy fruits will be described in a subsequent part of this work: hence, a brief notice of them will be sufficient here.

1. Stone Fruits. *Drupes.*—The Peach, the Apricot, the Nectarine, the Plum, and the Cherry, are the principal stone-fruits used in this country. They are usually regarded as difficult of digestion; and the popular opinion is probably the correct one, for Dr. Beaumont found that from six to ten hours were required for the artificial digestion of peaches. They are apt to disorder the digestive organs, and to occasion griping and relaxation.

2. Pomaceous Fruits. *Apples.*—The Apple, the Pear, and the Quince, are difficult of digestion; the Pear being the least so.

3. Baccate Fruits. *Berries.*—The Grape, the Gooseberry, and the Currant, are berries. Their skins (epicarps) and seeds are indigestible. The pulp is apt to relax the bowels. The Grape, if taken without the skin and seeds, is the safest of these fruits.

4. Aurantiaceous Fruits. *Hesperidium* or *Aurantium.*—The Orange, the Lemon, the Citron, the Lime, and the Shaddock, belong to this group. The Orange, when unripe, is apt to cause griping; but when quite ripe, is rarely inadmissible: the seeds and white tissue of the rind should, however, be rejected.

[1] The properties of this seed, which may be taken as the type of the oily seeds, will be fully described in a subsequent part of this work.

5. Cucurbitaceous Fruits. *Pepones.*—To this head belong the Melon, the Pumpkin, the Vegetable Marrow, and the Cucumber. They yield but little nutritive matter, and readily disagree with the dyspeptic.

6. Leguminous Fruits. *Legumes.*—The Tamarind contains but little nutriment. The legume of the Phaseolus vulgaris, or kidney-bean, is brought to the table when boiled.

7. Syconus.—Figs are nutritive, but are apt to occasion flatulence, griping, and relaxation of bowels, especially in children.

8. Sorosis.—The Mulberry yields but little nutritive matter, and readily disorders the bowels. The Pine-apple belongs to this division of fruits.

9. Etærio.—The fleshy receptacle of the Strawberry is not, for the most part, injurious; especially when the achenia (commonly termed seeds) are removed.

Class 3. Roots, Subterranean Stems, and Tubers.

The most important of these is the Potato; which, when in good condition and boiled, furnishes a highly nutritious and easily digested article of food. Potatoes are more palatable and nutritive when boiled so as to make them moderately soft, though not to injure their shape; but they are more digestible when boiled so as to be easily mashed. Waxy and new potatoes are less digestible than old mealy ones. Potatoes, which have germinated, have sometimes proved noxious to cattle, and which is said to arise from the large quantity of *solanina* contained in the buds. The process of cooking potatoes is probably useful in two ways: it splits the starch grains, and thereby renders them readily digestible; and secondly, it destroys or extracts some noxious matter. The latter circumstance seems proved by the fact, that the water in which potatoes have been boiled, has, on some occasions, been found to possess poisonous properties.

Of the *Cruciferous* or *Siliquose* roots used as food, the Turnip contains the most nourishment, and is readily digested, though occasionally it creates flatulence.

The *Umbelliferous* roots, in common use, are the Carrot and the Parsnip. These are saccharine, and slightly nutritive; but the volatile oil, which they contain, renders their flavour unpleasant to many persons, and causes them to be apt to disagree with dyspeptics.

Class 4. Buds and Young Shoots.

Onions, Leeks, Garlic, and the Shallot, are usually ranked among roots. They are, however, subterranean buds, with thick and fleshy scales. When deprived, by boiling, of their acrid volatile oil, they are slightly nutritive.

The young shoots of Asparagus are nourishing. When eaten, they communicate a peculiar odour to the urine. The melted butter eaten with them is injurious to the dyspeptic.

Class 5. Leaves and Leaf Stalks.

The herbaceous part of the Water-Cress, the leaves of Lettuce and of Endive, and the seed-leaves of White Mustard and Common Cress, are eaten raw under the name of salads (*Acetaria,*) with the addition of vinegar, oil, salt, and pepper. They yield very little nourishment.

The Cabbage, the Cauliflower, Broccoli, the Savoy, Spinach, &c., are employed only when boiled. They are apt to disagree with dyspeptics. Spinach usually relaxes the bowels.

The stalks of Rhubarb leaves are used for tarts and puddings. Their use is objectionable when there is a tendency to oxalate of lime calculi. "I have seen," observes Dr. Prout, (*Op. supra cit.* p. 65.) "well-marked instances in which an oxalate of lime nephritic attack has followed the free use of rhubarb, (in the shape of tarts, &c.,) particularly when the patient has been in the habit, at the same time, of drinking *hard water.*"

Class 6. Receptacles and Bracts.

The fleshy receptacle and bracts of the Artichoke are used as food.

Class 7. Stems.

From the stems of several Cycadaceæ, as well as of some Palms, is obtained a farinaceous substance, which is employed, in the countries where it is procured, as an article of food. Sago is procured from this source.

Class 8. Cryptogamia.—Flowerless Plants.

No important articles of food are obtained from this class.

1. Ferns.—From the rhizomes of ferns is obtained, in some of the Polynesian Islands, as well as in some other parts of the world, a farinaceous or ligneous matter, which is employed by the natives as a nutritive substance. (Tiedemann, *op. supra cit.* p. 203.)

2. Lichens.—Several species of *Gyrophora* (as *G. proboscidea* and *cylindrica*) are employed by the hunters of the Arctic regions of America as articles of food, under the name of *tripe de roche*. They supported Capt. Sir John Franklin and his companions, in 1821, for many days. The bitter principle of these plants, however, proved noxious to several of the party. (*Narrative of a Journey to the Shores of the Polar Sea.* Lond. 1823.) Iceland moss also yields nutritive matter; but, to be available as food, the bitter matter of the lichen must be separated.

3. Algæ. *Sea Weeds.*—Several species of the inarticulated Algæ are occasionally employed, in some parts of the British islands, as articles of food, or as condimentary substances. (See Greville's *Algæ Britannicæ.* Edin. 1830.) *Laver* is sometimes met with in the London shops.

4. Fungi. *Mushrooms.*—Though a considerable number of species of fungi are edible—in fact, several form delicious articles of food—a small number only is in common use in this country. This has arisen, in great measure, from the difficulty experienced by the public in discriminating wholesome from poisonous species. Nay, it would appear that the same species is under some circumstances edible, under others deleterious. This, if true, is a very proper ground for distrust. "So strongly did the late Professor L. C. Richard feel the prudence of this, that although no one was better acquainted with the distinctions of fungi, he would never eat any; except such as had been raised in gardens in mushroom beds." (Lindley, *Nat. Syst. of Bot.* 2d edit. p. 442.) The edible species in most common use in this country are, 1st. *Agaricus campestris*, (*common field* or *cultivated mushroom*,) which, in the adult state, is employed in the preparation of ketchup, and is eaten fresh, either stewed or broiled: the young or button mushroom is pickled. 2dly. *Morchella esculenta*, (*common morel*,) employed to flavour gravies, ragouts, &c. 3dly. *Tuber cibarium*, (*common truffle*,) a subterraneous fungus, used for seasoning. No less than thirty-three species of fungi are eaten in Russia. (Dr. Lefrere, *Lond. Med. Gaz.* xxiii. p. 414.)

b. Potulenta.—Drinks.

The liquids, taken by the mouth to quench thirst, are denominated drinks. Of these, a very brief notice is all that can be given here. Several of them will be more fully noticed in subsequent parts of this work.

1. Aqua. *Water.*—This is probably the natural drink of all adults. It is a vital stimulus, and is more essential to our existence than aliment. It serves at least three important purposes in the animal economy: firstly, it repairs the loss of the aqueous part of the blood, caused by the action of the secreting and exhaling organs; secondly, it is a solvent of various alimentary substances, and, therefore, assists the stomach in the act of digestion, though, if taken in very large quantities, it may have an opposite effect, by diluting the gastric juice; thirdly, it is probably a nutritive agent,—that is, it assists in the formation of the solid parts of the body. From the latter opinion, which I hold with Count Rumford, (*Essays*, vol. i. p. 194, 5th ed. 1800.) many, however, will be disposed to dissent.

Soft water is to be preferred as a drink to hard water, because it is a better solvent of vegetable and animal matters; and farthermore, because the continued ingestion of the saline constituents of hard waters may slowly prove injurious in some diseases. *The presence of decomposing organic matter* renders water highly noxious. Dr. Lambe[1] considered it to be the cause of various constitutional diseases, and hence he advocated the use of distilled water; but of the accuracy of his opinion we have not sufficient evidence. The obvious effect which results from the use of water containing putrescent matter, is dysentery.[2] It is a curious, but well established fact, that *pure* water more readily acquires a metallic impregnation from leaden cisterns or pipes, than *hard* water. Distilled water, aided by atmospheric air, readily corrodes lead: but if a neutral salt, as chloride of sodium or sulphate of soda, be added to the water, the corrosive action is impaired. Hence, rain-water is more apt than well-water to become impregnated with lead.

2. Toast-Water.—Water is rendered much more palatable and agreeable when impregnated with toasted bread or biscuit. The toast communicates to it a little gum, and an empyreumatic matter. From the latter the water acquires colour and flavour.

3. Tea.—Notwithstanding the extensive employment of tea in this country, it is no easy matter to ascertain its precise effects on the system. Its astringency is fully proved by its chemical properties. Its peculiar influence over the nervous system, and which is especially manifested after the use of green tea, is another well-established effect. This influence is, in some respects, somewhat allied to that exercised by fox-glove: for both tea and fox-glove diminish the tendency to sleep, and act as sedatives to the vascular system. Hence, tea is employed as a drink by those who are accustomed to nocturnal study. Strong green tea, taken in large quantities, is capable, in some constitutions, of producing most distressing feelings; (Dr. E. Percival, *Dubl. Hosp. Reports*, vol. i. p. 219.) and of operating as a narcotic. Part of the effects sometimes ascribed to it are referrible to the water, the temperature at which it is swallowed, or to the substances (milk and sugar) added to it. Weak tea rarely disagrees with the invalid, and is admissible and refreshing in a variety of maladies. It is well adapted for febrile and inflammatory complaints; and is particularly valuable when we are desirous of diminishing a tendency to sleep.

4. Coffee is a tonic and stimulating drink. It occasions thirst, and not unfrequently disorders the bowels. It is usually described as having constipating effects; but I know two individuals on whom it has a relaxing effect. It possesses anti-soporific powers, and is used, therefore, by those who desire nocturnal study.

5. Chicory, or Succory, yields a wholesome beverage, but which wants the fine aromatic flavour for which coffee is so celebrated. I am informed, however, that the flavour of coffee mixed with chicory is preferred by some persons to that of unmixed coffee.

6. Chocolate is a very nourishing beverage, devoid of some of the ill qualities ascribed to tea and coffee; but, on account of the oil which enters into its composition, it is difficult of digestion, and is apt to disagree with dyspeptics.

7. Coco is less oily, and being somewhat astringent, is adapted for persons with relaxed bowels.

8. Beer. *Malt Liquor*.—Under this head are included Ale, Stout, Porter, and the weaker kinds of beer, commonly known as Table or Small Beer. All

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[1] *A Medical and Experimental Inquiry into the Origin, Symptoms, and Cure of Constitutional Diseases.* Lond. 1805.

[2] Dr. Cheyne, in the *Dublin Hospital Reports*, vol. iii. p. 11.—Dr. Copland's *Dict. of Pract. Med.* art. *Dysentery*, p. 698–99.—At the Nottingham Assizes, in 1836, it was proved at a trial, on which I was a witness, that dysentery, in an aggravated form, was caused in cattle by the use of water contaminated with putrescent vegetable matter, produced by the refuse of a starch manufactory. (See a brief report of the trial in the *Veterinarian* for 1836, p. 457.)

these are fermented decoctions of malt and hops. Their specific gravity is as follows:—

	Sp. gr.		*Sp. gr.*
Ale, Burton, 1st sort . .	1·111 to 1·120	Porter, common sort . .	1·050
" " 2d sort . .	1·097 to 1·111	" double	1·055
" " 3d sort . .	1·077 to 1·092	Brown Stout	1·064
" Common	1·070 to 1·073	" " ditto best	1·072
" Ditto	1·058	Beer, common small . .	1·014
		" good table	1·033 to 1·039

Beer consists of *water*, *alcohol*, *lupulite*, (the bitter principle of hops,) *volatile oil of hops*, *gum*, *sugar*, *gluten*, *brown extractive*, *a small portion of tannic acid*, *carbonic acid*, and *the phosphates of lime and magnesia* held in solution by *phosphoric* and *acetic acids*. The quantity of alcohol in beer is as follows:—

	Proportion of spirit (sp. gr. 0·825) per cent. by Measure.	*Ditto, per cent. by Weight.*
Ale, Burton	8·88	7·326
" average	6·87	5·667
Brown Stout	6·80	5·610
London Porter (average) . .	4·20	3·465
" Small Beer . . .	1·28	1·056

By distillation the alcohol may be readily separated. On evaporation, beer furnishes a brown extractiform residue.

Beer differs from wine in several important particulars. Thus it contains a much larger quantity of nutritive matter, and a considerably less proportion of alcohol; but it has, in addition, a peculiar bitter and narcotic substance. That its inebriating quality does not wholly depend on the alcohol which it contains, is shown by comparing the quantity of spirit obtained by Mr. Brande from brandy, wine, and porter. From his experiments, it appears that the same quantity of spirit is contained in the following quantities of wine, brandy, and beer:—

Port Wine	1·00
Claret	1·52
Champagne	1·82
Brandy	0·43
Burton Ale	2·58
London Porter	5·46
Small Beer	18·16

Now if the intoxicating quality of beer depended on the spirit merely, the effect of five and a half pints of London porter, or two and a half pints of Burton ale, should be equal only to that of a pint of port wine; whereas its actual inebriating power greatly exceeds this.

That beer is nutritive, and, when used in moderation, salubrious, can scarcely be doubted. It proves a refreshing drink, and an agreeable and valuable stimulus and support, to those who have to undergo much bodily fatigue. The poor labourer who has repeatedly experienced its invigorating property, will by no means admit the truth of Dr. Franklin's assertion, (*Select Works*, by W. T. Franklin, vol. i. p. 36. Lond. 1818.) that a penny loaf and a pint of water yield more nourishment than a pint of beer. The hop operates as a tonic, and assists digestion. With dyspeptics, beer as well as other fermented liquors, are very apt to disagree. By them, therefore, its use should be carefully avoided. Farthermore, it is objectionable for those liable to lithic acid deposites, and for plethoric persons who have a tendency to apoplexy.

The difference between *ale* and *porter* deserves a slight notice. The first is pale-coloured and sweetish; being prepared from pale or amber-coloured malt,

which contains a large quantity of saccharine matter. Porter, on the other hand, is deep-coloured and devoid of any sweet taste. It is prepared from high dried or rather charred malt, which has had its saccharine matter destroyed by heat. Hence, ale is more objectionable for diabetic and dyspeptic patients than porter. From this statement we ought perhaps to except the ales prepared for the India market, which are free from saccharine matter, and contain double the usual proportion of hops. (See Prout, *op. supra cit.* p. 44.)

9. Wines.—It cannot be denied, that the most perfect health is compatible with total abstinence from wine; and that from the use of this liquid various diseases have been produced, kept up, or aggravated. I am by no means, however, disposed to deny the accuracy of the statement of Dr. Paris, (*Treatise on Diet*, p. 268, 5th ed.) that "there exists no evidence to prove that a temperate use of good wine, when taken at seasonable hours, has ever proved injurious to healthy adults;" since he has so qualified this sentence, that in any cases where ill effects appear to result from the use of wine by adults, they may safely be ascribed to the non-fulfilment of some of the conditions here mentioned,—(viz. the *temperate* use of wine,—the *goodness* of the liquor,—the *seasonable* time of taking it,—or the *health* of the individual.)

It must be admitted, that the most perfect health is compatible with the moderate enjoyment of wine, and that many individuals who attain a good old age, have, during a considerable period of their life, been in the habit of using wine daily. Moreover, persons who have been accustomed to the temperate use of wine, are likely to suffer if deprived of their accustomed stimulus. In a subsequent part of this work, some remarks will be offered on the different qualities of different wines, and their medicinal uses. I shall merely remark here, that in forming an opinion as to the kind of wine best adapted for the dietetical use of our patients, we should consider its colour, its alcoholic strength and intoxicating property, its sweetness, the nature and quantity of acid which it contains, and its age. The *red* wines contain more extractive and colouring matters, (derived from the husk of the grape,) which are apt to disagree with some dyspeptics. With regard to its *alcoholic strength* and *intoxicating quality*, it deserves to be especially remembered that the inebriating property of wine is not proportional to the quantity of contained alcohol,—since champagne is more intoxicating, though less alcoholic, than port wine. (See p. 95.) Its *sweetness* requires especial consideration in dyspeptic and urinary diseases; in some of which, (as in diabetes,) the employment of saccharine matter is highly objectionable. Without adopting the prejudices of Sir A. Carlisle, (*Essay on the Disorders of Old Age.*) against the use of *acids*, it cannot be doubted that the employment of acid wines (as claret and hock) is calculated to prove, on many occasions, injurious; and in such cases sherry is used in preference to other wines. In phosphatic urinary deposites, however, they prove serviceable. By keeping, wine deposites bitartrate of potash, and colouring and extractive matters, which are very apt to disagree with some patients. Hence *old* wines are to be preferred to *new* ones.

10. Ardent Spirits.—Brandy, Rum, Gin, and Whisky, are the ardent spirits most frequently used in this country. Various compounded spirits (those imported are termed *Liqueurs*) are also employed as cordials. The injurious effects of spirit will be pointed out in a subsequent part of this work. I shall here confine my attention to its dietetical use. Brandy is frequently used at the table, as a gastric stimulant, to promote the digestion of substances difficult of solution in the juices of the stomach, as the oily fish. That various uneasy sensations, referred to the scrobiculus cordis, are often relieved by it, cannot be denied; but of the existence of any other benefit we may fairly doubt; while the ill consequences of frequently resorting to spirit are undoubted. Dr. Paris states that in some cases of dyspepsia, wine and beer equally disagree with the stomach, producing acidity and other distressing symptoms; and in such, he observes, "very weak spirit may, perhaps, be taken with advantage." In confirmation of the accuracy

of the observation I can bear testimony; having repeatedly found the substitution of a very weak spirit preferrible to fermented liquors.

11. Carbonic Acid Waters.—To this head belong Soda Water, Ginger Beer, and Effervescing Lemonade. These are refreshing, grateful beverages; though by distending the stomach with gaseous air, they must prove injurious to the process of digestion.

12. Acidulated Waters.—Lemonade and Imperial are pleasant, refreshing drinks, which, however, are apt to disagree with dyspeptics.

13. Saccharine and mucilaginous Drinks.—Sugar-water and Gum-water are also liable to disturb the stomach of the dyspeptic.

14. Infusions or Decoctions of Animal Substances.—Under this head are included Beef Tea, Mutton, Veal, and Chicken Broths, and Soups. *Beef Tea* is a light, pleasant, and slightly nutritive article of diet, adapted for invalids. Spices are sometimes advantageously added to it. *Mutton Broth* is apt to disagree with persons having delicate stomachs, especially if the fat be not skimmed from it. It is frequently given to promote the operation of purgative medicine.

Chicken Broth is the least disposed to disturb the stomach of all the animal decoctions. It is especially adapted for invalids with great irritability of stomach. *Veal Broth* is less frequently used. *Soups* are not adapted for invalids. Their basis is gelatine, whose nutritive qualities have been already described. (See p. 83.)

15. Gruel and Barley Water.—*Gruel* is prepared from groats or oatmeal. It is a bland, nutritious, easily digestible, emollient liquid, well adapted for the use of invalids, and rarely disturbing the stomach. Sugar, lemon juice, aromatics, or butter, are frequently added, but they (especially butter) are by no means generally admissible. *Barley Water* is a thinner, less viscid liquid. It is used as a mild, demulcent, slightly nutritive drink, for invalids, in febrile and inflammatory disorders.

16. Milk.—Milk is the natural drink of man during the first period of his infancy. Its nutritive qualities have been already noticed. (See p. 85.) On account of the butter which it contains, it is apt to disagree with some adults: in common language, it sometimes lies heavy at the stomach. *Cream* is still more injurious. *Whey* is an agreeable beverage.

c. Condimenta.—Condiments.

These are substances which are taken with the food to improve its flavour, to promote its digestion, or to correct any injurious quality which it may possess. Some of them are also nutritive.

1. Saline Condiments.—Common salt, or the chloride of sodium, is the only saline condiment essential to health. It is taken by man, as well as by many animals, on account of its agreeable flavour; but the existence of a greater or less appetite for it, in all individuals, appears to me to show that this substance must serve some more important uses in the animal economy than that of merely gratifying the palate. In considering these, we observe, in the first place, that it is an essential constituent of the blood, which fluid probably owes some of its essential properties to its saline matter. Now as the blood is constantly losing part of its saline particles by the secretions (the tears, bile, &c.,) the daily loss is repaired by the employment of chloride of sodium as a condiment. In the second place, the free hydrochloric acid found in the stomach, and which forms an essential constituent of the gastric juice, is obviously derived from the salt taken with our food. Thirdly, the soda of the blood, and of some of the secretions, is doubtless obtained from the decomposition, in the system, of common salt. These are some (probably only a portion) of the uses which chloride of sodium serves in the animal economy. It deserves especial notice, that while salt is thus essen-

tial to health, the continued use of salted provisions is injurious. But their noxious quality is probably to be referred rather to the meat, whose physical and chemical qualities are altered, than to the presence of the salt; though we can readily conceive that an excessive use of salt, or of any other article of food, will be followed by injurious consequences. However relishing salted fish (as anchovies, herrings, cod, &c.) may be, they are difficult of digestion.

2. Acidulous Condiments.—Vinegar is a grateful condiment, and is used either alone, or with pickles. When taken in small quantities, it is quite wholesome. It allays thirst, and operates as a refrigerant. It probably promotes digestion, not merely by the stimulus which it communicates to the stomach, but by its power of dissolving several alimentary principles,—as fibrine, albumen, and gelatine. The frequent use of it is supposed to diminish obesity. It checks the secretion of milk, and at the same time injures the quality of this liquid. Lemon juice, or a solution of citric acid, is an acidulous condiment.

3. Aromatic and Pungent Condiments.—This division includes the spices (as Pepper, Nutmegs, &c.,) the savoury herbs of the family Labiatæ as (Thyme, Sage, &c.,) some Umbelliferous fruits (as Caraway,) several products of the family Cruciferæ (as Mustard, Horse-radish, &c.,) and the alliaceous substances (as Onions, Garlic, &c.) They are employed as condiments, partly for their flavour, and partly to promote the digestion of some kinds of food which experience has shown, are not by themselves easily or readily digested. Moreover, the cruciferous and alliaceous condiments are esteemed anti-scorbutics.

By the inhabitants of the torrid zone they are extensively used to counteract the debilitating influence of heat, as already mentioned. (See p. 47.) In temperate climates their employment is not so important; on the contrary, their copious use is injurious.

4. Oily Condiments.—Butter and oil are used at the table as condiments. Their general effects, as nutritive substances, have been already noticed. (See p. 81.) They become more difficult of digestion and more noxious to the dyspeptic, in proportion to the heat to which they are subjected in the process of cooking.

5. Saccharine Condiments.—Sugar, honey, and treacle, are employed as condiments. The nutritive properties of saccharine substances have been before noticed. (See p. 78.) When taken in small quantities, and largely diluted, as in tea, coffee, &c. sugar is said to be very apt to disagree, and give rise to flatulency and gastric uneasiness. Used in the form of preserves, it is also apt to disorder the stomach of dyspeptics.

Under the name of *Sauces*, are used at the table mixtures of various condiments. Ketchup (made from either Mushrooms or Walnuts,) Soy, and Essence of Anchovies, are those which are most frequently employed. Salt and spices are essential ingredients of them. Vinegar is also a constituent of some.

Dietetical Regimen.

In the treatment of many diseases, attention to diet is a point of considerable importance. In none is it more necessary than in non-febrile disorders of the digestive and urinary organs. In acute maladies, in which abstinence or low diet is requisite, there is usually no disposition to take food: on the contrary, solids of all kinds are generally loathed. In such cases, therefore, there is less chance of any error of diet being committed. Dietetical regimen is more important in chronic diseases of the assimilating organs, in which the appetite is unimpaired, or even increased,—since in such the patient is more apt to overstep the bounds of prudence, by the employment of a diet, improper either from the quantity or quality of the food used. In chronic local diseases, when the constitution is unimpaired and the appetite for food remains natural, I would by no means advocate the adoption of a spare or low diet; since I believe that in such cases the

indulgence of a moderate appetite for plain food, is attended with beneficial results. From this statement, however, maladies affecting the organs of assimilation must be excepted.

Several diets or kinds of dietetical regimen are employed in the treatment of diseases. The most important of these are the following:—

1. Animal Diet.—This term is applied to a diet composed of animal food, either exclusively or principally. The only disease, in which a diet exclusively of animal food is recommended, is diabetes. In this malady, strict abstinence from vegetable substances is attended with the diminution or cessation of the saccharine condition of the urine, and a reduction in the quantity of this fluid passed. It deserves especial notice that the quantity, as well as the quality, of the food taken in this disease, requires to be carefully attended to, as the craving for food is apt to induce the patient to indulge to an injurious extent. As an example of a dietary of animal food for a diabetic patient, I select the following, adopted by Dr. Christison, (*Edinb. Monthly Journal*, April 1841, p. 236.) for a patient in the Edinburgh Infirmary:—

	Ounces.	Ounces of dry nutritive principles contained therein.[1]
Fresh Meat	40	10·8
Cheese	2	2·0
Two Eggs	—	1·0
New Milk	48	8·0
Beef Tea	16	0·25
Total	-	22·05

In a second case only 20 oz. of meat were allowed.

In private practice, it will be convenient to allow other kinds of animal food in addition to the foregoing: as butter, chicken, sausages, fish, shell-fish, brawn, and poultry. For common drink, water, or beef-tea, or mutton-broth, may be sparingly allowed.[2]

The beneficial effects of a diet of animal substances exclusively in diabetes is, in most cases, temporary only; while its rigorous adoption is apt to be attended with febrile or inflammatory affections.[3] Moreover, a difficulty in its employment is often found in the inordinate craving for vegetable substances, and the loathing of animal food, experienced by the patient. Hence most practitioners have permitted the use of a limited quantity of farinaceous food, in the form of biscuit or bread. Rice may be occasionally admitted. Arrow-root, potatoes, and other low kinds of farinaceous substances, are less proper. Dr. Prout recommends sound porter in preference to wine or spirits.

In several other maladies the use of animal substances chiefly has been advised; as in the oxalate of lime diathesis, and in scrofula. Farthermore, it is admissible in other cases, where we are desirous of employing a highly nutritious and stimulating diet.

2. Vegetable Diet.—The exclusive employment of vegetable foods has been very rarely adopted. It has been eloquently advocated by Dr. Lambe,[4] who recommends it, in conjunction with the use of distilled water, as a remedy for cancer, scrofula, consumption, asthma, and other chronic diseases; but he has, I suspect, gained few, if any, proselytes to his opinions and practice.

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[1] The quantities stated in this column appear to me too high. They are taken from Dr. Christison's statement at p. 240, *op supra cit.*

[2] For some further remarks on the use of animal diet in diabetes, see p. 81 and 82.

[3] Dr. Marsh, in the *Dublin Hospital Reports*, vol. iii p 453, 1822.

[4] *Reports of the Effects of a Peculiar Regimen on Scirrhous Tumours and Cancerous Ulcers.* Lond. 1809.—*Additional Reports on the Effects of a Peculiar Regimen in cases of Cancer, Scrofula, Consumption, Asthma, and other Chronic Diseases.* Lond. 1815.

The term *spare* or *abstemious diet* is sometimes used to indicate the employment of vegetable substances principally (not exclusively.) It generally includes the use of the white fish, sometimes alternating with a limited quantity of poultry or butcher's meat. In plethoric habits, where the appetite is unimpaired, this diet is ordered in cases of threatened apoplexy, gout, &c. By its adoption we diminish the quantity of nutritive matter supplied to the system, while we keep the digestive organs actively employed.

3. Milk Diet.—Besides cow's milk, which constitutes the principal article of food, this diet includes the use of farinaceous substances (such as arrow-root, sago, and tapioca,) bread, and light puddings (of rice, bread, or batter.) Milk diet is ordered when we are desirous of affording support to the system with the least possible stimulus or excitement. It is well adapted for inflammatory diseases of the chest (phthisis especially,) of the alimentary canal, and of the bladder, when it is considered expedient to employ a nutritious but not stimulating diet. After hemorrhages, when the powers of the system have been greatly exhausted, a milk diet is frequently beneficial. It has also been considered one of the best means of preventing and of curing the gout. It is a good diet also for many of the diseases of children, especially those of a strumous or scrofulous nature. In some of the above-mentioned maladies, where the stomach is weak and irritable, cow's milk is apt to occasion vomiting and other unpleasant effects, in consequence of the butter which it contains. In such cases, skim-milk or ass's milk may be advantageously substituted.

4. Low Diet.—In acute inflammation, in fever, and after serious accidents, surgical operations, and parturition, patients are directed to adopt a low diet, consisting principally of the use of *slops* (as tea, toast-water, barley-water, and weak broth.) Small quantities of milk and farinaceous matters (in the form of bread, arrow-root, or tapioca, gruel, and light pudding) are sometimes permitted. The terms *thin diet*, *spoon diet*, *fever diet*, *simple diet*, and *broth diet*, are applied to particular modifications of low diet.

5. Full or Common Diet.—On many occasions where it is desirable to restore or support the powers of the system, patients are permitted to satisfy their appetite for plain vegetable and animal food. In many indolent diseases, in scrofula, in some affections of the nervous system (as chorea and epilepsy,) and in the stage of convalescence after acute diseases, &c. this kind of diet is frequently directed. In these cases beer is usually permitted. Wine, and even ardent spirit, are sometimes required. In some diseases of, and in accidents occurring in, confirmed drunkards, it is frequently found injurious to withhold the stimulus to which the patient's system has been long accustomed; and thus, wine, brandy, rum, or gin, is ordered, according to circumstances.

In concluding these remarks on the subject of dietical regimen, I have thought it advisable to give a tabular view of the Diets employed at the different hospitals of this metropolis.[1]

[1] The Diet-tables of the County, Scotch, and Irish hospitals, will be found in Dunglison's New *Dictionary of Medical Science*, art. Diet, p. 233. Philadelphia, 1842.

DIET-TABLES OF THE LONDOM HOSPITALS.

*** In addition to the substances specified in the following Tables, other articles (as chops, steaks, fish, wine, spirit, porter, &c.) are permitted, when specially ordered by the medical officers. These are denominated *extras*.

LONDON HOSPITAL.

	Common Diet.	*Middle Diet.*	*Low Diet.*	*Milk Diet.*
Per Day	12 oz. Bread. 1¼ pts. Beer, *Men.* 1 pint, *Women.*		8 oz. Bread.	12 oz. Bread.
Breakfast	Gruel.		Gruel.	Gruel.
Dinner	8 oz. Beef, with Potatoes, thrice a week. 8 oz. Mutton, with Potatoes, twice a week. 8 oz. Potatoes & Soup with Vegetables, twice a week.	The same, except that 4 oz. of Meat shall be given, instead of 8 oz.	Broth.	1 pint Milk.
Supper	1 pint of Broth.		Gruel or Broth.	1 pint Milk.

ST. BARTHOLOMEW'S HOSPITAL.

	Meat Diet.	*Broth Diet.*	*Thin or Fever Diet.*	*Milk Diet.*
Daily	Milk Porridge. 12 oz. Bread. 6oz. Mutn or Beef 1 pt. Broth [with Peas or Potatoes, 4 times a week.] 2 pts. Beer, *Men.* 1 pint, *Women.* 1 oz. Butter, twice a week.	Milk Porridge. 12 oz. Bread. 2 pints Broth. 1 pint Beer. 1 oz. Butter.	Milk Porridge. 12 oz Bread. 1 pint of Milk, with Tapioca, Arrow-root, Sago, or Rice, as may be prescribed. Barley-water.	Milk Porridge. 12 oz. Bread. 2 pts. Milk, with Tapioca, Arrow-root, Sago, or Rice, as may be prescribed. Barley-water. 1 oz. Butter. Bread Pudding, 3 times a week, when ordered.

GUY'S HOSPITAL.

	Full Diet.	*Middle Diet.*	*Low Diet.*	*Milk Diet.*	*Fever Diet.*
Daily	14 oz. Bread. 1½ oz. Butter. 1 quart Table Beer. 4 oz. Meat, when dressed.	12 oz. Bread. 1½ oz. Butter. 1 pt. Table Beer. 4 oz. Meat, when dressed, and ½ pint Broth.	12 oz. Bread. 1 oz. Butter. Tea & Sugar.	12 oz. Bread. 1 oz. Butter. 2 pts. Milk.	6 oz. Bread. 1 oz. Butter. Tea & Sugar.
			Half a pound of Beef (for Beef-tea,) or Arrow-Root or Sago, when ordered.		
	For each diet, Gruel or Barley-Water, as required.				

NORTH LONDON HOSPITAL.

	Full Diet.	*Middle Diet.*	*Low Diet.*	*Milk Diet.*
Daily	16 Bread. ½ pint Milk. ½ lb. Meat and ½ lb. Potatoes four days. 1 pint soup or Rice three days.	16 oz. Bread. ½ pint Milk. 1 pint Soup or Rice.	8 oz. Bread. ½ pint Milk. Oatmeal for Gruel.	16 oz. Bread. 2 pints Milk.

ST. THOMAS'S HOSPITAL.

	Full Diet.	*Milk Diet.*	*Dry Diet.*	*Fever Diet.*
Daily	2 pints of Beer. 14 oz. of Bread.	12 oz. of Bread.	14 oz. of Bread, 2 pints of Beer.	12 oz. of Bread, 2 pints of Beer.
Breakfast	Water Gruel.	1 pint of Milk.	Water Gruel.	Water Gruel.
Dinner	½ lb of Beef, when dressed twice a week; 4 oz. of Butter, or 6 oz of Cheese, thrice a week; ½ lb. of Mutton, when boiled, thrice a week.	1 pint of Milk four times a week. Rice Pudding thrice a week.	4 oz. of Butter, four times a week; Rice pudding and four oz. of Butter, three times a week.	½ of a lb. of Beef for tea.
Supper	1 pint Broth, four times a week.	1 pint of Milk.		

ST. GEORGE'S HOSPITAL.

	Extra Diet.	*Ordinary Diet.*	*Fish Diet.*	*Fever Diet.*	*Broth Diet.*	*Milk Diet.*
Daily	12 oz. Bread. *Men.* 2 pints Beer. *Women.* 1½ pints Beer.	12 oz. Bread. 1 pint Beer.	12 oz. Bread.	12 oz. Bread. Barley Water *ad libitum.*	12 oz. Bread.	12 oz. Bread.
Breakfast	1 pint Tea. ½ pint Milk.	1 pint Tea. ½ pint Milk.	1 pint Tea. ½ pint Milk.	1 pint Tea. ½ pint Milk.	1 pint Tea. ½ pint Milk.	1 pint Tea. ½ pint Milk
Dinner	12 oz. Meat, roasted (weighed with the bone before it is dressed) four days, —boiled three days. ½ lb. Potatoes	One half the meat allowed for extra diet. ½ lb. Potatoes.	4 oz. of plain boiled white fish (as Whiting, Plaice, Flounders, or Haddock.)	Arrow-root, &c. must be especially ordered.	1 pint Broth, 6 oz. light Pudding.	1½ pints Rice. Milk four days. ½ lb. Bread or Rice Pudding three days.
Supper	1 pint Gruel. ½ pint Milk.	1 pint Gruel. ½ pint Milk.	1 pint Gruel. ½ pint Milk.	1 pint Tea. ½ pint Milk.	1 pint Gruel. ½ pint Milk.	½ pint Milk.

WESTMINSTER HOSPITAL.

	Full Diet.	*Middle Diet.*	*Low Diet.*		*Spoon, or Fever Diet.*	*Incurable's Diet.*
			Fixed.	*Casual.*		
Daily	14 oz. Bread.	10 oz. Bread.	½ lb. Bread.	—	½ lb. Bread.	¾ lb. Bread. ½ lb. Meat. ½ lb. potatoes ½ pint Milk. 1 pint Porter
Breakfast	1 pint Milk Porridge, or Rice Gruel	1 pint Milk Porridge, or thin Gruel.	1 pint Tea, with Sugar and Milk.	—	1 pint Tea with Sugar and Milk.	
Dinner	½ lb. Meat roasted boiled, or chops. ½ lb. Potatoes.	½ lb. Meat roasted, boiled, or chops, ½ lb. Potatoes.	No fixed diet for Dinner.	1 pint of broth, or ½ lb. of Bread, or Rice Pudding, or 1 pint Beef Tea, or a Chop, or Fish.	Barley Water.	
Supper	1 pint Milk Porridge, or Rice Gruel.	1 pint Milk Porridge, or thin Gruel.	1 pint Tea with Sugar and Milk.	—	1 pint Tea with Sugar and Milk.	

MIDDLESEX HOSPITAL.

	Diæta Carnis, or Meat Diet.	*Diæta Jusculi or Soup Diet.*	*Diæta Lactis, or Milk Diet.*	*Diæta Simplex or Simple Diet.*	*Cancer Diet.*
Daily	12 oz. Bread.	12 oz. Bread.	12 oz. Bread.	6 oz. Bread.	12 oz. Bread. ½ lb. Meat. ½ lb. Potatoes. 1 pint Milk.
Breakfast	1 pint Milk.	1 pint Milk.	1 pint Milk.	1 pint Barley Water.	
Dinner	*Physicians' Patients.* ½ lb. Potatoes, 4 oz. dressed meat (beef or mutton,) roast and boiled alternately, 4 days. 4 oz. Meat in Soup, 3 days. *Surgeons' Patients.* ½ lb. Potatoes, 4 oz. dressed Meat (Beef or Mutton,) roast and boiled alternately.	1 pint Soup, made with 4 oz. Beef, alternately with 1 pint of Broth with Barley.	½ pint Milk, with Rice Pudding, 4 days, and with Batter Pudding 3 days.	1 pint Gruel.	
Supper	1 pint Gruel alternately, with 1 pint of Barley Water.	1 pint Gruel.	½ pint Milk, or 1 pint Gruel.	1 pint of Gruel or Barley Water.	

KING'S COLLEGE HOSPITAL.

	Full Diet.	*Middle Diet.*	*Milk Diet.*	*Low Diet.*	*Fever Diet.*
Daily	1 pint Beer, or ½ pint Porter. 14 oz. Bread.	14 oz. Bread.	1 lb. Bread.	8 oz. Bread.	—
Breakfast	1 pint Milk Porridge.	1 pint Milk Porridge.	1 pint Milk.	1 pint Gruel.	1 pint Gruel.
Dinner	½ lb. Meat. ½ lb. Potatoes.	½ lb. Meat. ½ lb Potatoes.	1 pint Milk.	1 pint Broth.	2 pints Barley Water.
Supper	1 pint Milk Porridge.	1 pint Milk Porridge.	1 pint Gruel.	1 pint Milk Porridge.	1 pint Milk Porridge.

2. Exercitatio.—Exercise.

(Gymnastics.)

Exercise is an important hygienic agent. Its proper consideration, however, requires far more space than can be devoted to it in this work. I must, therefore, content myself with a few remarks on its general effects, and refer the reader to some treatises in which it is more fully considered.

Though the word exercise, in its most extensive signification, has reference to the action of all the organs of the animal economy, yet it is usually limited to those of locomotion; and in this sense I employ it.

The exercise of the muscular system is followed by several marked effects:—of these, the first to be noticed are *mechanical*. Whenever the muscles are called into activity, they exert a local influence, of a mechanical kind, on the blood-ves-

sels in their immediate vicinity, and accelerate the circulation of the blood. This is followed by an augmentation of the animal heat; and, if the exercise be of a kind to call into activity a considerable number of muscles, the general circulation soon participates in the effects; the pulse is quickened, and the respiration and secretion are augmented. Another effect, which, in its origin, is probably of a mechanical nature, is the absorption of the fat between the muscles and their fasciculi. It seems to arise from the pressure exerted by the contracted muscle on the soft tissues immediately around it.

A second class of effects caused by muscular action may be denominated *organic* or *vital*. I refer now to the augmentation of volume, firmness, and elasticity, and increase of strength or power, which a muscle acquires from frequent but moderate use. Blacksmiths, fencers, and prize-fighters, furnish excellent illustrative examples of these effects.

But the action of the muscles can only be effected through the medium of the nervous centres and nerves. So that the latter are called into activity, and through them the whole system becomes influenced, when a number of muscles is exercised. These effects may be denominated *nervous*.

The fourth and last class of effects to be referred to, may be called *psychical* or *mental*. (See p. 41.) To this belong the different mental effects produced by agreeable and disagreeable,—by voluntary and compulsory,—exercises. Employed moderately, agreeable exercise acts as a salutary excitant to the intellectual faculties and sensations. I agree with Dr. James Johnson, (*Change of Air, or the Pursuit of Health and Recreation*, 4th ed. 1838.) "that travelling exercise, while it so much improves all the bodily functions, unhinges and unfits the mind, *pro tempore*, for the vigorous exercise of its higher faculties." But the first excitant being over, "the memory of scenes and circumstances, together with the reflections and recollections attendant thereon, furnish an ardent mind with rich materials and trains of thought, that may, by gifted individuals, be converted into language; and thus conveyed to thousands."

Thus, then, it appears that exercise, employed moderately, has a tonic and stimulating influence on the system, and is calculated to be beneficial in a great variety of complaints. Used immoderately, it exhausts both the mental and bodily powers, and produces great debility. In fever, in vascular excitement or inflammation of the brain, in inflammatory affections of the lungs, in maladies of the circulating organs (especially dilatation of the cavities of the heart, diseased valves, and aneurism,) in violent hemorrhages, gastro-enteritic inflammation, acute rheumatism, &c., muscular exertion is manifestly injurious; repose and inaction being indicated. In sprains and lacerations of the muscles, in fractures and dislocations, &c., it is obviously improper. In hernia, or a tendency thereto, great muscular exertion must be carefully avoided.

Exercises may be divided into the *active*, the *passive*, and the *mixed*. To the first belong walking, running, leaping, dancing, fencing, wrestling, &c.; to the second are referred, carriage exercise and sailing; while horse-exercise belongs to the third or last division.[1]

3. Climate.

Under the word Climate are included those topographical, atmospheric, and other conditions of a region or country, which have a beneficial or injurious influence on the health and lives of the inhabitants.

It is probable that we are yet ignorant of many circumstances which contribute to give the climatic character to a place; and, of those that are known, it is often not easy to define the separate influence of each.

[1] For farther information on the subject of Exercise, the reader is referred to Celsus, lib. i. cap. 2, and lib. ii. cap. 15; Sir J. Sinclair's *Code of Health and Activity*, Edinb 1806; Dunglison's *Elements of Hygiène*, Philadelphia, 1835; *Dict. de Médecine*, art. *Gymnastique*; *Dict. de Médecine et de Chirurgie pratiques*, art. *Gymnastique*; *Manuel d'Education physique, gymnastique et morale*, par le Colonel Amoros. Paris, 1830.

The most obvious circumstances which affect the climate of a region or country, are *temperature, humidity, purity of the atmosphere, wind, atmospheric pressure, intensity of light,* and *atmospheric equability* or *vicissitudes.*

1. Temperature.—In considering the temperature of a place, we must regard, not merely its annual mean, but its extremes. Inland tracts of country experience greater extremes than the coasts. This arises from land being more rapidly heated and cooled than water. Hence it attains a higher temperature in summer,—and a lower one in the winter. It also deserves notice that the western coasts of the extra-tropical continents have a much higher mean temperature than the eastern coasts. This is explained by the heat evolved in the condensation of vapour, swept from the surface of the ocean by the eastern winds. (Daniell's *Metereological Essays*, p. 105, 2d ed. Lond. 1827.) The effects of heat and cold on the human body have been already considered. (See pp. 46 and 57.) *Warm climates* are adapted for pulmonary invalids (especially consumptive patients,) the rheumatic, the scrofulous, and the paralytic. *Cold*, or rather *moderately cool*, climates are bracing, and are fitted for relaxed constitutions.

2. Humidity. *Hygrometric State of the Atmosphere.*—Evaporation from the cutaneous and pulmonary surfaces is augmented by a dry state of the atmosphere, and checked by a damp or moist state. But the transudation which depends on vital action is augmented by a warm moist atmosphere. (Edwards, *De l'Influence des Agens Physiques*, p. 338. Paris, 1824.) "Of all the physical qualities of the air," observes Sir James Clark, (*The Sanative Influence of Climate*, 3d ed. Lond. 1841.) "humidity is the most injurious to human life." A *moist*, or rather a *soft*, climate promotes vital transudation, and, therefore, is adapted for chronic bronchitis of a dry irritable kind, frequently denominated dry catarrh, and for some other maladies attended with a harsh, dry, parched skin. A *dry* climate, on the other hand, checks vital transudation, and, therefore, is better fitted for relaxed, languid constitutions, with profuse secretion and exhalation; as humid asthma, and those forms of chronic catarrh accompanied with copious expectoration.

3. Purity of the Atmosphere.—A pure condition of the atmosphere is an essential element of all healthy climates. The greater mortality of cities than of the country is principally referrible to the respiration of air vitiated by the congregation of a large number of persons in a comparatively limited space. Emanations from the soil, and from decomposing organic matter, also contribute to the contamination of atmosphere.[1] The injurious effect of fogs on pulmonary invalids is well known to every one. Curiously enough, however, some patients affected with spasmodic asthma breathe better in a smoky atmosphere (as that of London) than in pure air.

4. Wind.—Wind greatly modifies the effect of temperature on the body. Thus two successive days, whose temperature, as indicated by the thermometer, may be the same, shall produce in us—the one a sensation of warmth, in consequence of the calm, still, condition of the air,—while the other creates a feeling of cold, from the presence of a violent wind. So that, as Sir James Clark (*Op. supra cit.* p. 156.) has justly observed, "the influence of temperature on the living body is indicated much more accurately by our sensation than by the thermometer." Moreover, the humidity and the purity of the atmosphere are greatly modified by the motion or calmness of the air. The precise effects produced on climates by wind, must of course depend on its direction, violence, &c.

5. Atmospheric Pressure.—Diminished atmospheric pressure promotes evaporation. Elevated regions, therefore, are colder, drier, more bracing, and, *cæteris paribus*, better adapted for relaxed individuals, with profuse secretion and exhalation, than the opposite localities: but, on the other hand, they are injurious in bronchial or tracheal irritation, with diminished secretion.

In extra-tropical climates, a fall in the barometer, without a change or rise of wind, is usually followed by rain. Now a humid condition of the atmosphere checks evaporation, while the reduced barometrical pressure augments it. Hence, we have two opposing influences in operation. This condition of the air induces a feeling of languor and fatigue, and gives rise to sweating on the slightest exertion.

6. Intensity of Light.—The influence of light has been already considered. (See p. 44.)

[1] The production of Ague, by the exhalations from stagnant water and marshy soils, is well known to every one. My friend, Professor Daniell (*Lond. Edinb. and Dubl. Phil. Mag.* July, 1841,) has shown that the waters upon the Western coast of Africa, to an extent of 40,000 square miles, are impregnated with sulphuretted hydrogen, to an amount, in some places, exceeding that of some of the most celebrated sulphur springs of the world; and he suggests that the existence of this deleterious gas in the atmosphere, which must necessarily accompany its solution in the waters, may be connected with the awful miasma, which has hitherto proved fatal to the explorers and settlers of the deadly shores of Africa; as well as of other places.

The origin of sulphuretted hydrogen in sea, and some other waters, has been ascribed, by Dr. Marcet (*Phil. Trans.* 1819, p. 193,) Mr. Malcomson (*Trans. of the Geological Society*, 2d Ser. vol. v. p. 564, Lond. 1840,) Dr. A. Fontan (*Ann. de Chem. et de Phys.* July, 1840,) and Professor Daniell (*op. supra cit.*,) to the decomposition of sulphates of the waters, by putrefying vegetable matter.

7. Atmospheric Equability or Vicissitudes.—Rapid atmospheric changes are always injurious to health. Invalids, and those with delicate constitutions, often appreciate the slightest alterations in the condition of the atmosphere, and which are not observable by the healthy and the robust.

These are some only of the circumstances which affect the quality or character of a climate. Others doubtless exist; but their precise nature and influence have scarcely been ascertained. For example, we have yet to learn the influence of Electricity and Magnetism on the climate of a place.

I propose, now, to glance at the characters of those climates most commonly resorted to by invalids for therapeutical purposes. In doing so, I beg to acknowledge the great assistance I have received from the valuable work of Sir James Clark, to which I must refer the reader for farther details.

Climates may be conveniently arranged as follows:—

1. Climates of England.
2. Climates of France.
3. Climates of Spain and Portugal.
4. Climates of Italy, and the Mediterranean.
5. Climates of the Atlantic.

1. Climates of England.

"The British Islands are situated in such a manner as to be subject to all the circumstances which can possibly be supposed to render a climate irregular and variable. Placed nearly in the centre of the temperate zone, where the range of temperature is very great, their atmosphere is subject, on one side, to the impressions of the largest continent of the world; and, on the other, to those of the vast Atlantic Ocean. Upon their coasts the great stream of aqueous vapour, perpetually rising from the western waters, first receives the influence of the land, whence emanate those condensations and expansions which deflect and reverse the grand system of equipoised currents. They are also within the reach of the frigorific effects of the immense barriers and fields of ice, which, when the shifting position of the sun advances the tropical climate towards the northern pole, counteract its energy, and present a condensing surface of immense extent to the increasing elasticity of the aqueous atmosphere." (Daniell's *Meteorological Essays*, p. 114. 2nd ed. 1827.)

Sir James Clark thus arranges the climates of England:—

1. London.
2. The South Coast.
3. South-west Coast.
4. Cornwall, Land's End.
5. West of England.

1. London.—The mean annual temperature of London somewhat exceeds that of the suburban parts. "The excess of the temperature of the city varies through the year, being least in spring, and greatest in winter; and it belongs, in strictness, to the nights, which average 3·7° warmer than in the country; while the heat of the day, owing, without doubt, to the interception of a portion of the solar rays by a constant veil of smoke, falls, on a mean of years, about a third of a degree short of that in the open plain." (See Luke Howard's *Climate of London*, 1818–20. 2nd ed. 1833.) Hence in the winter, delicate invalids sometimes experience benefit in coming to London from the country. But the impure state of the atmosphere generally counterbalances these good qualities.[1] In some cases of spasmodic asthma, however, respiration is easier in London than in the country.

2. South Coast.—This comprehends the tract of coast between Hastings and Portland Island. Its mean annual temperature is about that of London, but the

[1] For farther details respecting the Climate of London, consult Professor Daniell's *Essay* on this subject. Also, Dr. Bateman's *Reports of the Diseases of London*. Lond. 1819.

summers are somewhat cooler, and the winters somewhat warmer, than the corresponding seasons of the metropolis.[1]

The principal places of resort for invalids, on this line of coast, are the following:—

a. HASTINGS.—A mild winter residence; placed low and well protected from the northerly winds. Sir James Clark (*Op. supra cit.* p. 177.) regards its climate "as somewhat intermediate between that of Devonshire and Clifton; less warm, but also less relaxing than the former. It is about the same temperature; but less dry and bracing than the latter, and it is inferior to it as a spring climate." It is well adapted for pulmonary invalids during the months of December, January, and February. The distinguished author above quoted declares, that it "is unfavourable in nervous complaints, more especially in nervous headachs connected with, or entirely dependent upon, an irritated condition of the digestive organs, and also in cases where a disposition to apoplexy or epilepsy has been manifested."

St. Leonards is about a mile from Hastings, and possesses a similar climate.

b. BRIGHTON.—The air is dry and bracing. The climate is most beneficial during autumn and the early part of winter, when it is milder and more steady than that of Hastings. It is adapted for relaxed individuals, with copious secretion and exhalation. It usually agrees well with children (especially those of a scrofulous habit) and convalescents.

c. ISLE OF WIGHT.—*Undercliff* presents an agreeable, mild, sheltered, dry, bracing climate, well adapted for the residence of many pulmonary and other delicate invalids throughout the year. It differs from the climate of Torquay (which is soft, humid, and relaxing) by its dry and bracing qualities. Hence it is suited for relaxed constitutions, with copious secretion. *Cowes and Ryde* are delightful summer residences.

d. SOUTHAMPTON.—This part of the coast is objectionable, on account of its temperature being equally variable with that of the environs of London.

3. SOUTH-WEST COAST.—This comprehends the tract of coast extending from Portland Island to Cornwall. Its general qualities are those of a mild, soft, humid climate, soothing but somewhat relaxing. It is adapted to pulmonary affections, especially those which are dry and unaccompanied with much expectoration. In dyspepsia, with symptoms of irritation or inflammation, constituting the gastritic dyspepsia of Sir James Clark, it is also beneficial. But in all forms of chronic diseases, with copious secretion and exhalation, and a languid and relaxed state of the constitution, it is injurious.

The following are the principal places of resort for invalids along the South-West Coast:—

a. SALCOMBE.—The Montpelier of Huxham. The warmest spot of this coast.

b. TORQUAY.—This is drier than the other parts of this coast, though its general character is soft and humid.

c. DAWLISH.—Next in dryness to Torquay.

d. EXMOUTH.—The higher parts of the town exposed to winds; the lower parts liable to occasional damp. Sir J. Clark declares that it is not adapted for persons with delicate chests.

e. SALTERTON.—Preferable to Exmouth. It is well protected from winds, especially the northerly ones.

f. SIDMOUTH.—Damp.

4. SOUTH COAST OF CORNWALL. *Land's End.*—In its general characters this climate resembles that of the south coast of Devon. From the latter, however, it differs, in its greater humidity, and in being more exposed to winds. It is, consequently, more relaxing. The class of cases in which it is calculated to be beneficial or injurious, are much the same as those for the south coast of Devon.[2]

The following are the chief places of residence for invalids along this coast:—

a. PENZANCE.—Exposed to the north-east winds during the spring months.

b. FALMOUTH.—The winter temperature is a trifle lower than that of Penzance.

5. WEST OF ENGLAND.—Under this head are grouped the places along the borders of the British Channel and the æstuary of the Severn. The mean temperature of this group is, during the winter, rather lower, but in March and April rather higher, than that of the south coast.

[1] For the character of this part of England consult Dr. Harwoods *Curative Influence of the Southern Coast of England, especially that of Hastings, with Observations on Diseases, to which a Residence on the Coast is most beneficial.* Lond. 1828.

[2] On the climate of this part of England, consult Dr. Forbe's *Observations on the Climate of Penzance and the District of the Land's End.* Penzance, 1820.—Also his *Medical Topography of the Land's End*, in the *Provincial Medical Transactions*, vol. ii.

Clifton.—This is the mildest and driest climate in the West of England. It is bracing, and well adapted for scrofulous and relaxed constitutions, with copious secretion and exhalation.

2. Climates of France.

The southern climates of France resorted to by invalids, may be divided into those of the South-West, and those of the South-East of that country.

1. South-West of France.—According to Sir James Clark the climate of this part of France is soft, relaxing, and rather humid; resembling in its general qualities that of the south-west of England. It is favourable to phthisical invalids, for those labouring under bronchial affections, with little expectoration, and for other chronic cases attended with a dry skin.

a. Pau.—Dr. Playfair (Sir J. Clark's *Sanative Influence of Climate*, p. 192.) thus sums up the qualities of this climate. "Calmness, moderate cold, bright sunshine of considerable power, a dry state of atmosphere and of the soil, and rains of short duration. Against these must be placed,—changeableness, the fine weather being as short-lived as the bad; rapid variations of the atmosphere within moderate limits. In autumn and spring there are heavy rains."

b. Bagneres de Bigorre, in the department of the High Pyrenees, has a mean temperature, during the months of June, July, August, and September, of 66° F. Dr. Wm. Farr (*A Medical Guide to Nice.* Lond. 1841.) declares the climate to be anti-irritating and moist, and to be favourable to the consumptive. Its season is from June to September.

2. South-East of France.—Sir J. Clark says the general character of the climate is dry, hot, and irritating. It is adapted for torpid, relaxed habits, but is decidedly improper for the consumptive and those labouring under irritation and inflammation of the air-tubes.

a. Montpelier.—Long but undeservedly celebrated as a residence for phthisical invalids.
b. Marseilles.—Exposed to cold winds. Soil dry and arid.
c. Hyeres.—Sir J. Clark declares it to be the least exceptionable residence in Provence for the pulmonary invalid.

3. Climates of Portugal and Spain.

Precise information respecting the climates of these countries, to which pulmonary invalids occasionally resort, is much to be desired.

1. Portugal.—Dr. Bullar (*A Winter in the Azores.* Lond. 1841.) states that the mean annual temperature of *Lisbon* is 12° F. higher than that of London; and that the mean temperature of its winter is 16° F. higher than that of London. But notwithstanding its mildness, it is objectionable for persons affected with phthisis, on account of the inequality of its temperature.

2. Spain.—*Biscay* is subject to sudden and extraordinary changes in temperature; the mercury having been known to rise and fall from 3° to 4° F. within a few minutes. (Inglis, *Spain in* 1830, vol. i. p. 39. Lond. 1831.) This must, of course, make it an unfit residence for pulmonary invalids. *Madrid* is elevated more than 300 fathoms above the level of the sea. Its annual mean temperature is 59° F. (Humboldt, in De Laborde's *View of Spain*, vol. i. p. clxiii. Lond. 1809.) *Cadiz*, being nearly surrounded by the sea, has a comparatively temperate climate.

4. Climates of Italy and the Mediterranean.

The climates included under this head are exceedingly diversified, so that it is difficult to lay down any general character of them.

a. Nice.—The climate of this place is somewhat similar to that of the South-East of France. It is mild, equable, and dry; being adapted for torpid, relaxed individuals, with abundant secretion from the mucous membranes. Dr. William Farr (*A Medical Guide to Nice*, p. 10. Lond. 1841.) says, the great objection to it is its dryness, and the exciting and irritating

nature of its atmosphere. It is beneficial in chronic bronchitis, with copious expectoration,—in chronic rheumatism,—scrofula,—gout, and atonic dyspepsia.

b. Genoa.—Climate dry and healthy, with a sharp exciting air. It is adapted for relaxed constitutions, but is unfit for phthisical invalids.

c. Florence.—Not favourable for invalids.

d. Pisa.—According to Sir James Clark, the climate "is genial, but rather oppressive and damp. It is softer than that of Nice, but not so warm; less soft, but less oppressive, than that of Rome." Pisa is frequented by consumptive invalids.

e. Rome.—The climate of this city is one of the best in Italy. Sir James Clark characterizes it as being mild, soft but not damp, rather relaxing and oppressive, and remarkable for the stillness of its atmosphere. It is well adapted for phthisis, bronchial affections of a dry irritating kind, and chronic rheumatism.

f. Naples.—The climate of Naples is warm, variable, and dry. Sir James Clark compares it to that of Nice, but states that it is more changeable, and, if softer in the winter, is more humid. Dr. Cox, (*Hints for Invalids about to visit Naples*, p. 17. Lond. 1841.) however, declares that the mean diurnal variation is far less than is generally supposed. It is an unsuitable residence for most pulmonary invalids, especially those affected with tubercular phthisis. In bronchial cases, with profuse secretion, benefit is sometimes obtained from it. In general debility and deranged health, it is also serviceable. Dr. Cox says it is beneficial in dyspepsia, rheumatic neuralgia, and scrofula.

g. Malta.—The climate of Malta is mild, dry, bracing, and pretty equable. It is serviceable in chronic bronchitis, [with profuse secretion,] scrofula, dyspepsia, and hypochondriasis.

5. Atlantic Climates.

The climates of the Atlantic islands, resorted to by invalids, may be arranged in two groups,—the one eastern, the other western.

1. Eastern Atlantic.—This group includes Madeira, the Canaries, and the Azores.

a. Madeira.—The climate of Madeira is mild, humid, equable, and steady. Sir James Clark regards it as the finest in the northern hemisphere. It is superior to all other climates for incipient phthisis. This superiority consists in the mildness of the winter, the coolness of the summer, and the remarkable equality of the temperature during the night and day, as well as throughout the year. Experience, moreover, seems to have fully demonstrated the advantage which patients, with incipient symptoms of consumption, derive from a residence in this island.[1]

b. The Canaries.—*Teneriffe* is the only island of this group possessing accommodation for invalids. Though its mean annual temperature is higher than that of Madeira, its equability is less.

c. The Azores or Western Islands.—Dr. Bullar declares these to be "rather colder than Madeira, and somewhat more equable, and perhaps more humid; but they have not at present those accommodations for strangers which the latter island possesses, nor have they communications by steam with England." (*A Winter in the Azores.* Lond. 1841.) *St. Michaels*, the largest of the Azores, has a mild, humid, equable climate.

2. Western Atlantic.—This group includes the Bermudas, the Bahamas, and the West Indies. It is more subject to rapid changes of temperature than the Eastern Atlantic group.

a. The Bermudas.—The climate is warm, variable, and dry. The mean annual temperature is considerably higher than that of Madeira; but the climate is variable and windy during the winter, and hot and oppressive in the summer (Sir J. Clark.)

b. The Bahamas.—The climate is warm, but is subject to rapid changes of temperature. Dry cold winds prevail. Hence the Bahamas are unsuited to consumptive invalids.

c. The West Indies.—The temperature of these islands is too high, and its variations too great, to admit of their being a desirable residence for patients affected with pulmonary consumption; but as a prophylactic for those predisposed to this disease, it is highly spoken of. In scrofula, the climate proves beneficial. Calculous complaints and ossific deposites are rare. The most healthy islands of the group are *Jamaica*, *Barbadoes*, *St. Vincent's Antigua*, and *St. Kitt's*.

[1] For farther information respecting the medical qualities of the island of Madeira, the reader may refer with great advantage to Sir James Clark's work, before cited; Dr. Gourlay's *Observations on the Natural History, Climate, and Diseases of Madeira*, 1811; Dr. Renton, in the *Edinburgh Medical and Surgical Journal*, vol. xxvii. 1817; and Dr. Heineken's paper in the *Medical Repository*, vol. xxii. 1824.

The diseases for which change of climate is most frequently resorted to are—

1st. *Pulmonary Complaints*, especially Phthisis, Chronic Bronchitis resembling Phthisis, Asthma, Hemoptysis, and diseases of the Larynx and Trachea.
2. *Dyspeptic and Hypochondriacal Complaints.*
3. *Chronic Rheumatism.*
4. *Scrofula.*
5. *Urinary Diseases.*
6. *Liver Complaints.*
7. *In the Convalescence from Fever, and other acute maladies.*

1. **Pulmonary Complaints.**—These maladies are benefited by removal from a colder to a warmer climate. Equability, purity, and calmness of the atmosphere, are other desirable qualities in a climate for pulmonary invalids. The nature of the malady and constitution of the patient, however, render all climates possessed of these qualities not equally suited for every case.

a. Phthisis.—"For such consumptive patients," observes Sir James Clark, "as are likely to derive benefit from climate, I consider that of *Madeira* altogether the best. *Teneriffe* and the *Azores* approach most nearly in the character of their climate to Madeira." Of the climates of the South of France and Italy the same experienced writer says, when "there exists much sensibility to harsh and keen winds, and more especially, if immediate vicinity to the sea-coast is known to disagree, *Rome* or *Pisa* is the best situation for a winter residence. When, on the contrary, the patient labours under a languid feeble circulation, with a relaxed habit, and a disposition to congestion or to hemorrhage, rather than to inflammation; and, more especially, when the sea air is known by experience to agree, *Nice* deserves the preference." Late experience has shown, that *Montpelier*, *Marseilles*, and other places in the south-east of France, once celebrated as affording a good winter climate for consumptive patients, are decidedly improper for phthisical invalids. Of English climates, those of *Undercliff*, *Torquay*, and *Hastings*, are best adapted for this disease. *Torquay* and *Penzance* disagree with persons of a relaxed habit. *Clifton*, during the spring months, often agrees well.

b. Chronic Bronchitis.—In relaxed constitutions, with copious expectoration, the climates of *Undercliff*, *Clifton*, *Brighton* and *Nice*, are those which agree best. But on the other hand, for dry, bronchial, and trachial irritation, *Torquay*, *Madeira*, *Rome*, and *Pisa*, are to be preferred.

2. **Dyspepsia and Hypochondriasis.**—In selecting a climate for these complaints, we must attend to the character of the malady and the constitution of the invalid. Thus, in the atonic dyspepsia of relaxed and sluggish individuals, with copious secretions, we select a dry and bracing climate; and in such, *Brighton*, *Clifton*, *Nice*, or *Naples*, would probably prove beneficial. But when the dyspepsia assumes an inflammatory form, with dry tongue and a febrile condition of system, the soft and humid climates are to be preferred,—such as *Torquay*, *Pau*, *Rome*, and *Pisa*.

3. **Chronic Rheumatism.**—In this malady, mild climates generally have been found beneficial. According to Sir James Clark's experience, *Rome* and *Nice* are the best climates on the continent. In relaxed and cachectic individuals, the latter place is to be preferred.

4. **Scrofula.**—In this malady the *West Indies* prove highly serviceable. *Nice* and *Rome*, on the continent, have appeared to be favourable. In this country *Clifton* is perhaps the climate best adapted for scrofula.

5. **Urinary Diseases.**—Warm climates relieve most affections of the urinary organs, especially calculous complaints, diabetes, and vesical irritation. The benefit probably arises from the excitement of the skin and the abundant cutaneous secretion, and is to be explained on the principle of antagonism already alluded to. (See p. 47.) In the *West Indies* calculous complaints are very rare.

6. **Liver Complaints.**—Various hepatic derangements are induced by a residence in tropical climates; (See p. 48.) and in such cases benefit is obtained by a return to the more temperate climates of Europe.

7. In the **Convalescence** after fevers and inflammatory diseases, change of climate is often found highly beneficial.

III.—AGENTIA MECHANICA ET CHIRURGICA.—MECHANICAL AND SURGICAL AGENTS.

The consideration of these subjects does not fall within the province of this work.

IV.—AGENTIA PHARMACOLOGICA SEU MEDICAMENTA.—PHARMACOLOGICAL AGENTS OR MEDICINES.

(Medicamina; Φαρμακα.)

Pharmacological Agents or Medicines are substances, not essentially alimentary, used in the treatment of diseases, and which when applied to the body, alter or modify its vital actions.

Aliments are vital stimuli (see p. 44, foot-note,) which vivify, and can themselves be vivified; (See Müller's *Elements of Physiology*, by Baly, vol. i. p. 31.) since they are assimulated to our organs, and become integrant parts of the living body.

Poisons are distinguished from medicines principally in the *degree* of their effects, and the *uses* to which they are applied; for the most powerful poisons become, when administered under proper regulations, very valuable medicines.

Pharmacology (*Pharmacologia*, from φαρμακον, *a medicine;* and λογος, *a discourse*,) or Materia Medica, is that branch of Acology devoted to the consideration of medicines.

α. General Pharmacology (*Pharmacologia generalis*) treats of medicines generally.
β. Special Pharmacology (*Pharmacologia specialis*) treats of medicines individually.

Pharmacology is divided into three departments, termed respectively *Pharmacognosy*, *Pharmacy*, and *Pharmacodynamics*.

1. PHARMACOGNOSIA,—PHARMACOGNOSY.

(Physiographische Arzneimittellehre, *Pfaff;* (*System der Materia Medica*, 1er Band, S. 2. Leipzig, 1808.) Pharmaceutische Waarenkunde, *Goebel;* (Goebel and Kunse's *Pharmaceutische Waarenkunde*, Eisenach, 1827-29.) Histoire des drogues simples, *Guibourt;* (*Histoire Abrégée des Drogues Simples*, 3me éd. Paris, 1836.) Pharma comathie, *Cottereau.*[1])

Pharmacognosy (from φαρμακον, *a medicine;* and γιγνωσκω, *I know*) is that department of Pharmacology which treats of the origin, properties, varieties, quality, and purity of Unprepared Medicines or Simples (*medicamenta cruda.*)

In other words, Pharmacognosia treats of all that relates to the commerce of drugs.

Strictly speaking, it is a department of what the Germans call *Waarenkunde* (*Merchandize-Knowledge;*) and hence is sometimes called *pharmaceutische Waarenkunde* (*pharmaceutical Merchandize-Knowledge.*) As we have no word in the English language corresponding to Waarenkunde, I would suggest that of *Agorasmalogy* (from αγορασμα, *merchandize;* and λογος, *a discourse.*)

Unprepared Medicines or Simples are either Foreign or Indigenous. The former are imported by the merchant, and sold on his behalf, by the drug-broker, to the wholesale druggist.

Much valuable information connected with the commerce of Foreign drugs will be found in the following works and periodicals:—

1. *A Dictionary, practical, theoretical, and historical, of Commerce and Commercial Navigation.* By J. R. M'Culloch, Esq. A new edition, with Supplement to Jan. 1839.
2. *Bill of Entry, B.* published daily.
3. *Trade List and Weekly Register of Customs and Parliamentary Accounts.*—[The *London Medical Gazette* gives a monthly list of Drugs on sale, with their prices and several duties taken from the *Trade List.*]
4. *The Public Ledger.* A daily newspaper, containing the advertisements for the drug sales.
5. *Parliamentary Papers.* The following returns are especially useful to the pharmacologist:—

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[1] *Traité Elémentaire de Pharmacologie.* Paris, 1835.—*Pharmacomathie*, from φαρμακον and μαθω, *I seek*, or *inquire.*

a. *A General Statement of the Imports and Exports of the principal Articles of Merchandize between the United Kingdom and the several Foreign Countries and British Possessions Abroad, in the year* 1827.
b. *A Statement of the Imports and Exports of the United Kingdom for the year* 1830, *ending* 5th *January*, 1831.
c. *A Statement of the Imports and Exports of the United Kingdom for the year* 1831, *ending* 5th *January*, 1832.

Indigenous vegetable substances are usually collected by the herbalist. Most of the plants grown in this country, and for which there is a large consumption, are cultivated at Mitcham, and other places.

In this country we have no recent works expressly devoted to Pharmacognosy. *The London* and *Edinburgh Dispensatories*, and Lewis's *Materia Medica*, contain a good deal of valuable information on this subject.

The following are the best continental works on the subject:—

N. J. B. Guibourt's *Histoire Abrégée des Drogues Simples*, 3me éd. Paris, 1836.
T. W. C. Martius's *Grundriss der Pharmakognosie des Pflanzenreiches*. Erlangen, 1832.
T. W. C. Martius's *Lehrbuch der pharmaceutische Zoologie*. Stuttgart, 1838.
F. Goebel and G. Kunze's *Pharmaceutische Waarenkunde*. Eisenach, 1827-29.

2. PHARMACO-CHEMIA SEU PHARMACIA,—PHARMACEUTICAL CHEMISTRY OR PHARMACY,

(Chemische Arzneimittellehre, *Pfaff*; Pharmacotechnie, *Cottereau*.)

Pharmacy (from φαρμακον, *a medicine*) is that department of Pharmacology which treats of the preparation, compounding, preservation, and dispensing of medicines (*medicamenta præparata et composita*.)

I must refer my readers to the following works for an account of the principles and operations of Pharmacy:—

R. J. Kane's *Elements of Practical Pharmacy*. Dublin, 1831.
N. E. Henry and G. Guibourt's *Traité de Pharmacie pratique et théorique*. 3me éd. par N. J. B. G. Guibourt. Paris, 1841.
E. Soubeiran's *Nouveau Traité de Pharmacie théorique et pratique*. 2nde éd. Paris, 1840.
J. A. Buchner's *Einleitung in die Pharmacie*. 3te Aufl. Nürnberg. 1827.

3. PHARMACO-DYNAMICA.—PHARMACODYNAMICS,

(Dynamische Arzneimittellehre, *Pfaff*; Pharmacodynamie, *Cottereau*.)

Pharmacodynamics (from φαρμακον, *a medicine;* and δυναμις, *power*) is that department of Pharmacology which treats of the effects and uses of medicines.

CHAPTER I.—ON THE MEANS OF ASCERTAINING THE EFFECTS OF MEDICINES.

Formerly the virtues of medicines were inferred from resemblances (fancied or real) in form, colour, &c. between these substances and parts of our organism. These marks or indications of medicinal powers were called *Signatures*, and were supposed to arise from Astral influences.[1]

Thus, Poppyheads were inferred to act on the head,—Elder-pith on the spinal marrow,—Euphrasia, or Eye-bright, on the eye,—Pulmonaria, or Lungwort, on the lungs,—Citrons on the heart,—Sow-bread on the stomach,—Cassia fistula on the bowels,—Aristolochia on the uterus,—and Orchis on the testicle,—because these substances resembled, respectively, the parts on which they were supposed to operate.—Again, Saffron was used in jaundice,—Lithospermum, or Gromwell, in calculous affections,—and Scrophularia in piles,—on account of the representation of the disease which each of these substances was fancied to bear.

There are four principal methods which, in modern times, have been resorted to for the purpose of determining the effects of medicines. These are founded, respectively, on—

1. The *Sensible* qualities of medicines.
2. The *Natural-Historical* properties.
3. The *Chemical* properties.
4. The *Dynamical* properties.

[1] See Sprengel, *Histoire de la Médecine*, t. iii. p. 321. Paris, 1815.—Also, Schroder's *Compleat Chymical Dispensatory*, by Rowland. Lond. 1669.

1. The Sensible Qualities of Medicines.—*Colour*, *Taste*, and *Odour*, have been used to indicate, in a very general way, the medicinal properties of plants. But to all the general positions which have hitherto been advanced concerning them, so many exceptions exist, that none possess much, if any, practical value.

It appears to me to be a waste of time and space to dwell on this subject; I shall, therefore, refer the reader, for farther information, to the writings of Linnæus, (*Philosophia Botanica*, p. 283, ed. 4ᵃ. 1787.) Cullen, (*A Treatise of the Materia Medica*, vol. i. p. 138. Edinb. 1789.) and Edwards and Vavasseur. (*Manuel de Matière Médicale.* Paris, 1831.) In another part of this work, I shall have occasion to notice Mr. Greeves's classification of the articles of the Materia Medica according to their sensible qualities. Some interesting information on the colour, odour, and taste of plants, is contained in Landgrebe's work on Light. (*Ueber das Licht.* Marburgh, 1834.)

2. The Natural-Historical Properties.—*Exterior Form* and *Structure* are made use of in natural history, to determine the affinities of natural bodies: hence they are denominated *natural-historical properties*.

a. Of Minerals.—No conclusions, respecting the medicinal properties of minerals, can be deduced from crystalline form and structure.

If two dissimilar substances assume the same crystalline form, they are said to be *isomorphous;* and if the same substance be capable of crystallizing in two distinct forms, it is said to be *dimorphous*. Mr. Blake asserts, (*Edinburgh Med. and Surg. Journ.* for July, 1841.) that the most striking points of resemblance exist generally between isomorphous compounds in their action on the animal tissues when *introduced into the blood*. Be this as it may, their action, when *taken into the stomach*, is often very dissimilar. Thus, the Triphosphate of Soda is isomorphous with the Triarseniate of the same base; but no one will pretend to assert that their action on the system is alike. Arsenious Acid is isomorphous with Sesquioxide of Antimony, yet their effects on the system are very dissimilar. Mr. Blake admits that the Salts of Lead and of Silver are exceptions to his statement: their action on the pulmonary tissue being analogous, though they are not isomorphous.

b. Of Vegetables.—The relations existing between natural-historical qualities and medicinal effects have been attentively examined with respect to vegetables. It has long been supposed, that those plants which resemble each other in their external appearances, are endowed with analogous medicinal properties. Cæsalpinus was, according to Dierbach,[1] the founder of this doctrine: though Decandolle (*Essai sur les Propriétés Medicales des Plantes*, p. 4, 2ⁿᵈᵉ éd. Paris, 1816.) regards Camerarius as the first who clearly announced it. Linnæus (*Op. supra cit.* p. 278.) says, "Plantæ quæ *genere* conveniunt, etiam virtute conveniunt; quæ *ordine* naturali continentur, etiam virtute propius accedunt; quæque *classe* naturali congruunt, etiam viribus quodammodo congruunt." I may also refer to Isenflamm, Wilcke, Gmelin, Jussieu, and Barton, as other supporters of this opinion. But the most important writer in favour of it is Decandolle, who, in 1804, published the first edition of his work on this subject; and, in 1816, a second edition of it appeared. In the year 1831, we had another interesting treatise on the same subject, by Dierbach. There are other writers, however, who deny altogether the possibility of judging of the virtues of plants by their exterior forms and botanical characters. Of these, it will be sufficient to mention Gleditsch. (*De Methodo Botanicâ, dubio et fallaci virtutum in plantis indice.* Ed. 2ⁿᵈᵃ. Lipsiæ, 1742.)

It must be admitted, that vegetable substances owe their peculiar qualities to the structure, and consequent action, of the organs producing them; and, therefore, that differences in the structure of an organ are attended with corresponding differences in the qualities of its products. It consequently follows, that the medicinal qualities of plants of the same natural order should be similar or analogous. That they are so to a certain extent is fully ascertained by numerous facts. If one vegetable species serve as nutriment for either animal or plant, we

[1] *Abhandlung über die Arzneikräfte des Pflanzen, vergleichen mit ihrer Structur und ihren chemischen Bestandtheilen.* Lemgo, 1831.

frequently observe that other species of the same genus, or even of a different genus, but of the same order, are also adapted for a like use; while, on the other hand, if any particular species be injurious, neighbouring species are likewise more or less so. Experience has fully proved, that in a very large number of instances there exists an analogy between the exterior forms and the medicinal properties of plants, so that we can sometimes predict the active principle and mode of operation of a vegetable, merely by knowing to what part of a natural arrangement it properly belongs. Cruciferæ, (fig. 3,) for example, *Raphanus sativus*, present the greatest uniformity in their botanical, chemical, and medicinal characters. They contain a volatile, acrid principle, which renders them stimulant; and, having been employed successfully in scurvy, they are frequently termed antiscorbutics. The Labiatæ (fig. 4,) which constitute, perhaps, the most natural family of the whole vegetable kingdom, contain a bitter, resinous, or extractive matter, and an etherial, aromatic, or volatile oil: which two principles, mixed in different proportions, are found in all the species, to which they communicate tonic and carminative properties. Neither Cruciferæ nor Labiatæ contain a single unwholesome or even suspicious species. In Coniferæ (fig. 5,) we find the different species pervaded with an oleo-resinous juice, in consequence of which they possess stimulant properties.—Many other families might be quoted to the same effect; and, therefore, we admit, as a general rule, that plants, of similar structure, possess similar medicinal qualities.

The objections to this general rule are two-fold:—

1st. *Plants of the same Natural Order are frequently endowed with dissimilar Medical Properties.* The root and leaves of *Daucus Carota* are wholesome and nutritive, but the analogous parts of *Conium maculatum* are highly poisonous. Both of these plants, however, belong to the same natural order,—Umbelliferæ (fig. 6.) In some cases we find plants even of the same genus differing considerably in their medicinal properties; as *Cucumis Melo* and *Cucumis Colocynthis*, of the order Cucurbitaceæ. If we are to believe the statements of credible writers, even Gramineæ, which Decandolle declares to be "la famille la plus naturelle," contains more than one exception to the general statement in question. For the most part, the plants of this family are farinaceous and nutritive. "None," says Dr. Lindley, (*Natural System*, 2nd ed. 1836.) "are unwholesome in their natural state, with the single exception of *Lolium temulentum* (fig. 7,) a common weed in many parts of England, the effects of which are undoubtedly deleterious, although perhaps much exaggerated." I may remark, however, that several other grasses have been asserted to be unwholesome. Loudon (*Encyclopædia of Plants*, p. 64.) tells us that the seeds of *Bromus mollis* bring on giddiness in the human species and quadrupeds, and are fatal to poultry. The root of *Bromus purgans* is said to be used in Canada as an emetic, in doses of forty grains. *Bromus catharticus*, a Chilian plant, has a thick root, which is stated to act as a purgative.[1] Humboldt[2] tells us that *Festuca quadridentata* (fig. 8) is very poisonous, and even fatal to animals. Perhaps this may be the grass described by some under the name of *Carapoucha*, and which by others has been called *Carapullo*. Frezier[3] says, in speaking of Lima, "There is an herb called *Carapullo*, which grows like a tuft of grass, and yields an ear, the decoction of which makes such as drink it delirious for some days. The Indians make use of it to discover the natural disposition of their children. All the time when it has its operation, they place by them the tools of all such trades as they may follow,—as by a maiden, a spindle, wool, scissors, cloth, kitchen furniture, &c.; and by a youth, accoutrements for a horse, awls, hammers, &c.: and that tool they take most fancy to in their delirium, is a certain indication of the trade they are fittest for,—as I was assured by a French surgeon, who was an eye-witness of this verity." On this statement, Dr. Lindley (*Flora Medica*, p. 613. Lond. 1838.) remarks, that it is uncertain whether the plant referred to be really of the order Gramineæ. "I cannot trace the name," he observes, "and the only Lima plant that I find bearing a name at all like it, is Physalis pubescens, which, according to the *Flora Peruviana*, is there called *Capuli*."

In the family Solaneæ we meet with other exceptions, as in the fruit of *Capsicum annuum* and *Atropa Belladonna*. I might select many other instances (especially from the family Leguminosæ) to the same effect, but shall content myself with the examples already adduced, as sufficiently warranting the assertion that, in the present state of science, botanical affinities cannot be *confidently* relied on by the medical practitioner for determining the effects of

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[1] *Dictionn. de Matière Médic. par F. V. Merat et A. J. De Lens*, tom. i. p. 672. [3] *Voyage*, t. i.
[2] *Voyage to the South Sea and along the Coasts of Chili and Peru*, in the years 1712, 1713, and 1714.

Fig. 7.

Lolium temulentum, or
Bearded Darnel.

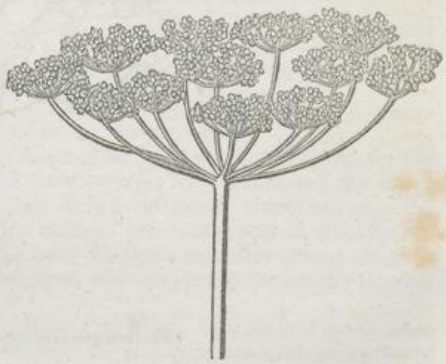
Fig. 3.

Fig. 4.
Glechoma hederacea.
(Labiatæ.)

Fig. 5.

Picea vulgaris.
(Nees ab Esenbeck.)
(Coniferæ.)

Fig. 6.



Fœniculum vulgare.
(Umbelliferæ.)

remedial agents. I cannot, therefore, agree with Dr. Lindley, (*Natural System*, 2nd edit. p. viii.) that "a knowledge of one plant is a guide to the practitioner, which enables him to substitute *with confidence* some other plant that is naturally allied to it." As a *general rule* we may admit, that plants of the same family agree in the *nature* of their medicinal operation, but to this statement there are many remarkable exceptions, which diminish, though they do not absolutely destroy, its utility in practice.

Fig. 8.

Festuca quadridentata (Kunth.)

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

2ndly. *Plants of dissimilar structure are sometimes endowed with similar or very analogous medical properties.* An oleo-resinous juice, called turpentine, is obtained from *Pistachia*

Terebinthus, a plant of the order TEREBINTHACEÆ, and a substance possessing almost identical properties, and bearing the same name, is procured from the genera *Pinus*, *Larix*, and *Abies*, of the order CONIFERÆ. Balsam of Copaiba, which agrees with the turpentines in all its leading properties, and whose constituents are actually isomeric with those of the turpentines, is procured from LEGUMINOSÆ. Yet the structure of Coniferæ is totally dissimilar to that of either Terebinthaceæ or Leguminosæ. Again, the effects of *Lobelia inflata*, a plant belonging to the order LOBELIACEÆ, are so analogous to those of *Nicotiana Tabacum*, which belongs to SOLANACEÆ, that the first-mentioned plant has received the name of Indian *Tobacco*. The term *Hellebore* (ἑλλέβορος) has been applied to two very different plants, viz. *Helleborus niger* and *Veratrum album*, in consequence, I presume, of an observed similarity of operation (both being drastic purgatives and narcotico-acrids;) yet the first-mentioned plant is an exogen or dicotyledon, and belongs to the order RANUNCULACEÆ,—while the second is an endogen or monocotyledon, of the order MELANTHACEÆ.

c. *Of Animals.*—No attempts have been made to trace any relation between the toxicological, medical, or edible properties and the anatomical structure of animals. This has probably arisen from the comparatively small number of these beings which possess medicinal or poisonous properties; for we are enabled to employ, as food, animals of every class, from the highest to the lowest. Among Quadrupeds and Birds no species is poisonous, (Fleming's *Philosophy of Zoology*, vol. ii. p. 110. Edinb. 1822.) unless, indeed, the Arctic bear be an exception, whose liver is stated by Captain Scoresby (*Account of the Arctic Regions*, vol. i. p. 520. Lond. 1820.) to be deleterious. Among Fishes, Mollusks, and Insects, however, several species are hurtful; and it is frequently found that where one is deleterious, kindred species are likewise more or less so. Thus all the coleopterous insects belonging to the tribe *Cantharidiæ* of Latreille possess blistering properties.

3. THE CHEMICAL PROPERTIES of medicines have been sometimes resorted to for the purpose of determining the influence which these bodies have over the organism. For we sometimes find that substances possessed of similar chemical qualities operate in an analogous manner on the system. Thus Sulphuric, Nitric, and Hydrochloric acids, act very much alike; as do also Potash and Soda. But these analogies are not common, and we frequently meet with substances whose chemical properties are similar, but whose medicinal qualities are most incongruous, as in the case of Quinia and Morphia: while, on the other hand, bodies whose chemical properties are exceedingly unlike, sometimes act in a very analogous manner; for example, Manna and Bitartrate of Potash.

The properties of bodies are so completely altered by chemical combination, that it is, in most cases, difficult to form a correct opinion as to the action of a compound medicine, merely by knowing the nature and proportion of its constituent parts. The compounds of some of the metals, however, offer exceptions to this statement.

Mr. Blake (*Proceedings of the Royal Society*, Jan. 28th, 1841.) contends that a very close relation exists between the chemical properties and physiological effects.

4. THE DYNAMICAL PROPERTIES. *Observation of the effects caused by the application of medicines to the animal body.*—Some have examined the action of medicines on *dead* animal tissues, and drawn inferences therefrom as to the operation on the living organism. This mode of proceeding was adopted by Dr. Adair Crawford.[1] But it is admissible only for those remedies whose action is either mechanical or chemical; and, therefore, with respect to the greater number of our remedial means, it is useless.

The examination of the effects of medicines on *living* animals is a much more valuable and important mode of investigation; for it may be asserted, as a general rule, that a substance which is poisonous to one species is more or less so to all classes of animals; and, in a considerable number of instances, its action is of the same nature or quality, though usually very different in degree, and modified by the variations in the development of the several organs and functions. It has indeed been stated that many substances which are poisonous to man are innocuous to animals, and *vice versâ*. That this statement is wholly untrue, I will

[1] *An Experimental Inquiry into the Effects of Tonics and other Medicinal Substances.* Lond. 1816.

not venture to affirm, but I think that it is an exaggerated one; and I believe, with Dr. Christison, (*Treatise on Poisons*, 3rd ed. p. 65.) that "if the subject be studied more deeply, the greater number of the alleged diversities will prove rather apparent than real."

The animals employed for the purpose of ascertaining the operation of medicines are, ordinarily, the dog and the rabbit, and, occasionally, the cat and the horse. The dog and cat are supposed to be "affected by almost all poisons exactly in the same way as ourselves." (Christison, *op. supra cit.* p. 64.)

The principal peculiarities which are observed in the operation of medicines in our domestic animals, may be conveniently arranged under three heads, as follow:—

a. Those relating to the nervous system.
b. Those connected with the structure of the digestive organs.
c. Those relating to the skin.

a. To the unequal development of the *Nervous System* of different animals, is to be referred the peculiarities observed in the operation of the substances termed Cerebro-spinants, or Narcotics, on different animals. Charvet, (*De l'Action comparée de l'Opium*, p. 164. Paris 1826.) in noticing the effects of opium, observes that the brain of the dog being much less developed than that of man, "is not so liable to sanguineous congestion, and when this condition is observed, it is not very intense—stupor is the only symptom of it; never coma, loss of consciousness, nor profound sleep." I have observed that the root of Monkshood does not act precisely alike on rabbits and dogs. In the latter, one of the most remarkable symptoms of its operation is diminution of feeling: in the former, the function of feeling is much less obviously affected, but we observe more evident paralysis of the hind extremities and muscular weakness. Moiroud (*Pharmacologie-Vétérinaire*, p. 51. Paris 1831.) says that "the smallest quantity of Nux Vomica is sufficient to poison the dog, while the goat eats with impunity Hemlock, and the hog, Henbane."

b. From differences in the structure of the *Digestive Organs* arise some peculiarities in the operation of medicines. In carnivorous animals, vomiting can be readily excited; whereas in herbiverous ones it is either not effected at all, or only with extreme difficulty, as in the horse and the rabbit. In the horse, the soft palate is so placed as almost to preclude the possibility of vomiting. "Whatever is returned from the stomach of the horse, passes through the nose.—(Youatt, *The Horse*, p. 152. Lond. 1831.) As the rumen or paunch of ruminants possesses little sensibility and few blood-vessels, it is but slightly affected by medicinal agents. Hence in the administration of medicines to these animals, it is necessary to let them trickle slowly down so that they may flow along the œsophagean canal, and through the manyplies or third stomach, into the abomasum, or fourth or true stomach. Mr. Youatt (See the article "*Ergot of Rye.*") ascribes the occasional inertness of ergot of rye on the ruminant, to its being hastily poured from a large vessel, by which it falls into the paunch, and there remains inert.—Lastly, it is remarkable that colocynth, jalap, gamboge, and briony, which operate as violent purgatives on man and carnivorous animals, have comparatively little effect on the horse and other herbivorous animals. (Moiroud, *op. supra cit.* pp. 51, 269, and 274.)

c. The *skin* also presents some peculiarities in the operation of Medicines. Thus dogs are but little under the influence of sudorifics: while the skin of horses is exceedingly susceptible of the action of oil of turpentine.

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

In ascertaining the action of remedial agents on the *living* body, it is necessary that we examine their influence both in healthy and diseased conditions. For, by the first we learn the positive or actual power of a medicine over the body; while by the second, we see how that power is modified by the presence of disease. Moreover, in the latter condition we sometimes discover remedial influences which our knowledge of the effects of medicines on the healthy body could not have lead us to anticipate. The beneficial operation of arsenious acid in agues, or in lepra, could never have been inferred from any experiments made with this substance in health merely; nor could we have formed a correct estimate of the effects and proper dose of opium by employing it in tetanus, nor by

using mercurials in fever. The homœopathists assert, and with truth, that the study of the effects of medicines in the healthy state is the only way of ascertaining the *pure* or *pathogenetic* effects of medicines—since when we administer our remedies to invalids "the symptoms of the natural disease, then existing, mingling with those which the medicinal agents are capable of producing, the latter can rarely be distinguished with any clearness or precision." (Hahnemann's *Organon*, translated by C. H. Devrient, p. 190.)

CHAPTER II.—OF THE ACTIVE FORCES OF MEDICINES.

The production of effects, by the application of medicines to the living body, depends on the existence of two classes of powers or forces; the one residing in the medicine, (and called the *active forces of medicines*,) the other in the organism.

Bodies act on each other in one or more of three ways; viz. *mechanically*, by their weight, cohesion, external form, and motion; *chemically*, by their mutual affinities; and *dynamically*, by agencies which are neither mechanical nor chemical merely. Hence we may examine the actions of medicines under the three heads of mechanical, chemical, and dynamical.

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

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

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

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

the last are used as anthelmintics—the second, to overcome intus-susception, or intestinal invagination.

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

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

Chemical changes are sometimes produced in the secretions of distant parts by the internal use of certain agents. Thus the qualities of the urine are modified by the administration of acids or alkalis. These modifications or changes depend, at least in a considerable number of instances, on the chemical influence of the substances swallowed. For when either alkalis or acids are swallowed, they pass out of the system, in part at least, by the kidneys; and in the urine they possess their usual chemical properties, modified by the presence of any substances with which they may have united. Moreover, the qualities which they impress on the urine, are similar to those which they produce when added to this secretion after its evacuation from the bladder. Thus, by the internal use of alkalis, it has been found that the natural acidity of the urine may be destroyed, and an alkaline quality substituted for it: the same condition of urine is produced by the addition of alkalis to this fluid out of the body. Again, the internal use of soda or magnesia may give rise to the appearance of white sand (phosphates) in the urine: and the same kind of deposite is produced in healthy urine by the addition of a few drops of an alkaline solution to it. Farthermore, by the administration of acids (sulphuric or hydrochloric,) phosphatic deposites are diminished or entirely prevented, while the employment of alkalis promotes them: and a few drops of hydrochloric acid added to urine, in which the earthy phosphates are suspended, dissolve them. In other words, as the modifications which acids and alkalis produce in the condition of the urine, are precisely those which we might expect from the known chemical properties of these bodies, it is rational to infer that they depend on the affinities of these substances.

Do substances (such as acids, alkalis, and metallic salts,) which are known to possess affinities for the constituents of the blood and of the tissues, exercise those affinities in their passage through the system? and are the constitutional effects of those substances referrible to chemical influences? It is impossible to give satisfactory answers to either of these questions. We cannot deny the chemical influence of these agents; but we are hardly authorized to ascribe the whole of their effects to it. The truth is, that the facts on which we are required to form our opinion are too few to enable us to draw any accurate or precise conclusions. By the internal use of madder, the bones and some other parts become coloured; and the long-continued employment of the nitrate of silver gives rise occasionally to a deposite of silver under the skin. But with two or three exceptions of this kind,

no changes in the living tissues or organs have been demonstrated. We know that when external agents are taken into the system, they become subject to a superior power, and are no longer at full liberty to obey the ordinary laws of affinity. It must be some power superior to that recognised in chemical operations which prevents the action of the gastric juice on the stomach during life.

Müller, (*Elements of Physiology*, by Baly, vol. i. p. 58, et seq.) however, ascribes the operation of most external agents to their chemical influence. Vital stimuli, (a certain degree of external heat, atmospheric air, water, and nutriment,) he observes, "do not merely produce a change in the composition of the organic structures, and stimulate by disturbing the balance in the system, but renovate the tissues by entering, in a manner indispensable to life, into their composition." On the other hand, all agents of this kind, as well medicinal substances, as caloric, electricity, and mechanical influences, "may, when their action is excessive, have the opposite of a vivifying effect, by producing such a violent change in the organic matter, that the combinations necessary to life cannot be maintained." "A great number of substances are important as medicaments, from producing a chemical change in the organic matter, of which the result is, not an immediate renovation of material and increase of vital force, but the removal of that state of combination of the elements which prevented healthy action, or excited diseased action; or the chemical change produced is such as to render the organ no longer sensible to a morbid stimulus; or it is such that certain apprehended destructive changes in its composition are no longer possible, as in the antiphlogistic plan of treatment; or, lastly, these substances produce a change in the nutritive fluids. Such substances are *alteratives*. By these remedies an organ morbidly changed in composition cannot be rendered sound by, as it were, a chemical process, but such a slight chemical change can be produced as shall render it possible for nature to restore the healthy constitution of the part by the process of nutrition. These remedies, again, may be divided into two principal kinds, according as they act chiefly on the nervous system, or on the other organs dependent on that system. Among those of the first kind, the most important are the so called narcotics; those of the latter kind comprehend the numerous medicines which exercise their action on diseases in other organs. These remedies, also, by removing the obstacles to cure, become indirectly vivifying or renovating stimuli; and they may themselves, by disturbing the balance in a part, produce symptoms of irritation. If used to excess, they either give rise to the injurious effects of the heterogeneous stimulants, or, by inducing a sudden change of composition, annihilate the vital force, as is the case with the narcotics. Since, however, such alterative medicines affect the composition of an organ each in its own way, one alterative may, after a time, lose its influence, as it were, by saturation, while the organ may still be susceptible of the influence of another. A great number of the instances of habituation are referrible to this cause."

3. Dynamical.—Some substances exercise a most potent influence over the organism, without producing any obviously mechanical or chemical changes in the organic tissues. Such substances are said to act *dynamically;* as hydrocyanic acid, morphia, strychnia, &c.

In the inorganic kingdom we have evidence of an influence which cannot be denominated either mechanical or chemical. The communication of magnetical and electrical properties to iron by mere contact with another body, without the production of any change of form or of composition, either of the iron itself or of the imparting body, is an example of this. Now, to influences of this kind the term *dynamical* has been applied; and several pharmacologists[1] have employed it to indicate those influences of medicines over the organism which are ascribable to neither mechanical nor chemical causes. As the term is a convenient one, I have adopted it.

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

In some few instances the effects of medicines are analogous to those of electricity. Thus the instantaneous death caused by hydrocyanic acid is something like an electrical phenomenon. "A drop of acid, mixed with a few drops of alcohol," says Magendie, (*Formulaire*, 8me éd. p. 174. Paris, 1835.) "when injected into the jugular vein, kills the animal instantly, as if he had been struck with lightning." The same physiologist has compared the convulsive

[1] Burdach, *System der Arzneymittellehre*. Leipzig, 1807.—C. H. E. Bischoff, *Die Lehre von den chemischen Heilmitteln*. Bonn. 1825.—Vogt, *Lehrbuch der Pharmakodynamik*, 2d Aufl. Giessen, 1828.

shock, caused by the Upas Tieuté, "to that which takes place when a current of galvanic fluid is directed along the spinal marrow of an animal recently killed." (Orfila, *Toxicologie Générale.*) Again, "If an animal be touched whilst under the action of this substance [extract of nux vomica,] it experiences a commotion similar to that of a strong electrical shock; and this takes place every time the contact is renewed. (*Formul.* p. 5.) The recent assertions of Prof. Zantedeschi and Dr. Favio (to which I have had already occasion to refer,) (See pp. 68 & 69.) with respect to the existence of electric currents in the animal body, are especially interesting in connexion with the above speculations. These experimentalists declare, that convulsive movements strengthen or exalt the neuro-electric current,—a statement which agrees with Magendie's remark as to the effect of nux vomica. Bischoff, (*British and Foreign Medical Review* for July, 1841, p. 245.) however, denies the existence of electric currents in the nerves.

CHAPTER III.—ON THE PHYSIOLOGICAL EFFECTS OF MEDICINES.

The effects which medicines are capable of producing in healthy individuals, are denominated *Primary*, *Immediate*, or *Physiological*.

Formerly, no distinction was made between the effects which medicines produce in health, and those which they give rise to in disease; and the terms *Virtues*, *Properties*, *Faculties*, and *Powers*, were applied to both classes of effects. But Bichat, and subsequently Barbier and Schwilgué, pointed out the propriety of considering them separately.

The Physiological Effects may, for convenience, be divided into such as are *local*, or which occur in the part to which the agent is applied; and those which are *remote*, or which take place in parts more or less distant from that to which the medicine is applied.

1. Local Effects.

(Topical Effects.)

The local or topical effects of medicines are of three kinds,—*mechanical*, *chemical*, and *vital*.

1. Mechanical Effects.—The operation and primary effects of the hairs of *Mucuna pruriens*, and of demulcents, are mechanical. But mechanical effects are usually attended, or followed, by changes in the vital actions of the part; so that the total effect is *mechanico-vital*.

2. Chemical Effects.—A very large number of medicinal agents effect chemical changes in the parts to which they are applied.

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

Those medicines or agents, which produce a local chemical effect, admit of a three-fold division:—

a. Some produce the complete destruction of the parts with which they are placed in contact. *Oil of Vitriol*, *Nitric*, and *Hydrochloric Acids*, and the *Caustic Alkalies*, belong to this series. Liebig[1] refuses to call these substances poisons. They merely destroy, he says, the continuity of particular organs, and are comparable, in their operation, to a heated iron or a sharp knife.

[1] *Organic Chemistry in its Application to Agriculture and Physiology.* Edited by Lyon Playfair, Ph. D. London, 1840.

b. Some enter into chemical combination with the tissues, or their organic components. To this series belong *Sulphate of Copper*, *Bichloride of Mercury*, *Acetate of Lead*, *Chloride of Zinc*, *Nitrate of Silver*, *Arsenious Acid*, *Tannic Acid*, &c. The components of the living part, when combined with any of these substances, are less susceptible of decay and decomposition than previously. Hence they are unfitted for the exercise of the "principal property which appertains to their vital condition; viz. that of suffering and effecting transformation:" in other words, their vitality is destroyed. In some cases the quantity of inorganic matter sufficient to destroy the life of a part, is very small; as in the case of arsenious acid and bichloride of mercury. Liebig[1] ascribes this to the high atomic weights of fibrine and albumen; and he states, that $3\frac{1}{10}$ grs. of arsenious acid, or 5 grs. of corrosive sublimate, are sufficient to form a neutral compound of equal equivalents with 100 grs. of fibrine, as it exists in muscle or blood; and that $1\frac{1}{4}$ grs. of arsenious acid are sufficient to unite with 100 grs. of albumen.

c. Some agents produce chemical effects distinct from those of the preceding two series. *The Salts with an alkaline or earthy base*, and *Alcohol*, belong to this group. Liebig says, their action does not depend on their power of entering into combination with the component parts of the organism. Common salt and alcohol act by abstracting water from the moist tissues.

Liebig admits that some poisons act by catalysis. Thus, decomposing animal or vegetable matters are, he thinks, capable of inducing in the blood of a healthy individual a decomposition similar to that of which they themselves are the subjects. They exhibit, he says, a strong similarity to the action of yeast on liquids containing sugar and gluten. The poisons of small-pox, plague, and syphilis, act, he thinks, in this way. This view, which is a revival of an ancient opinion, is ingenious, but improbable.

3. Vital Effects.—The effects placed under this head are those which are unaccompanied by any obvious mechanical or chemical lesions.

Although it is probable, that no one component of a tissue can suffer much change in its vital activity without disturbing the actions of other components, yet we observe that the blood-vessels, the secretory apparatus, the organic fibres, and the nerves of a part, are affected, in unequal degrees, by different medicines.

a. In some cases the *blood-vessels* appear to be principally affected. Thus, Cantharides, Savine, Gamboge, Croton Oil, Mustard, &c., cause pain, heat, redness, and other symptoms of inflammation: these agents we denominate *irritants* or *acrids*.

b. In some instances the *secretory apparatus* is remarkably affected. Thus, Oxide of Zinc and Lime Water have a desiccating effect when applied to a secreting surface.

c. The effect of astringents and emollients is on the *organic fibres* chiefly.

d. The *nerves*, in some cases, are the parts principally affected. Thus, Aconite causes numbness, tingling, and a pricking sensation, with scarcely any visible alteration in the condition of the part.

2. Remote Effects.

(General Effects.)

Nature of the Effects.—In general the effects produced in parts more or less remote from the seat of application, are physiological or vital; that is, they consist of alterations of the vital actions. In some few instances, however, chemical changes are obvious.

a. Vital Effects.—Some substances, when taken into the stomach, influence the functions of remote organs, without our being able to detect, after death, any change in the structure or appearance of the parts whose functions are thus affected. Thus, Hydrocyanic Acid disturbs the cerebral functions,—and Foxglove acts as a diuretic, without inducing any visible topical alteration in the brain and kidneys respectively.

On the other hand, some agents give rise to visible changes in the condition of the parts acted on. Thus, Cantharides, in large doses, excites inflammation of the bladder,—Drastic Purgatives, of the rectum.

b. Chemical Effects.—The deposition of silver under the skin and in some internal organs, by the administration of the nitrate of that metal, and the red colour communicated to bones by the internal employment of Madder, are proofs that the solids remote from the seat of application may undergo slight chemical changes. Vogt, (*Pharmakodynamik*, Bd. i. S. 15.) however, denies that any

[1] *Op. supra cit.* Liebig says, that 6361 parts of anhydrous fibrine are united with 30000 parts of water in muscular fibre or blood.

remote chemical effects can be induced. I have already (See p. 120.) assigned reasons for believing that the alteration effected in the quality of the urine by the internal use of Acids and Alkalies, are the effects of a chemical influence.

Medium by which Remote Effects are produced.—It has been hitherto generally supposed that there were two modes by which a medicine or poison affected remote parts: these were,—

1st. *By absorption*,—that is, by the passage of the medicinal or poisonous molecules into the blood.

2ndly. *By sympathy*,—that is, by an impression transmitted through the nerves.

Sir Benjamin Brodie (*Phil. Trans.* for 1811, p. 178; and for 1812, p. 205.) inferred this double medium of operation from his experiments on several poisons. It has, however, always appeared somewhat improbable that an agent should be capable of affecting remote parts in two ways. "All fair analogy," observe Messrs. Morgan and Addison, (*An Essay on the Operation of Poisonous Agents on the Living Body*, p. 14. Lond. 1829.) "forbids the conclusion that a poison or an ordinary cause of disease shall at one time produce constitutional disturbance through the medium of one system of organs, and at another time through the medium of another system of organs." Difficulties, however, have hitherto appeared in the way of an exclusive adoption of either mode of operation; and, therefore, while Magendie, on the one hand, advocated the operation of absorption only, and Messrs. Morgan and Addison, on the other hand, that by sympathy only, most writers, dissatified with these exclusive views, have adopted Sir Benjamin Brodie's opinion of a double mode of operation. Although late investigations strongly favour, if, indeed, they do not absolutely establish, the correctness of Magendie's opinion, I think it expedient, so long as any doubt remains, to examine both theories; and, therefore, the following two chapters will be devoted to these subjects.

CHAPTER IV.—ON THE ABSORPTION OF MEDICINES.

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

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

b. Detection in other parts of the body.—Tiedemann and Gmelin[1] have detected, by physical or chemical characters, the following substances in the *blood* of animals to whom those agents had been administered: Camphor, Dippel's Oil, Musk, Indigo, Rhubarb, Lead, Cyanuret of Potassium, Sulphocyanuret of Potassium, Iron, Mercury, Baryta, and Alcohol. By other experimenters, Asafœtida, Sal Ammoniac, Iodine, Hydrocyanic, and Sulphocyanic acids, &c., have been found.[2]

In the *solids* of the body several substances have been recognised: for example, Madder in the bones, Silver in the skin, Copper in the liver, Lead in the liver, spinal cord, and muscles, Mercury in various parts, &c.

In the *secretions* various medicinal agents have been recognised.—Thus, *in the cutaneous secretions*, Mercury, Iodine, Sulphur, the odorous Matter of Musk, of Garlic, and of Onions, and other substances, have been detected; *in the breath*,

[1] *Versuche ueber d. Wege auf welchen Substanzen aus dem Magen u. Darmkanal ins Blut gelangen.* Heidelberg, 1820.

[2] For authorities consult Magendie's *Elementary Compendium of Physiology*, and Christison's *Treatise on Poisons.*

several substances have been recognised by their odour; for example, Camphor, Alcohol, Ether, Phosphorus, Asafœtida, Sulphur, the odorous matter of Garlic, and of Onions, &c. The *milk* sometimes acquires medicinal properties, in consequence of the employment of certain substances by the nurse. Thus it is rendered purgative by Senna, and narcotic by Opium. "Alkalies given to the nurse will relieve acidity in the child's stomach; and Mercury given through a similar medium will cure syphilitic symptoms in the infant at the breast."[1] Bitters, Indigo, Iodine, and Madder, have also been distinctly recognised in the milk. *In the urine* so many substances have been discovered, that it will be most convenient to exhibit them in a tabular form. The following is taken principally from the experiments of Drs. Wöhler and Stehberger, as mentioned by the late Dr. Duncan. (*Supplement to Edinburgh Dispensatory*, 1829.)

SUBSTANCES WHICH PASS OFF BY THE URINE.

(A.) Unchanged, or nearly so.

Salts.

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

Fig. 9.

Cactus opuntia;
Small Indian or Prickly Fig.

Colouring Principles.	*Odorous Principles somewhat altered.*
Indigo, Madder (in 15 minutes.)	Oil of turpentine.
Rhubarb (in 20 minutes.)	—— juniper.
Gamboge.	Valerian.
Logwood (in 25 minutes.)	Saffron.
Turmeric (Lewis.)	Asafœtida.
Red radishes.	Garlic.
Mulberry.	Castoreum.
Black cherry (in 45 minutes.)	Opium.
Cassia Fistula (in 55 minutes.)	Narcotic principle of Amanita muscaria.
Elder rob (in 75 minutes.)	Asparagus (*Cullen.*)
Cactus Opuntia (see fig. 9.)	

Other Matters.

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

(B.) In a state of combination.

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

(C.) In a decomposed state.

Tartrate, Citrate, Malate, Acetate — of potash, or soda, are changed into the carbonate of the same alkali.

Sulphuret of potassium, changed, in a great measure, into the sulphate of potash.

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1 Dr. Locock, in *The Cyclop. of Pract. Medicine*, art. *Lactation*. The same authority states that a patient of Mr. Keate took Mercury by giving the Nitrate of this metal to an ass, and drinking the milk.

If the accounts published respecting the *Amanita muscaria* be correct, its effects are most extraordinary. A variety of this fungus has a powerful narcotic or rather inebriating effect; and that the active molecules get into the blood is proved by the fact of the urinary secretion being impregnated with them, and thus possessing an intoxicating property; and we are told that the inhabitants of the north-eastern parts of Asia use it for this property. A man, for example, may have intoxicated himself to-day by eating some of the fungus; by the next morning he will have slept himself sober; but by drinking a tea cupful of his urine, he will become as powerfully intoxicated as on the preceding day. "Thus," says Dr. Greville, on the authority of Dr. Langsdorf, "with a very few *Amanitæ*, a party of drunkards may keep up their debauch for a week;" and "by means of a second person taking the urine of the first, a third of the second, and so on, the intoxication may be propagated through five individuals."[1]

Amanita muscaria.

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

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

a. Detection of substances in the venous blood.—Tiedemann and Gmelin (*Op. supra cit.*) administered a variety of colouring, odorous, and saline substances to animals, mixed with their food, and afterwards examined the state of the chyle, and of the blood of the (splenic, mesenteric and portal) veins. The *colouring* substances employed were—Indigo, Madder, Rhubarb, Cochineal, Litmus, Alkanet, Gamboge, and Sap-green; none of them could be detected in the chyle, but some were found in the blood and urine. The *odorous* substances used were—Camphor, Musk, Spirits of Wine, Oil of Turpentine, Dippel's Oil, Asafœtida, and Garlic: they were for the most part, detected in the blood and urine, but none were found in the chyle. The *saline* substances tried were—Acetate of Lead, Acetate and Cyanuret of Mercury, Chloruret and Sulphate of Iron, Chloruret of Barium, and Ferro-cyanide and Sulpho-cyanide of Potassium. A few of these were detected in the chyle, and most of them in the venous blood and urine. From these experiments we may conclude, that although saline substances occasionally pass into the chyle, odorous and colouring matters do not; all the three classes of substances, however, are found in the venous blood. These results, observe Tiedemann and Gmelin, are opposed to those of Lister, Musgrave, J. Hunter, Haller, Viridet, and Mattei, but agree with those of Hallé, Dumas, Magendie, and Flandrin.

b. Division of all Parts but Blood-vessels.—Magendie's Experiment.—Magendie and Delille (Magendie's *Elementary Compend. of Physiology*, translated by Dr. Milligan, p. 284. Edin. 1823.) performed a striking experiment, with the view of settling, if possible, the question of venous or lymphatic absorption of medicines and poisons. They divided all the parts of one of the posterior extremities of a dog, except the artery and vein, the former being left entire, for the purpose of preserving the life of the limb. A portion of the *Upas Tieuté* was then applied to a wound in the foot: in the short space of four minutes the effects of the poison were evident, and in ten minutes death took place To the inferences drawn from this experiment, however, several objections have been stated: first, the exhibition of opium, to diminish the pain of the operation, has been said to vitiate the whole of the experiment; secondly, the coats of the arteries and veins contain lymphatics, by which absorption might be carried on; and thirdly, as the poison was introduced into a wound, the poison might have combined with the blood, and have rendered it deleterious, without the process of

[1] See also on this subject, *The History of Kamtschatka and the Kuriliski Islands*, translated by Dr. J. Grieve, p. 258. Gloucester, 1764.

absorption taking place. The first two of these objections have been obviated. In a second experiment, Magendie severed the artery and the vein, and reconnected them by quills, so as to preclude the possibility of absorption taking place by the lymphatics of these vessels: the effects were the same. Some years since I assisted my friend Mr. Lloyd, assistant surgeon of St. Bartholomew's Hospital, in performing an analogous experiment, using *Strychnia* instead of the *Upas Tieuté*, and without administering opium: death took place in twelve minutes.

The late Dr. Thomas Davies (*Lectures on the Diseases of the Lungs and Heart*, p. 213. Lond. 1835.) observes on this experiment, that as the absorbents and veins communicate, it is possible that the poison flowed first into the absorbents, and from thence into the veins of the amputated portion of the limb.

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

d. Blood-vessels tied: poisons do not act.—Segalas tied the veins of a portion of intestine, and applied poison, but no effects were produced. Emmert observed, that when the abdominal aorta was tied, hydrocyanic acid was applied to the foot without producing any effect, but when the ligature was removed, symptoms of poisoning came on. (Müller's *Elements of Physiology*, by Baly, vol. i. p. 242.) Mr. Blake (*Edinb. Med. and Surg. Journ.*, vol. liii. p. 45.) found, that if a ligature be put around the vena portæ, and then poison be introduced into the stomach, it failed to act.

It deserves notice, that the Academy of Medicine of Philadelphia found that nux vomica, introduced into the intestines, produced tetanus, although the vena portæ was tied. (Müller, *op. supra. cit*, vol. i. p. 240.)

e. Rapidity of absorption and circulation too great for the lymphatics or lacteals.—Mayer (Müller's *Physiology*, by Baly, vol. i. p. 239.) found that Ferro-cyanide of Potassium could be detected in the blood, in from two to five minutes after its injection into the lungs. From this it has been inferred that it enters the blood too speedily for it to be explained by the slow circulation of the lymph. From later experiments, it appears that the rapidity with which poisons enter the blood has been greatly underrated. Professor Herring, of Stuttgardt, (Quoted by Dr. Christison, in his *Treatise on Poisons*, p. 8, 3d ed. 1835.) found that the time which a solution of Ferro-cyanide of Potassium, injected into the jugular vein, requires to reach that of the opposite side, was, in various experiments, from twenty to thirty seconds. And Mr. Blake (*Edin. Med. and Surg. Journ.* vol. liii. p. 42.) states, that the time required for a substance which does not act on the capillary tissue, to pass from any part of the vascular system back to the same part again, in dogs, varies from twelve to twenty seconds.

Rapid as is the circulation of poisonous molecules, it has been supposed not to be sufficiently so to explain the operation of certain poisons which have been said to act instantaneously; and hence an argument has been raised in favour of the nerves being the medium by which the deadly impression is conveyed. But Mr. Blake (*Edin. Med. and Surg. Journ.* vol. liii. p. 42.) asserts that an interval, always more than nine seconds, elapses between the introduction of a poison into the capillaries or veins, and the first symptom of its action;—a period sufficiently long for a poison to be brought into general contact with the tissues it affects.

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

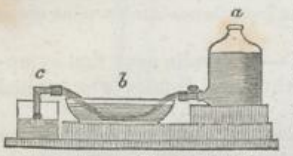
Some of the experiments performed by the Academy of Medicine, at Philadelphia, appear to be in favour of absorption being effected chiefly by the lymphatics: but they are not conclusive.

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

1. *Absorption by physical agency* (*Imbibition*, Magendie; *Exosmose* and *Endosmose*, Dutrochet.)—Two fluids separated by an interposed dead membrane, mutually, though not equally, permeate the membrane, so as to become intermixed with each other.

If a current of water, coloured by litmus, be allowed to pass from a bottle (fig. 11,) through a vein immersed in diluted sulphuric acid, contained in a glass dish (*b*,) into a reservoir (*c*,) the litmus liquor is soon observed to become reddened by its passage through the vein, in consequence of the acid permeating the venous coats. If the relative position of the fluids be altered,—that is, the litmus put in the dish (*b*,) and the acid passed from the bottle (*a*) through the vein, the litmus will still become reddened, showing that the acid has passed in this case from within outwards.

Fig. 11.



Apparatus to illustrate Physical Absorption.

Gases and vapours, as well as liquids, also readily permeate dead animal membrane. But the same membrane is unequally permeated by different gases.

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

[A fact of an analogous character and confirmative of the doctrine of penetration through living tissues is detailed by Dr. Mitchell. He states, that "while engaged in investigating Magendie's theory of venous absorption, I coloured the diaphragm of a living cat blue, by placing a solution of prusiate of potash on one side, and that of sulphate of iron on the other." See papers on the *Penetrativeness of Fluids, by* J. K. Mitchell, M. D., &c. *American Journal of Medical Sciences, November*, 1830, in which are detailed other ingenious and interesting experiments on this subject.—J. C.]

With these results before us, we cannot refuse to admit the imbibition of living tissues, though in them this process cannot be effected so readily as dead tissues.

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

Absorption of a Medicine, or Poison, essential to the production of its remote effects.—Magendie and Müller (*Physiol.* p. 246, et seq.) consider the

passage of poisons into the circulation essential to their operation on the system: while Messrs. Morgan and Addison (*Essay on the Operation of Poisonous Agents.* Lond. 1829.) deny that in any case absorption is absolutely necessary for the operation of a poison. "We are not opposed," observe the latter gentlemen, "to the theory of venous absorption, but to that theory which would associate with it the *absolute necessity* for the admission of a poison into a vein." The following facts appear to me to prove, that absorption is essential to the production of the remote effects:—

1. *Activity of Substances injected into the Blood-vessels.*—Medicinal or poisonous agents, injected into the blood-vessels, exert the same kind of specific influence over the functions of certain organs, as when they are administered in the usual way; but that influence is more potent. Thus, Tartar Emetic causes vomiting, Castor oil purging, Opium stupor, and Strychnia convulsions, when thrown into the veins.

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

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

a. Nature of the tissue.—Nux vomica acts with the greatest energy when applied to the pulmonary surface,—with less when introduced into the stomach,—and with the least of all, when applied to the skin. The same order of gradation is observed with respect to opium. Now, the faculty of absorption, or of imbibition, as Magendie calls it, does not take place with equal intensity in all tissues. Certain physical conditions (viz. a fine and delicate structure and great vascularity) enable the pulmonary surface to absorb or imbibe with extreme rapidity: in this respect, indeed, it is not equalled by any tissue of the body. Hence, then, if we assume that nux vomica and opium act by becoming absorbed, we can easily comprehend why they are so energetic when applied to this part. The membrane lining the alimentary canal absorbs with less facility than the pulmonary membrane, which may be accounted for by its less vascularity, and by its being covered, in some parts at least, by an epidermoid layer, and in all its parts by mucus, which, to a certain extent, checks absorption. The cutaneous surface, lastly, being covered by an inorganic membrane (the epidermis) does not possess the same physical faculties for absorption met with in either of the foregoing tissues; and hence the comparative inertness of medicines when applied to it. In fact, it is only by the long-continued application of these agents to the skin, that we are enabled to affect the general system; and that the obstructing cause is the epidermis, is shown by the facility with which the system may be influenced when this layer is removed, as has been proposed and practised by Lembert and Lesieur, constituting what has been denominated the *endermic* or *emplastro-endermic* method of treating diseases; of which method I shall have occasion to speak hereafter.

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

c. Condition of system.—Magendie asserts, as the result of experiments, that plethora uniformly retards, and depletion as constantly promotes, absorption. If, therefore, we wish to

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

4. *Division of all parts but blood-vessels. Magendie's experiment.*—The experiment of Magendie, already related, (See p. 126.) of applying the *Upas Tieuté* to the leg of a dog, connected to the body only by two quills, is another argument in favour of the operation of medicines by absorption: for in this case the action of the poison could have taken place only after it had passed into the blood.

5. *Division of the spinal cord.*—Some poisons, as Hydrocynanic acid, are equally active when applied to the legs of an animal whose spinal marrow has been divided. In this case, the effect of the poison could not be the result of its action on the nerves of sensation and voluntary motion. But it may be said the division of the lumbar spine does not prevent the action of poisons by the nervous system, because it does not destroy the action of the excito-motory or sympathetic systems, the nervous branches of which are distributed to the lining membrane of the blood-vessels. I am aware that it is an experiment liable to objection; but, on the whole, it is certainly favourable to the opinion of the operation of poisons by absorption; more particularly when we bear in mind that the motion of the blood is necessary to the action of the poison; for if the circulation of a part be obstructed, the poison will no longer act.

6. *Ligature on the veins.*—If the veins leading from a poisoned part be tied, the symptoms of poisoning do not occur. (See p. 127.)

These reasons are, to my mind, conclusive, that in a large number of instances at least, if not in all, the operation of a medicine on remote parts of the system depends on its absorption. Nor can I admit that this opinion is at all invalidated by the arguments and experiments of Messrs. Morgan and Addison.

Other arguments in favour of the view here taken, may be derived from some experiments made by Mr. Blake, (*Lond. Med. Gaz.* for June 18th, 1841.) of which a short notice only has as yet appeared. Mr. Blake states that the rapidity of the action of a poison, is in proportion to the rapidity of the circulation. Thus, he says, a substance injected into the jugular vein of a horse, arrives at the capillary termination of the coronary arteries in ten seconds; of a dog, in twelve seconds; of a fowl, in six seconds; of a rabbit, in four seconds; and he adds, that the time required for the first symptoms of the poison to present themselves, bears a close relation to the rapidity of the circulation.

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

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

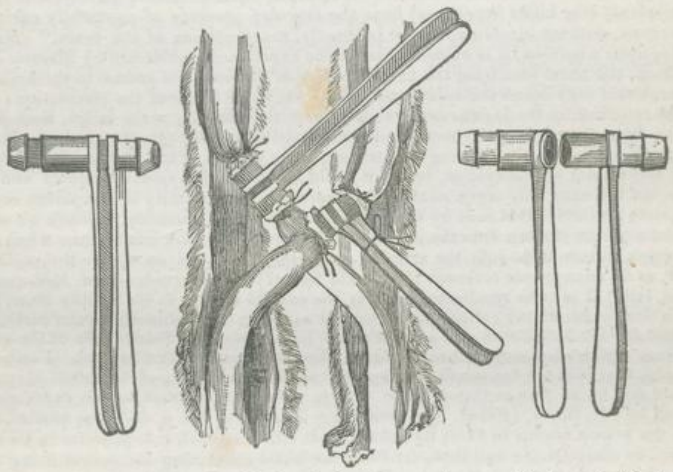
2. The Effects of Injuries and Poisons analogous.—Mr. Travers (*Farther Inquiry concerning Constitutional Irritation.*) points out very forcibly the analogy to be observed between the effects of severe injuries and of poisons which operate rapidly on the system. Thus both strychnia and punctured wounds cause tetanus, and he, therefore, concludes their *modus operandi* must be identical; consequently, as there is nothing to absorb in the one case, so absorption cannot be essential in the other. But although the symptoms caused by the above poison are very analogous to those of traumatic tetanus, yet we are not to conclude that the effects of strychnia and of a puncture are precisely alike. We have abundant evidence to prove, that very dissimilar conditions of the nervous centres may be attended with similar symptoms. Phrenitis and delirium tremens resemble each other in symptoms, yet experience has shown that they are very dissimilar diseases, and require different methods of treatment.

A morbid state of the cerebral faculties, strongly resembling that induced by congestion, may be produced by loss of blood. "The fact of two substances producing similar symptoms in one organ," observes Müller, (*Op. cit.* p. 56.) "does not prove that these substances produce exactly the same effects, but merely that they act on the same organ, while the essential actions of the two may be very different." And I confess I see nothing unphilosophical in supposing that the same morbid condition of the part may be induced in more than one way: for as every part of the organism depends, for the performance of its proper functions, on the receipt of arterial blood and of nervous influence, so alterations in the supply of either of these essentials may modify or even suspend the functions of a part.

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

By the aid of a double brass tube (fig. 12,) consisting of two short brass cylindrical tubes, to each of which a long handle is attached (fig. 14,) they established a complete circulation

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



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

between the carotids of a poisoned and of a sound dog, by connecting the lower and upper ends of the divided arteries in both animals, so that each supplied the brain of the other with the portion of blood which had previously passed through the carotid artery to his own, and, consequently, the poisoned dog in this case received from the unpoisoned animal a supply of arterial blood equal to that with which he was parting (Fig. 13.) One of the dogs was then inoculated with a concentrated preparation of strychnia, which had been found upon other occasions to produce death in these animals in about three minutes and a half. In three minutes and a-half the inoculated animal exhibited the usual tetanic symptoms which result from the action of this poison, and died in little less than four minutes afterwards, viz., about seven minutes from the time at which the poison was inserted, during the whole of which period a free and mutual interchange of blood between the two was clearly indicated by the strong pulsation of the denuded vessels throughout their whole course. The arteries were next secured by ligature, and the living was separated from the dead animal; but neither during the operation, nor subsequently, did the survivor show the slightest symptom of the action of the poison upon the system.

The inference which has been drawn from this experiment is, that the arterial blood of an animal under the influence of poison is not poisonous. But it appears to me that this is not a necessary inference, and as it is opposed to the result of other experiments, it requires careful investigation ere we admit it. Vernière (Christison, *Treatise on Poisons*, 3d. ed. p. 10.) has proved

that if the extract of nux vomica "be thrust into the paw of an animal after a ligature has been tightened round the leg, so as to stop the venous, but not the arterial circulation of the limb, blood drawn from an orifice in a vein between the wound and ligature, and transfused into the vein of another animal, will excite in the latter the usual effects of the poison, so as even to cause death; while, on the contrary, the animal from which the blood has been taken will not be affected at all, if a sufficient quantity is withdrawn before the removal of the ligature."

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

A remarkable error pervades the whole train of reasoning adopted by Messrs. Morgan and Addison, and vitiates some of their conclusions. They assume that Magendie considers actual contact with the brain as essential for the operation of the Upas poison. (See pp. 42, 43, 47, 49, &c. of the *Essay*.) This assumption, however, is not correct. "In 1809," says Magendie, (*Formulaire*, 8me éd. p. 1.) "I laid before the first class of the French Institute, a series of experiments which had conducted me to an unexpected result; namely, that an entire family of plants (the bitter Strychnos) have the singular property of powerfully exciting the spinal marrow, without involving, except indirectly, the functions of the brain." Now, this being Magendie's opinion, it is evident that, in the experiment performed by Messrs. Morgan and Addison, the blood sent from the carotid artery of the poisoned animal to the brain of the sound one, could only reach the spinal marrow by the usual route of the circulation; that is, it must be returned by the jugular veins to the heart, from thence to the lungs, back again to the heart; from thence into the aorta, and then distributed through the system. Now it is not too much to suppose that, during this transit, some portion of the poison might be decomposed, or thrown out of the system, before it could arrive at the spinal marrow: and even if this were not the case, this organ could only receive a small quantity of the poison contained in the system; namely, that sent by the vertebral to the spinal arteries. Hence we ought to expect that a poison thrown into the arteries will operate less powerfully than when thrown into the veins, unless it be into the arteries supplying the parts on which the poison acts. Moreover, as an anonymous reviewer [Sir David Barry?] has observed, (*Lond. Med. and Phys. Journ.* vol. lxiii.) it is to be recollected, that as the carotid artery, in its healthy state, is little more than one-fourth of the caliber of the vessels carrying blood directly to the brain, consequently the dog not inoculated was subject to the influence of one-fourth only of the quantity of the poison which was conveyed to the *brain alone* of the inoculated animal. Farthermore, I would add, that it is not too much to suppose that the circulation of the blood through the tube would not be so free as through the artery. Another objection to this experiment has been raised by Mr. Blake, (*Edinb. Med. and Surg. Journ.* vol. liii. p. 48.) who asserts, that as "soon as the poison begins to exert its influence on either animal, the pressure in its arterial system will be diminished; and thus, far from the blood containing the poison being sent to the brain of the sound animal, the only effect of the arrangement will be to cause a reflux of pure blood from the arteries of the sound dog into those of the poisoned one."

How do Medicines and Poisons, which have entered the blood-vessels, affect distant organs?—Viewing the question theoretically, we can conceive three ways, by one or more of which remote parts might become affected after medicinal globules have passed into the blood.

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

In the first place, it must be admitted that in many diseases the properties of the blood are altered, and in some cases these alterations often appear to be primary; that is, they precede alterations of the solids.—Secondly, in some diseases the blood acquires poisonous properties, and is capable of transmitting the affec-

tion of the individual from whom it was taken.—Thirdly, by the use of poisons, medicines, and particular kinds of diet, the properties of the blood become altered, while at the same time the condition of the solids is modified. Now as from the food is formed the chyle, from the chyle the blood, and from the blood the solids, a necessary connexion must exist between the quality of the ingesta and the condition of the solids. For facts and arguments relative to these positions, I must refer to Andral's work before quoted.

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

In some cases the action is mechanical, as when air is introduced into a vein. "A very small quantity of air," says Magendie, (*Lancet*, Nov. 15, 1834.) passed slowly into a vein, mixes with the blood, traverses the lungs, and is exhaled with the pulmonary transpiration, without causing any remarkable accident; but when the quantity is increased, especially in a sudden manner, the air mixes with the blood contained in the heart, and forms with it a foamy kind of liquid, which does not pass readily through the capillary system of the pulmonary artery. In consequence of this obstacle to the passage of the blood through the lungs, the respiration and circulation become necessarily troubled, and the animal soon dies in a state of asphyxia,—not from any pernicious action of the air on the nervous system."[1] Water, when introduced into the circulation, probably acts merely as a diluent. For though when mixed with blood out of the body it causes a change in the condition of the red blood disks, we can hardly suspect that it produces a similar effect within the blood-vessels, from the circumstance that large quantities of water may be thrown into the veins without causing any remarkable disorder of system; whereas, if the disks were altered, great disorder of the system might be expected. Solutions of various substances (as sal ammoniac, chloruret of sodium, carbonate of potash, sugar, &c.) produce no obvious change in the disks out of the body.

Some substances exercise a chemical action on the blood; as the mineral acids, the alkalis, various metallic salts, alcohol, &c. The affinity of these agents is principally directed to the fibrin and albumen of the liquor sanguinis, and to the constituents of the blood disks. Hydrocyanic acid even would appear to be a chemical agent, since it makes the blood oily, fluid, and bluish in colour. Such substances, therefore, as exercise a chemical influence, cause speedy death when they are thrown into the veins, unless, indeed, the quantity introduced be very small. It is possible that organic substances may, as Dr. Christison supposes, be decomposed in the blood, without that fluid undergoing any apparent change. "A very striking proof of this is furnished by oxalic acid. Dr. Coindet and I, in one of our experiments, injected into the femoral vein of a dog eight grains and a-half of oxalic acid, which caused death in thirty seconds. Here it was impossible that the poison could have passed off by any of the excretions; yet we could not detect even that large proportion in the blood of the iliac vein and vena cava, collected immediately after death. As the blood possessed all its usual properties, we must suppose that the poison underwent decomposition in consequence of a vital process carried on within the vessels." (*Treatise on Poisons*, 3d. ed. p. 16.) Liebig (*Organic Chemistry.*) has suggested another mode by which medicinal agents may effect chemical changes in the condition of the blood. It is well known that the acetate of potash is converted, during its passage through the system, into carbonate of potash. Now, to undergo this alteration, it must absorb oxygen, and set carbonic acid and water free; and as there is no evidence that the system yields oxygen, Liebig assumes that the change

[1] For farther information *On the Influence of Air in the Organs of Circulation*, see Dr. J. R. Cormack's *Prize Thesis* on this subject. Edin. 1837.

takes place in the lungs. So far his opinion seems plausible. But he goes on to observe that this change in the lungs would prevent part of the oxygen inspired from performing its usual office: in other words, the arterialization of the blood would be impaired. This part of the explanation seems to me improbable.

We can readily believe that slight chemical changes may be effected in the blood disks, without our being able to demonstrate them: yet these changes may be sufficient to produce great disorder of system.

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

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

2. *By pervading the structure of the organ acted on.*—The usual mode of explaining the action of medicines after their absorption, is, that when they have got into the blood, they are carried in the ordinary course of circulation to the heart, and from thence to the lungs. Here the blood undergoes certain chemical changes, and is probably deprived of part of the medicinal particles: at least this appears to be the case with respect to certain odorous substances. The blood, still impregnated with medicinal particles, being returned to the heart, is transmitted from thence to all parts of the system. In their passage through the tissues of the different organs, it is presumed that these particles act on one or more parts which are endowed with a peculiar susceptibility to their influence. Thus the opiate particles are supposed to exert a specific influence on the cerebral tissues; strychnia is thought to act on the gray matter of the spinal marrow; mercury, on the salivary glands; diuretics, on the kidneys; and so on. Müller supposes that a change is effected on the composition of the organic matter of the part acted on. The molecules are ultimately got rid of by the excretory organs. On this supposition, then, the blood is merely the "vehicle of introduction."

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

Several objections present themselves to this explanation. Many medicinal substances may be detected in the secretion of an organ, though no evident influence has been exercised over the organ itself. Thus the colouring particles of rhubarb may be recognised in the urine, although the action of the kidneys does not appear to be altered; and, therefore, it may be said, that in those cases where the quality of the secretion is affected, we have no right to infer that it depends on the passage of medicinal particles through the secreting vessels. But we know the susceptibility of the same part is not the same to all medicines; for it is not every medicine which, when applied to the stomach, produces vomiting.

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

I have already (p. 130) alluded to another objection to this theory—namely, that injuries sometimes produce the same symptoms as poisons. But it must be recollected that, in a large number of instances, injuries do not produce the same symptoms; and in those cases where the effects of the two are analogous, I see no difficulty in assuming that there are two modes of affecting the nervous system. Moreover, we know that two different conditions of the brain may present the same symptoms.

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

The jugular vein of a full-grown dog was secured by two temporary ligatures; one of which was tied round the upper, and the other round the lower part of the exposed vein. The vessel was then divided between these two ligatures, and the truncated extremities re-connected by means of a short brass cylinder or tube (fig. 16) within which was placed a portion of woorara, of the size of a grain of canary-seed (fig. 15.) Both the temporary ligatures were then removed (fig. 17,) the accustomed circulation through the vessels was re-established, and in forty-five seconds the animal dropped on the ground, completely deprived of all power over the muscles of voluntary motion; in two minutes, convulsions and respiration had entirely ceased. This result was to be expected, whatever theory be adopted.

Fig. 15. Fig. 16. Fig. 17.

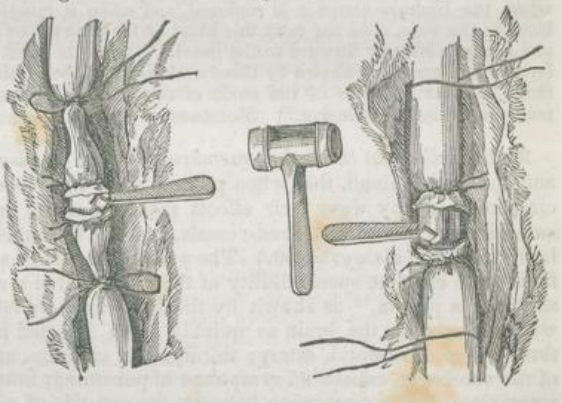
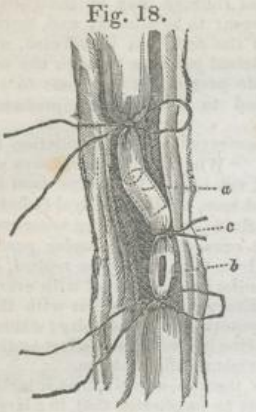


Fig. 15.—*The divided vein reconnected by a brass tube containing poison. The ligatures not yet removed.*
Fig. 16.—*Brass connecting-tube containing the poison.*
Fig. 17.—*Ligatures loosened.*

In another experiment two temporary ligatures were applied to the jugular vein, as in the former case. A cylinder of quill, containing a little woorara, was then introduced into the vein between the two ligatures; another ligature was then applied (fig. 18,) and the upper temporary ligature removed (fig. 19.) In the space of 108 seconds after the removal of the ligature, the animal dropped in convulsions, as in the former case, and expired in three minutes and a quarter. Now, in this experiment, the direct entrance of the poisoned blood into the heart, &c. was prevented by the lower ligature; hence, if the poison operated by contact with the brain, a greater length of time was necessary for its effects to be produced; inasmuch as the circulation was no longer going on through the trunk of the jugular itself, and, therefore, if the poison acted by actual contact, it must have got into the system by the vessels of the vein.

Fig. 18.



a. *Cylinder of Quill containing poison introduced into the vein by the aperture*, b; *the ligature*, c, *being afterwards applied. The ligature*, d, *not yet removed.*

Fig. 19.

Ligature, d, *unloosened;* c, *remaining.*

This experiment, however, cannot be regarded as conclusive. For although the "result is certainly different from what might have been anticipated, on the supposition of the circulation of the poison in the blood being essential to its action, yet we cannot regard it as a conclusion against that supposition, unless it were shown that the poison, when the ligature above it is removed, and when it mingles itself with the stream of blood in the vein, does not taint this blood as far back as the next anastomosing branches, and so make its way forward to the heart. That this is not the effect of removing the farther ligature is not shown by these authors; and their other experiments in favour of their peculiar doctrine of the mode of action of poisons, we have no difficulty in pronouncing to be inconclusive."[1] Moreover, the poison may act by diffusion.

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

Of all these "proofs," however, the only important, though not unobjectionable one, is the first. The validity of the second objection has been denied by Mr. Blake (see p. 138.) The second and third are merely negative; their object being to show that poisons do not act by pervading the structure of the part: and to the fourth I have before offered some objections.

In conclusion, then, I would observe, that while Messrs. Morgan and Addison have thrown some doubt over our previously received notions on the operation

[1] See a criticism in *The British and Foreign Medical Review*, vol. v. for Jan. 1837.

of medicines, it cannot be admitted that they have established their own hypothesis; and farther experiments are still required to settle this doubtful question.

In a recent discussion on the operation of poisons, at the Royal Medical and Chirurgical Society, (*Lond. Med. Gazette*, June 18, 1841.) Dr. Addison admitted that "the researches of Mr. Blake and others, had rendered the balance in some measure favourable to the theory of absorption."

CHAPTER V.—ON THE OPERATION OF MEDICINES BY NERVOUS AGENCY.

Messrs. Morgan and Addison contend, "that all poisons, and perhaps, indeed, all agents, influence the brain and general system, through an impression made upon the sentient extremities of the nerves, and not by absorption and direct application to the brain."

The circumstances which have been adduced in favour of this view, are—

1. The rapid action of some poisons.
2. The effects being disproportionate to the facility for absorption.
3. The effects of several poisons being analogous to those of severe injuries.
4. The rapidity of action not being diminished by increasing the distance of the brain from the part of the vascular system into which the poison is introduced.

1. *The rapid operation of some poisons.*—One drop of pure hydrocyanic acid, says Magendie, placed in the throat of the most vigorous dog, causes it to fall dead after two or three hurried inspirations. Sir Benjamin Brodie once happened to touch his tongue with the end of a glass rod which had been dipped in the essential oil of bitter almonds; scarcely had he done so, before he felt an uneasy, indescribable sensation at the pit of the stomach, great feebleness of limbs, and loss of power to direct the muscles, so that he could hardly keep himself from falling. These sensations were quite momentary. In the cases now quoted, the rapid action of the poisons seems almost incompatible with the idea of their absorption. Dr. Christison (*Transactions of the Royal Society of Edinburgh*, vol. xiii.) says, that two grains of conia, neutralized with thirty drops of diluted muriatic acid, being injected into the femoral vein of a young dog, stopped respiration, and with it all external signs of life, in two seconds, or three at farthest.

In this case the death appears to have been too speedy to admit of the supposition that the effect occurred in consequence of the direct contact of the poison with the brain or spinal marrow.

Mr. Blake (*Edinb. Med. and Surg. Journ.* vol. liii. p. 35.) has met this argument by declaring that poisons are not instantaneous in their action, but that sufficient time always elapses between the application of a poison and the first symptom of its action, to admit of its contact with the tissue which it affects. Thus he found, that after half a drachm of concentrated hydrocyanic acid had been poured on the tongue, eleven seconds elapsed before any morbid symptom appeared, and death did not occur until thirty-three seconds after the exhibition of the poison; and on repeating Dr. Christison's experiment, he found that fifteen seconds elapsed after ten drops of conia (saturated with hydrochloric acid) had been injected into the femoral vein of a dog, before symptoms of the action of the poison appeared; and death did not occur until thirty seconds after the injection. Now the time required for a substance to be absorbed by the capillaries, and diffused through the body, may not exceed, according to Mr. Blake, nine seconds. So that the interval which elapsed in the preceding experiments, between the application and the effect, is quite sufficient to admit of the absorption and circulation of the poison.

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

This experiment requires repetition. Even if the result be as stated by Orfila, the inference drawn from it is by no means a necessary one. As alcohol coagulates the blood when mixed with this fluid, its absorption would be more active in the dilute than in the concentrated state. Now, the secretions and contents of the stomach may, by diluting the alcohol, promote its absorption.

3. *The effects of some poisons being analogous to those of severe injuries.*—Thus, a tetanic state is produced by Strychnia as well as by a punctured wound.

As tetanus can be produced without the absorption of any thing, (as when it arises from the laceration of a nerve,) it is not necessary, it has been urged, to suppose this process in the case of strychnia. Mr. Blake (*Edinb. Med. and Surg. Journ.* vol. liii. p. 37.) has endeavoured to meet this objection by suggesting that, in the first case, the disease may arise from the propagation of some pathological state from the injured nerve to the nervous centres; for were the symptoms the mere result of the local irritation of a nerve, we might expect, he observes, to produce them at pleasure, by merely irritating the nerve; but it is well known, he adds, that this is not the case. The latter part of this statement is not quite correct; for Dr. Marshall Hall (*On the Diseases and Derangements of the Nervous System*, p. 333. Lond. 1841.) says, that "if one of the lateral nerves [of the decapitated turtle] be laid bare, and pinched continuously, the muscles of the upper extremities, as well as the lower, are forcibly contracted. This is, in my opinion, the very type of tetanus."

4. *The rapidity of action not being diminished, by increasing the distance of the brain from the part of the vascular system into which the poison is introduced.*—Messrs. Morgan and Addison found, that the woorara poison produced its effects, when thrown into the femoral artery, a few seconds sooner, than when introduced into the carotid artery. Now, if contact with the brain were necessary to the action of this poison, a longer time would be required in the former than in the latter case for the production of any morbid symptoms.

Mr. Blake, however, asserts that in his experiments he found, that the nearer to the nervous centres is the part of the vascular system into which the poison is introduced, the more rapid is its action.

CHAPTER VI.—OF THE PARTS AFFECTED BY THE REMOTE ACTION OF MEDICINES.

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

A medicine may affect a distant organ directly or indirectly. The stupor caused by Opium is presumed to arise from the direct influence exercised by this drug over the cerebrum, since it cannot be otherwise accounted for. The convulsions produced by Strychnia, on the other hand, depend on the influence which this agent exercises over the true-spinal or excito-motory system, and to its indirect action on the muscles.

Some medicinal agents and poisons confine their direct remote influence principally to one organ, and indirectly disorder the functions of other organs, through the relations which exist between the affected organ and other parts of the body. Strychnia is an example of this kind. In some cases, however, poisons appear to exercise a direct influence over several remote parts. Arsenic and Mercury are agents of this kind.

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

1. The Blood.—We can readily believe that some agents may affect the whole system by altering the qualities of the blood. I have already (See p. 133.) adduced several reasons for believing, that changes are induced in the condition of the circulating fluid by some medicinal substances. If this be admitted, we

can then readily understand how these agents affect the general system. "In fact, when all the tissues thus receive a vitiated blood, is it not consistent with sound physiology to admit, that their regular modes of vitality, nutrition, and secretion, must be more or less deeply modified? We must either admit this conclusion, or deny the influence which, according to every physiologist, the blood exerts over each solid. It may, then, happen that one or more organs are affected in a more decided manner than the rest, and there may thus be produced in them various lesions that are only accidental and secondary: but it is not in these lesions the origin of the affection lay; it is not on them all the symptoms depend; nor, lastly, is it to them alone we are to have recourse, to throw a light upon the true nature of the disease, as well as upon the treatment proper to be pursued." (Andral, *Pathol. Anat.* by Drs. Townsend and West, vol. i. p. 663.)

It is probable that Mercury, the Alkalis, and many other agents, affect the quality of the blood.

2. Cerebral and True Spinal Systems.[1]—Substances which promote sleep, as Opium, or prevent it, as Green Tea; or which disorder the mental faculties, as Alcohol; or which impair sensibility,[2] as Belladonna and Aconite, act on the cerebral system. Those agents which cause convulsions, as Strychnia; or paralysis, as Conia, affect the true spinal system.

3. Muscular System.—If the tone and irritability of the muscular fibre be, as it probably is, a direct function of the true spinal system, agents which affect these properties should properly be classed in the preceding division. At present, however, it is convenient to consider them under a separate head. Opium, Alcohol, Conia, and many other agents, diminish the irritability of the muscular fibre; while Strychnia and Brucia increase it. The substances denominated Tonics, increase the firmness and elasticity of muscles.

4. Circulatory System.—The action of the organs concerned in the circulation of the blood is affected by medicines, principally through the agency of the nervous system. Foxglove and Tobacco diminish the force of the circulation; while Alcohol, used in moderation, augments the volume and frequency of the pulse. Lead has a constringing effect on the blood-vessels. The temperature of the body is raised by agents which excite the circulation, and, *vice versâ*, it is reduced by those which lower the action of the vascular system. Diluted Acids and the Neutral Salts of the Alkalis appear to check preternatural heat, and they are, in consequence, denominated Refrigerants. Some other agents, probably, affect the calorific function by influencing respiration.

5. Respiratory System.—The action of the muscles of respiration is affected by those agents, already referred to, which either augment or lessen the irritability of the muscular system generally. Laennec[3] supposed, and probably with truth, that some cerebro-spinants (*e. g.* Belladonna and Stramonium) diminish the necessity of respiration. It is not improbable that certain medicines may, by their presence in the blood, retard or promote the process of respiration (*i. e.* the changes which the blood suffers in the lungs.) Liebig has suggested that the vegetable salts of the Alkalis (as the Acetate of Potash) do this, as I have already explained. (See p. 133.) The sensibility of the membrane lining the aerian passages is diminished by Opium and some other cerebro-spinants. The preparations of Lead, as well as Opium, check the secretions of this part;—while some substances, denominated Expectorants, appear at times to promote it. In diseases of this membrane we sometimes find the vital actions of the part modified by agents (such as Ipecacuanha and Senega) which, although they are usually denominated expectorants, do not always produce any evident increase in the

[1] These terms are used in the sense assigned to them by Dr. Marshall Hall, (see his work *On the Diseases and Derangement of the Nervous System.* Lond. 1841.)

[2] Belladonna causes dimness of sight; Aconite is a topical benumber of the nerves of touch.

[3] *A Treatise on the Diseases of the Chest*, translated by Dr. J. Forbes, pp. 77 and 99. Lond. 1827.

secretions of the bronchial membrane. Emetic Tartar and Corrosive Sublimate, when used in poisonous doses, occasion an inflammatory condition of the pulmonary tissue.

6. Digestive System.—The sensibility and the secretions of the gastro-intestinal membrane are diminished by Opium. Mercury, on the other hand, promotes the secretions of this part. It especially affects the salivary glands and the mouth, causing salivation; and, when used in large quantities, ulceration and sloughing. Belladonna and Stramonium (as well as Hyoscyamus) produce dryness of the fauces; and, when given in poisonous doses, diminish or even destroy the power of deglutition. Many substances, denominated Emetics, occasion vomiting: some of these, as Mustard, do so by their acridity; others, as Ipecacuanha and Emetic Tartar, by a specific influence over the stomach. The digestive process is readily affected by medicines. Opium checks it, and allays hunger; Condiments and the Bitter Tonics, under some circumstances, promote the appetite and digestion. In some disordered conditions of the stomach we have several medicines which often exercise a remarkably beneficial influence. Thus, Hydrocyanic Acid, Creosote, Trisnitrate of Bismuth, Magnesia, Calumba, and Effervescing Liquors, frequently allay vomiting and stomach pain. Purging is effected by the substances denominated Cathartics; and constipation by Opium. Mercury increases the secretion of the liver (and of the pancreas?)

7. Urinary System.—The sensibility of the organs composing this system is diminished by Opium, and its alkali Morphia, which cause relaxation, and, in extreme cases, paralysis of the muscular fibres of the bladder and ureters. Strychnia increases the irritability of the muscular fibres of the bladder. Cantharides occasions irritation, and, in large doses, inflammation of the bladder. Several Volatile Oils (as those of Copaiba, Turpentine, Cubebs, &c.) affect the mucous membrane of the urethra and bladder, and relieve, or cure, blennorrhagia of these parts. Uva Ursi, Buchu, and Pareira brava, evince a controlling influence over some morbid conditions of the vesical mucous membrane. The Tincture of the Sesquichloride of Iron sometimes relieves spasmodic stricture of the urethra. Drastic purgatives, especially those acting on the lower part of the bowels, irritate the urinary organs, especially the bladder. The secretion of the kidneys is augmented by certain substances, denominated Diuretics, and is lessened, in diabetes, by Opium. The Alkalis, Acids, certain Neutral Salts, Oil of Turpentine, &c. modify the quality of the urine.

8. Sexual System.—Ergot of Rye excites contractions of the uterus, by which matters contained in the cavity of this viscus are expelled. Savine operates as a stimulant to the blood-vessels and excretory apparatus of the uterus, and thereby acts as an emmenagogue. Opium dulls the sensibility of the sexual organs. Phosphorus and Cantharides have long been regarded as venereal excitants. Strychnia is said to possess a similar power.

9. Secreting and Exhaling Organs.—Mercury, the Alkalis, and Iodine, augment the activity of the secreting and exhaling organs. The Oleo-Resins, and the Balsams, stimulate the mucous surfaces. Opium diminishes the mucous secretions. Diuretics promote the secretion of urine—Diaphoretics the cutaneous exhalation—Sialogogues the saliva and buccal mucus—Emmenagogues the catamenia—Expectorants the bronchial secretion, &c.

CHAPTER VII.—OF THE GENERAL NATURE OF THE EFFECTS OF MEDICINES.

The vital actions of the system may be either changed or annihilated by medicines and poisons. The changes may be *quantitative* or *qualitative*. Agents which merely augment or lessen vital activity, effect quantitative changes, and are termed, respectively, *stimulants* and *sedatives;* while those which alter the nature of vital action occasion qualitative changes, and are the true *alteratives.*

Agents which destroy the essential composition of an organized tissue, destroy or annihilate vital action.

1. STIMULANTS.—These agents are of two kinds: *general vital stimuli*, and *special stimuli*. (Müller's *Physiology*, by Baly, vol. i. p. 59.)

α. General Vital Stimuli.—These are agents whose constant operation is essential to the maintenance of life. They are caloric, water, atmospheric air, and nutriment. They support life by effecting constant changes in the composition of the organized body.

β. Special Stimuli.—These agencies vivify or strengthen only under certain conditions. They "produce this effect by restoring the composition of the organ by their ponderable or imponderable influence, or by so changing its composition that the renovation by the general vital stimuli is facilitated. All this, however, depends on the state of the diseased organ; and the cases in which the so-called stimulant and tonic remedies have really their supposed effect, are very rare." Special stimuli may be arranged in three groups, according as their principal action is on the nervous system, the circulatory system, or the gastro-enteritic organs.

1. *Nervous Stimuli*, e. g. Alcohol.
2. *Cardiaco-vascular Stimuli*, e. g. Ammonia.
3. *Gastro-enteritic Stimuli*, e. g. Spices.

2. SEDATIVES.—These are agents whose action is the reverse of that of stimulants; hence they have been termed *Contra-stimulants*. Cold is the most unequivocal sedative. Aconite is a sedative with regard to the sensitive nerves; Digitalis, to the cardiaco-vascular organs.

3. ALTERATIVES.—These are neither stimulants nor sedatives merely. They give rise to some alteration in the nature or quality of vital action, probably by effecting a change in the composition of the organic tissues. This class includes nearly the whole of the articles comprising our Materia Medica.

1. Brunonian Theory.

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

Considered in a therapeutical point of view merely, the following objections present themselves to this theory:—

1. Many agents produce exhaustion without previously occasioning any obvious over-excitement (as the respiration of sulphuretted hydrogen or hydrocyanic acid gases.)

2. Medicines differ from each other in something more than the degree of their power; compare together the effects of foxglove, ammonia, hydrocyanic acid, cinchona, mercury, alcohol, elaterium, and opium, and the truth of this remark will be obvious.

3. The great majority of our medicines act neither as stimulants nor sedatives merely; they alter the quality of the vital actions: and this alterative effect has been quite overlooked by the Brunonians.

2. Doctrine of Contra-Stimulus.

(New Italian Doctrine.)

This doctrine is a modification of the preceding. It was advanced about the commencement of the present century by Rasori and Borda, and was subsequently adopted by Tommasini and some other distinguished Italian physicians.

It admits two classes of medicines, the one called *stimulants* or *hypersthenics*,—the other, *contra-stimulants* or *hyposthenics*. The first exalt, the second depress, the vital energies. Hence this doctrine obviates one of the objections to the hypothesis of Brown, since it admits the existence of agents possessing a positive power of reducing vital action.

The following is Professor Giacomini's[1] arrangement of medicines:—

Class I.—Hypersthenics.

Order 1. *Cardiaco-vascular Hypersthenics.* Ammonia and its Carbonate.
Order 2. *Vasculari-cardiac Hypersthenics.* The Ethers.
Order 3. *Cephalic Hypersthenics.* Opium, Morphia, and Narcotina.
Order 4. *Spinal Hypersthenics.* Alcohol, Rum, Cherry Spirit, and Wine.
Order 5. *Gastro-enteritic Hypersthenics.* Volatile Oils, Cinnamon, Cloves, and Nutmegs.

Class II.—Hyposthenics or Contra-Stimulants.

Order 1. *Cardiaco-vascular Hyposthenics.* Hydrocyanic Acid, Laurel Water, Bitter Almonds, Peach Leaves and Flowers, Black Cherries, Cantharides, Digitalis, Squills, Colchicum, White Hellebore, Cebadilla, Camphor, Peppermint, Sage, Chamomile, Venice Turpentine, Balsam of Copaiva, Juniper, Carbonic Acid, Nitre, Acetate of Potash, and Asparagus.

Order 2. *Vasculari-cardiac Hyposthenics.*

Sect. 1. *Arterial Vascular Hyposthenics.* Antimonials, Aconite, Ipecacuanha, Elder Flowers, Dulcamara, Sarsaparilla, Guaiacum, Sulphur, Sulphuret of Potash, Sulphuretted Mineral Waters, Ergot of Rye, Cinchona, Willow Bark, Iceland Moss, and Iron.

Sect. 2. *Venous Vascular Hyposthenics.* Sulphuric, Nitric, Hydrochloric, and Nitro-muriatic Acids, Chlorine, Oxalic, Citric, Acetic, and Boracic Acids, Mustard, and Scurvy-Grass.

Order 3. *Lymphatico-glandular Hyposthenics.* Mercurials, Iodine, Burnt Sponge, Bromine, Chloride of Barium, and Hemlock.

Order 4. *Gastric Hyposthenics.* Bismuth, Quassia, Calumba, Wormwood, Wormseed, Gentian, Taraxacum, and Bitters.

Order 5. *Enteritic Hyposthenics.* Tamarinds, Cassia, Prunes, Manna, Fixed Oils of Almonds, Olives, Linseed, and Castor, Cream of Tartar, Sulphates of Magnesia, Potash, and Soda, Carbonate of Magnesia, Senna, Rhubarb, Jalap, Aloes, Scammony, Purgative Elixir, Gamboge, and the Oils of Caper Spurge, and Croton.

Order 6. *Cephalic Hyposthenics.* Belladonna, Stramonium, Henbane, and Tobacco.

Order 7. *Spinal Hyposthenics.* Strychnia, Nux Vomica, St. Ignatius's Bean, Toxicodendron, Lead, Arnica, Asafœtida, and Valerian.

Contra-stimulants obviate or counteract the effects of stimulants. Thus Wine being universally admitted to be a stimulant, those agents, which relieve the inebriation produced by it, are denominated contra-stimulants. Reasoning thus, the supporters of this doctrine deny that purgatives stimulate the stomach or intestines; for though they evacuate the contents of the alimentary canal, yet their general effects are depressing. If it be objected, that their continued use causes inflammation, it is answered that the same effect is produced by the most powerful contra-stimulant,—cold; and they account for it by ascribing it to re-action, which, though a consequence of contra-stimulus, is not directly caused by it. But by the same process of reasoning, it would not be difficult to show that some of the substances which the Italian physicians denominate stimulants (as Opium,) are really contra-stimulants, since they are frequently useful in relieving excitement. Indeed, the supporters of this doctrine are by no means agreed among

[1] *Trattato filosofico-sperimentale dei Soccorsi Terapeutici.* Padova, 1833–36.

themselves as to the stimulant or contra-stimulant quality of certain medicines; for some of them regard Cinchona as belonging to the class of stimulants, others to that of contra-stimulants.

It will be obvious, from the preceding remarks, that the supporters of the doctrine of contra-stimulants disregard, or overlook, the physiological or immediate effects of medicines, but direct their sole attention to the secondary effects or consequences, which are uncertain, and often accidental; for many of the agents denominated contra-stimulants do not always, or even frequently, relieve excitement, but often have the contrary effect. The founders of this doctrine have, therefore, assembled under the same head, substances causing the most dissimilar and opposite effects; while they have separated others whose general operation is very analogous. They assume the existence of certain diseases, which they call Sthenic, because they are produced by too much stimulus, and admit the existence of contra-stimulants, because certain agents sometimes, or frequently, relieve this state. In other words, they judge of the nature of a disease by the effect of the curative means, and of the virtues of medicines by the nature of diseases. So that if a disease, now supposed to be Sthenic, should hereafter prove to be Asthenic, the medicines used to relieve it would immediately pass from the class of contra-stimulants to that of stimulants!

But the most important objection to the doctrine of contra-stimulus is, that its supporters have totally overlooked that alterative action which nine-tenths of the most important articles of the Materia Medica evince. When we attentively watch the effects of medicines, it will become manifest that few of them excite or depress merely. Their most characteristic property is that of changing or altering the quality of vital action; and, among the more active of our medicinal agents, scarcely two agree in producing the same kind of alteration. This defect in the doctrine of contra-stimulus equally applies to the doctrine of Brown; and appears, to me, to be fatal to both hypotheses.

There is, however, one part of the doctrine of contra-stimulus which is interesting, since it has led to some useful practical results. It is asserted, that the doses of contra-stimulants should be proportioned to the degree of excitement; and that, when inflammatory action runs high, the patient can bear very large doses without any obvious evacuation; the disease being subdued wholly by the contra-stimulant effect upon the solids of the body. This asserted capability of bearing increased doses has been denominated *Tolerance* of medicines; and has led to the employment of medicines in much larger doses, and at shorter intervals, than were previously ventured on; and in the case of Emetic Tartar, the practice has proved highly successful. But, if the hypothesis were true, the tolerance ought to decrease as the disease declines; which certainly does not hold good with respect to Emetic Tartar, as will be hereafter mentioned. The truth appears to be, then, that many medicinal substances may be administered with safety, and, in certain maladies, with advantage, in doses which were formerly unheard of; and for this fact we are indebted to the founders of the doctrine of contra-stimulus.[1] It must be admitted, however, that the effects of blood-letting, as observed in different diseases, favour the notion of the supporters of contra-stimulus with respect to the tolerance of remedies. It is well known that in certain maladies, as congestion or inflammation of the brain, large quantities of blood may be abstracted without causing syncope, and not only with impunity, but with benefit. In this case, therefore, the disease appears to confer a protective influence,—in other words, the state of excitement increases the tolerance of the remedy. But, on the other hand, in fever, intestinal irritation, dyspepsia, and cholera, the abstraction of a much smaller quantity of blood is attended with syncope; so that these maladies

[1] For farther information respecting the doctrine of contra-stimulus, see *Della Nova Dottrina Medica Italiana. Prolusione alle Lezioni di clinica medica per l'Anno scolastico* 1816–1817, del Professore Tommasini. Firenze, 1817. *Quarterly Journal of Foreign and British Medicine and Surgery*, vol. iv. p. 213, Lond. 1822; *The Edinburgh Medical and Surgical Journal*, vol. xviii. p. 606; and the *Lancet*, vol. ii. for 1837-38, p. 696, 779, and 862.

appear to diminish the tolerance of blood-letting. Dr. Marshall Hall has laid great stress on these facts,[1] and proposes to employ blood-letting as a diagnostic to distinguish irritation from inflammation. Thus when we are doubtful whether a disease is encephalitis or intestinal irritation, he says "we must prepare the arm, open a vein, and then place the patient upright, and let the blood flow until the lips become pallid; if the case be encephalitis, an extreme quantity of blood will flow, even thirty or forty ounces, or more, before there is any appearance of syncope; if it be intestinal irritation, syncope occurs before one-fourth of that quantity of blood has left the circulating system."[2]

Thus assuming *the degree of tolerance of blood-letting in health* to be ℥xv., he says the *augmented tolerance* in congestion of the brain will be ℥xl.-l.—in inflammation of the serous and synovial membranes, ℥xxx.-xl.—in inflammation of the parenchyma of organs, ℥xxx.—and in inflammation of the skin and mucous membranes, ℥xvi. The *diminished tolerance* in fevers and eruptive fevers, he fixes at ℥xij.-xiv.—in delirium tremens and puerperal delirium, at ℥x.-xij.—in laceration or concussion of the brain, and in intestinal irritation, at ℥viij.-x.—in dyspepsia and chlorosis, at ℥viij.—and in cholera, at ℥vi.[3]

But though I admit the general fact that some diseases augment, while others lessen the tolerance of blood-letting, yet I am by no means prepared to admit all the inferences which Dr. Hall has drawn from this. The distinction which he sometimes makes between irritation and inflammation, is oftentimes more ideal than real; as when he endeavours to show that the pleurisy caused by broken ribs is rather irritation than inflammation.[4] And, moreover, while we may fairly doubt whether blood-letting is capable of distinguishing inflammation from irritation, the propriety of resorting to so powerful an agent in doubtful cases, is fairly questionable. "In my opinion," observes my friend Dr. Billing, "before such a decided step is adopted, the physician ought to have made up his mind as to what is the nature of the disease." (*First Principles of Medicine*, p. 67, foot note, 4th ed. Lond. 1841.)

CHAPTER VIII.—ON THE CIRCUMSTANCES WHICH MODIFY THE EFFECTS OF MEDICINES.

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

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

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

b. Chemical Combination.—The soluble salts of the Vegetable Alkalis are more active than the uncombined alkalis, and *vice versâ*, the insoluble salts are less active. Lead and Baryta are rendered inert by combination with Sulphuric Acid.

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

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

α. By combining together several forms or preparations of the same substance; as when we conjoin the Tincture, Decoction, and Extract of Cinchona in one formula.

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

[1] *Researches principally relative to the Morbid and Curative Effects of Loss of Blood.* 1830.
[2] *On the Diseases and Derangements of the Nervous System*, p. 352. Lond. 1841.
[3] *Introductory Lecture to a Course of Lectures on the Practice of Physic: delivered at the Medical School in Aldersgate Street*, p. 42. London [1834.]
[4] *Lancet*, Nov. 4, 1837; and *Principles of Diagnosis, and of the Theory and Practice of Medicine*, p. 355. Lond. 1837.

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

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

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

β. By adding some substance capable of guarding the stomach or system against its deleterious effects; as when we combine Aromatics with Drastics, to correct the griping qualities of the latter;—or Opium with Mercurials, to prevent the latter affecting the bowels.

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

α. By uniting those substances which are calculated to produce the same ultimate results, although by totally different modes of operation: as when we combine Digitalis and Potash to produce diuresis,—the first acting on the absorbents, the second on the secreting vessels of the kidneys.

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

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

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

β. By combining substances which have the property of acting chemically upon each other; the result of which is, the formation of new compounds, or the decomposition of the original ingredients, and the development of their more active elements: as when solutions of Acetate of Lead and Sulphate of Zinc are mixed to procure a solution of the Acetate of Zinc: and when the Compound Iron Mixture of the Pharmacopœia is prepared.

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

V. *To afford an eligible form.*

α. By which the efficacy of the remedy is enhanced; as in the preparation of Decoctions, Infusions, Tinctures, &c.

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

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

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

e. Dose.—The modifications produced in the effects of medicines by differences of dose, are well seen in the case of Opium, Mercurials, and Turpentine.

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

a. Age.—One of the most distinctive characters of organized beings is that of undergoing perpetual mutation during the whole period of their existence; thus constituting the phenomena of age. In order the better to appreciate these changes, the life of man has been portioned out into certain periods of *ages*, as they have been termed, though as these pass imperceptibly into each other, there is no absolute or fixed distinction; and, consequently, the number of these periods

has not been generally agreed on; some admitting only three, others four, five, six, seven, or even eight; the most popular number being seven.

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

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

Years.	25	20	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Doses.	40	35	30	29	28	27	26	25	24	23	22	21	20	18	16	13	10
			Months.		11	10	9	8	7	6	5	4	3	2	1	½	
			Doses.		9		8		7		6		5	4	2	1	

Suppose the dose at the end of the first year to be 1, then at the fifth it will be 2, at the fifteenth 3, and at the twenty-fifth 4. In the above table the dose for an adult is supposed to be 40 grains. Dr. Young (*Introduction to Medical Literature*, p. 453, 2d ed. Lond. 1823.) gives the following rule for determining the doses for children under twelve years of age:—"the doses of most medicines must be diminished in proportion of the age to the age increased by 12. For example, at two years old, to $\frac{1}{7} = \frac{2}{2 + 12}$. At twenty-one, the full dose may be given." But no rule is of much value, as the degree of development is very unequal in different children of the same age. Moreover the rule that applies to one medicine will not hold good with respect to others. This is particularly obvious in the cases of Opium and Calomel: the first must be given to children with the greatest caution, and in excessively small doses, whereas the second may be given to them almost as freely as to adults. Acetate of Lead, Nitrate of Silver, Arsenious Acid, and some other metallic compounds, ought, perhaps, never to be prescribed internally for infants.

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

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

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

d. Habit.—The habitual use of certain medicinal or poisonous agents, especially narcotics, diminishes the influence which they ordinarily possess over the body. Of the truth of this statement we have almost daily proofs in those who are confirmed drunkards, chewers and smokers of tobacco, and opium-eaters. Instances of the use of enormous doses of opium, with comparatively slight effects, will be found in every work on pharmacology. One of the most remarkable I have met with, is that related by G. V. Zeviani.[1] A woman of the name of Galvani, during a period of thirty-four years, took more than *two cwt.* of solid opium! ! When nineteen years old she fell down stairs, and divided her urethra by a knife. Although the wound healed, she was unable to pass her urine in the usual way, but vomited it up daily with excruciating pain, to relieve which, she resorted to the use of opium, the doses of which were gradually increased to 200 grains daily.

[1] *Sopra un vomito Urinoso*, in the "*Memorie di Matematica e Fisica della Societa Italiana*." Verona. t. vi. 1792-4. p. 93.

Dr. Kreysig (*British and Foreign Medical Review*, vol. ix. p. 551. Lond. 1840.) has recently published a case of vomiting of a urinous liquor.

The influence of acrid or irritating substances is but little diminished by repetition,—a remark which applies especially to bodies derived from the mineral kingdom. There are, indeed, a few instances illustrative of the effect of habit in lessening the sensible influence of inorganic agents, but their number is small. The most common is the tolerance obtained by the repeated use of Tartar Emetic in peripneumonia.

Several attempts have been made to account for the effect of habit. Some ascribe it to an increased power acquired by the stomach of decomposing the medicinal agent,—an explanation adopted, in the case of poisons, by Dr. Christison, (*Treatise on Poisons.*) and which he illustrates by reference to the increased facility acquired by the stomach of digesting substances which had at first resisted its assimilative powers. If this explanation were correct, we ought to observe the effect of habit principally when substances are swallowed, and little, or not at all, when they are applied to a wound, to the cutis vera or other parts unendowed with digestive powers, and opium ought to have its usual effects in ordinary doses, on application to any part of the body of an opium eater, except to his stomach. Müller, (*Op. Cit.* p. 60.) as I have before noticed, (See p. 119.) ascribes a great number of instances of habituation to the substance affecting the composition of an organ, and losing its influence by saturation, while the part may still be susceptible of the action of another agent. But a strong objection to this hypothesis, is, that the effect of habit is observed principally in the case of narcotic vegetables, and is scarcely perceived in inorganic substances which evince the most powerful affinities for inorganic principles. The same physiologist ascribes part of the phenomena observed in the effects of habit, to the excitability of the organ being deadened by the stimulus being too often repeated.

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

Begin (*Traité de Thérapeutique*, t. ii. p. 701. Paris, 1825.) tells us, that M. Blaise, in a case of tetanus, administered, in ten days, four pounds, seven ounces, and six drachms of Laudanum, and six ounces, four drachms, and forty-five grains of solid Opium! Begin (*Op. cit.* t. i. p. 113.) endeavours to explain these facts by assuming, that the stomach acquires an increase of assimilative power, so that it is capable of digesting these enormous quantities of opium, in consequence of which the usual narcotic effects do not take place. He supports this hypothesis by stating, that if, during tetanus, opium be injected into the veins in much smaller quantities, it produces its usual effects. But if this latter assertion be correct, it does not at all warrant Begin's assumption; and, bearing in mind that opium administered by clysters during tetanus is less powerful than usual, and also taking into consideration the case related by Mr. Abernethy, I think we have evidence sufficient to warrant our non-admission of this hypothesis. All, therefore, that can be said in the way of explanation is, that in tetanus the nervous system has undergone some change, by which its susceptibility to the influence of opium is considerably diminished.

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

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

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

h. Race.—Differences of race have been supposed to give rise, in some cases, to differences in the action of medicines on the body. Thus Charvet (*De l'Action comparée de l'Opium*, p. 59. Paris, 1826.) ascribes to this circumstance the different effects of Opium on the Javanese and Malays (both belonging to the Mongolian race) as compared with those produced on Europeans, Turks, and Persians (the Caucasian race.) "The Javanese," says Lord Macartney, (*Embassy to China*, vol. i. p. 263–4. Lond. 1792.) "under the influence of an extraordinary dose of opium, becoming frantic as well as desperate, not only stab the objects of their hate, but sally forth to attack, in like manner, every person they meet, till self-preservation renders it necessary to destroy them." A similar account is given by Raynal (*Histoire Philosophique et Politique des Deux Indes*, t. 1er, p. 359. Genève, 1780.) of the effects of Opium on the Malays.

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

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

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

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

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

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

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

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

k. Idiosyncrasy.—Under this denomination are included these peculiarities which affect the functions of organs, without having any obvious relation to development, and which are not common to a number of individuals. Its effect in modifying the effects of medicines and poisons is, in general, to increase their activity. Thus, some individuals are peculiarly susceptible of the action of Opium, some of Mercury, and others of Alcohol. The odour of Ipecacuanha will, in certain persons, produce short and difficult respiration, approaching almost to a paroxysm of asthma. The late Mr. Haden[1] has related a case in which two drachms and a-half of Tincture of Colchicum produced death: the mother of the patient was also exceedingly susceptible of the action of colchicum even in very small doses. In some instances the effect of idiosyncrasy is to diminish the activity of the medicines. Thus some persons are exceedingly insusceptible of the action of Mercury.

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

CHAPTER IX.—ON THE THERAPEUTICAL EFFECTS OF MEDICINES.

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

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

1. **By the influence of a medicine over the causes of diseases.**—This may be *direct* or *indirect*. Medicines which act directly are termed by Hufeland (*Op. supra cit.* p. 19.) *specifica qualitativa*. As examples, the Chemical Antidotes may be referred to. Those anthelmintics (as Oil of Turpentine,) which poison intestinal worms, also belong to this division. If the efficacy of Sulphur in the cure of itch depend on its destroying the *Acarus Scabiei*, this will be another instance of the direct operation of an agent on the cause of a disease. As an example of a medicine acting *indirectly*, I may mention the dislodgement of a biliary calculus, contained in the ductus choledochus, by the administration of Ipecacuanha as an emetic: or the removal, by a Purgative, of a morbid condition of system, kept up by the presence of some depraved secretion in the bowels, the result of a previous disease.

[1] Dunglison's *Translation of Magendie's Formulary*, with Notes by C. T. Haden, Esq., p. 98, 4th ed. Lond. 1825.

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

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

a. Topical Agents.—Under this head we include Unguents or Lotions used in cutaneous diseases, ulcers, &c.; Gargles in affections of the mouth and throat; Collyria in ophthalmic diseases; and Injections into the vagina and uterus in affections of the urino-genital organs. In all such cases we can explain the therapeutic effect in no other way than by assuming that the medicine sets up a new kind of action in the part affected, by which the previous morbid action is superseded; and that the new action subsides when the use of the medicine is suspended or desisted from. Sometimes it may be suspected that the influence which certain medicines exercise in diseases of remote organs, arises from their particles being absorbed, and, through the medium of the circulation, carried to the parts affected. Thus the beneficial influence which the Turpentines occasionally exert in affections of the mucous membranes (as in gleet and leucorrhœa) may perhaps be owing to a topical influence of this kind; as also Strychnia in affections of the spinal marrow.

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

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

1. Antipathia.

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

We adopt this practice when we employ Purgatives to relieve constipation; Depletives to counteract plethora; Cold to alleviate the effects of scalds; Narcotics to diminish preternatural sensibility or pain; and Opium to check diarrhœa.

But Purgatives are not to be invariably employed in constipation, nor Opium in pain. Reference must be constantly had to the cause of these symptoms. If confinement of bowels depend on a torpid condition of the large intestines, pow-

erful purgatives may be administered with great benefit; but if it arise from acute enteritis or strangulated hernia, they will probably increase both the danger and sufferings of the patient. Again, Opium may be beneficially given to relieve the pain of colic, but it would be highly improper in all cases of acute pain, as in pleurisy.

The homœopathists object to antipathic remedies, on the ground that though the primary effects of these agents may be opposite to the phenomena of a disease, the secondary effects are similar to them. "Constipation excited by Opium (primitive effect) is followed by diarrhœa (secondary effect;) and evacuations produced by Purgatives (primitive effect) are succeeded by costiveness, which lasts several days (secondary effect.") (Hahnemann, *Organon*, § lxi.) The only mode of meeting statements of this kind is to appeal to experience. Is opium ever beneficial in diarrhœa? Are purgatives useful in any instances of constipation? The homœopathists reply to both of these questions—No. We answer—Yes. Here, then, we are at issue with them on a matter of fact.

2. Homœopathia.

The *homœopathic* (so called) from ομοιος, *like* or *similar*, and παθος, (*a disease*) method of treating diseases consists in administering a medicine capable of producing effects similar to the one to be removed, and the axiom adopted is "*similia similibus curantur*."

Hahnemann's first dissertation on homœopathy was published in 1796, in Hufeland's Journal.[1] In 1805 appeared his "*Fragmenta de viribus medicamentorum positivis*." But the first systematic account of this doctrine appeared in 1810, in a work entitled "*Organon der rationellen Heilkunde*."

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

The author of the fifth book, Επιδημιων, attributed to Hippocrates, speaks of a patient attacked by the most violent cholera, and who was cured solely by White Hellebore; which, according to the observations of Forestus, Ledelius, Reimann, and many others, produces of itself a kind of cholera. The English sweating sickness of 1415, which was so fatal that it killed 99 out of 100 affected with it, could only be cured by the use of Sudorifics. Dysentery is sometimes cured by Purgatives. Tobacco, which causes giddiness, nausea, &c. has been found to relieve these affections. Colchicum cures dropsy, because it diminishes the secretion of urine, and causes asthma in consequence of exciting dyspnœa. Jalap creates gripes; therefore it allays the gripes, which are so frequent in young children. Senna occasions colic; therefore it cures this disease. Ipecacuanha is effectual in dysentery and asthma, because it possesses the power of exciting hemorrhage and asthma. Belladonna produces difficult respiration, burning thirst, a sense of choking, together with a horror of liquids when brought near the patient; a flushed countenance, eyes fixed and sparkling, and an eager desire to snap at the by-standers; in short, a perfect image of that sort of hydrophobia which Sir Theodore de Mayerne, Münch, Buchholz, and Neimicke, assert they have completely cured by the use of this plant. When, indeed, Belladonna fails to cure canine madness, it is attributable, according to Hahnemann, either to the remedy having been given in too large doses, or to some variation in the symptoms of the particular case, which required a different specific—perhaps Hyoscyamus, or Stramonium. Drs. Hartlaub and Trinks have subsequently added another homœopathic remedy for hydrophobia—namely, Cantharides. Opium cures lethargy and stupor, by converting it into a natural sleep. The same substance is a cure for constipation. Vaccination is a protection from small-pox, on homœopathic principles. The best application to frost-bitten parts is Cold, either by the use of some freezing mixture or by rubbing the part with snow. In burns

[1] See the *Preface to the English Translation of the "Organon."*

or scalds the best means of relief are the exposure of the part to Heat, or the application of heated Spirit of Wine or Oil of Turpentine.

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

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

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

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

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

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

Hahnemann gravely asserts, that the length of time a powder is rubbed, or the number of shakes we give to a mixture, influences the effect on the body. Rubbing or shaking is so energetic in developing the inherent virtues of medicines, that latterly, says Hahnemann, "I have been forced, by experience, to reduce the number of shakes to two, of which I formerly prescribed ten to each dilution." (*Organon.*) In mixing a powder with sugar, the exact period we are to rub is, therefore, laid down: in dissolving a solid in water, we are told to move the phial "*circa axin suam*," and at each attenuation to shake it *twice*—"*bis, brachio quidem bis moto, concute.*" (See Dr. Quin's *Pharmacopœia Homœopathica.*)

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

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

2dly. In many cases homœopathic remedies would only increase the original disease; and we can readily imagine the ill effects which would arise from the exhibition of Acrids in gastritis, or of Cantharides in inflammation of the bladder, or of Mercury in spontaneous salivation.

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

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

3. Allopathia.

The *allopathic*, (so called from αλλος, *another*, and παθος, *a disease*,) or *heteropathic* method, consists in the employment of medicines which give rise to phenomena altogether different or foreign (neither similar nor exactly opposite) to those of the disease.

Under this head is included that mode of cure effected by what is called *Antagonism* or *Counter-irritation;* that is, the production of an artificial or secondary disease, in order to relieve another or primary one. It is a method of treatment derived from observation of the influence which maladies mutually exert over each other. For example, it has been frequently noticed, that if a diarrhœa come on during the progress of some internal diseases, the latter are often ameliorated, or perhaps rapidly disappear, apparently in consequence of the secondary affection. The result of observations of this kind would naturally be the employment of alvine evacuants in other analogous cases where diarrhœa did not spontaneously take place: and this practice is frequently attended with beneficial results. The appearance of a cutaneous eruption is sometimes a signal for the disappearance of an internal affection; and *vice versâ*, the disappearance of a cutaneous disease is sometimes followed by disorder of internal organs. Here, again, we have another remedy suggested, namely, the production of an artificial disease of the skin, as by Blisters, by an ointment containing Tartar Emetic, or by other irritating applications;—a suggestion, the advantage of which experience has frequently verified. I might bring forward numerous other examples to prove the fact, (which, however, is so well known as to require little proof,) that action in one part will often cease in consequence of action taking place in another. Diseases, then, appear to have what Dr. Pring (*An Exposition of the Principles of Pathology*, p. 352, *et seq.* Lond. 1823.) calls a *curative relation* with respect to each other: and we shall find that the greater part of our most valuable and certain remedies operate on the principle of antagonism or counter-irritation; that is, they produce a secondary disease which is related to

the primary one. Dr. Parry (*Elements of Pathology and Therapeutics*, 2nd edit. 1825.) calls this the "*cure of diseases by conversion.*"

Vomiting is a powerful means of relief in bubo, as well as in swelled testicle. Mr. Hunter says, he has seen bubo cured by a vomit. I have frequently seen the progress of swelled testicle, in gonorrhœa, stopped by the exhibition of full doses of Tartar Emetic. Now, it is very improbable that the benefit arises from the mere evacuation of the contents of the stomach. The only plausible explanation to be offered, is, that the Emetic sets up a new action in the system, which is incompatible with that going on in the groin or in the testicle. If this notion be correct, Emetics act in these cases as counter-irritants. The efficacy of Purgatives, in affections of the head, is best accounted for by supposing that they operate on the principle of counter-irritation. Blisters, Cauteries, Issues, Moxa, and other remedies of this kind, are generally admitted to have a similar mode of operation. Even the efficacy of Blood-letting, in inflammatory affections, is better explained by assuming that this agent induces some new action incompatible with the morbid action, than that it is merely a debilitant. The immediate effect sometimes produced on disease, by this remedy, is so remarkable as hardly to admit of the supposition of its acting as a mere weakening agent. One full blood-letting will sometimes put an immediate stop to ophthalmia; and I have seen, even while the blood was flowing, the vascularity of the eye diminish, and from that time the disease progressively declined. When to this fact we add, that the same disease is often successfully treated by other different, and even opposite remedies, such as Mercury and stimulant applications, we find a difficulty in explaining their beneficial agency, except by supposing that they influence disease by some relation common to all of them. This view of the counter-irritant operation of blood-letting is supported by Dr. Clutterbuck, (*Lectures on the Theory and Practice of Physic*, published in the *Lancet*, vol. x. 1826.) Dr. Pring, (*Op. cit.* pp. 465–8.) and others. The term *counter-irritant* is, however, objectionable, since literally it expresses that the secondary disease should be a state of irritation,—a term hardly applicable to the condition caused by blood-letting. But this, as well as other remedial agents, (mental impressions, for example,) agrees with the counter-irritants, commonly so called, (blisters, &c.,) in influencing diseases only by an indirect relation; it would be better, therefore, either to extend the meaning of the term counter-irritant, or to employ some other, such as *counter-morbific*.

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

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

Using the term counter-irritation in its most extended sense, we see our list of agents producing this effect is a most extensive one. It comprehends Emetics, Purgatives, Diffusible Stimulants, Mercury, Blisters, Cauteries, Issues, Setons, Moxa, Blood-letting, (including Arteriotomy, Venesection, Cupping, and Leeches,) Irritating Lavements, Frictions, Sinapisms, Rubefacients, the Hot and Cold Baths, and even Mental Impressions. That is, all these agents excite some action in the system which has a relation (oftentimes beneficial) with the morbid action: to use Dr. Parry's words, these agents cure disease by *conversion*.

The most unsatisfactory part of the subject is, the theory or hypothesis of the manner in which the mutual relations of diseased actions are effected. Dr. Parry presumes most diseases consist in local determinations of blood, and that it is a law of the human constitution that excessive morbid determination to two different parts shall not exist in the same person at the same time. Neither of these assumptions, however, is quite correct; but, if both were true, they still leave untouched the question, how determination of blood to one organ is cured by producing a determination to another. To account for it, some assume that the

system can produce only a certain quantity of nervous energy, and that as, in every disease, there is an undue or preternatural distribution of nervous energy, so the production of an artificial disease in one part must, by consuming the nervous energy, diminish the disease in another. But the whole hypothesis is grounded on assumptions perfectly gratuitous and incapable of proof. As Dr. Pring justly observes, were this hypothesis true, it would lead us to employ, not bleeding, purgatives, blisters, and all indirect remedies in hepatitis or consumption, but the exercise of the treadmill for a few hours; so that a patient, labouring under phrenitis or pneumonia, should be made to walk fifteen or twenty miles a day, by which it would be presumed, so much nervous energy would be consumed in the arms and legs, that there could not possibly be any preponderance or excess in any other seat.

Let us, then, discard absurd hypotheses of this kind; and, for the present, be content with the knowledge of the fact, that one disease, whether artificially or spontaneously generated, will often, but not invariably, supersede another.[1]

The *Antagonisms* of determinations of blood and of the secretions have been before noticed. (See p. 47.) Müller (*Elements of Physiology*, by Baly, vol. i. p. 473-4.) states, that the antagonism of the secretions is subject to the following laws:—

1. The increase of a secretion in a tissue, *a*, which is less irritable than the organ, *b*, is incapable of producing a diminution in the secretion of the latter; hence, for example, artificially excited secretions from the skin, as by a blister, in the neighbourhood of the eye, in inflammation of the latter organ, are of no service, because the eye is a more irritable part than the skin.

2. An increased secretion in a certain tissue, *a*, cannot be diminished by exciting the same secretion in another part of the same tissue, *a*; on the contrary, such a procedure would rather increase the secretion from all parts of the tissue than diminish it, because the relation which exists between the different parts of one and the same tissue is that of sympathy, not of antagonism. Hence, a discharge from the generative or urinary organs cannot be arrested by an artificially excited diarrhœa.

3. On the contrary, the secretions of tissues which do not belong to the same class of structures, often antagonize each other. Thus, increase of the cutaneous secretion frequently induces diminution of the secretion of the kidneys: in summer, the cutaneous exhalation is more abundant, and the urinary secretion proportionally scanty; in winter, the reverse is the case. Effusion of watery fluids into the cellular membrane and serous cavities is attended with dryness of the skin, and diminution of the urinary secretion, the quantity of which is observed to increase in the same proportion as dropsical effusions diminish. Suppression of the exhalation from the skin by cold, gives rise to mucous discharges from the intestinal and pulmonary mucous membranes.

4. It is only towards the termination of consumptive diseases that this relation of antagonism between the secretions ceases to exist; when, in consequence of the relaxed state of the tissues, all are at length increased in quantity; in the colliquative state that precedes death in phthisical patients, colliquative diarrhœa, profuse sweating, and dropsical effusions, take place simultaneously.

5. When one tissue is excited to increased action by an impression made upon another, either the secretion of the two must have been in some respects similar, as in the case of the skin and kidneys, both of which have the office of excreting water from the blood; or the organ thus excited must have had a predisposition to morbid action, which is the rational explanation for the circumstance, that the impression of cold produces in one person an affection of the mucous membrane of the lungs; in another, a disordered secretion of mucus in the intestinal canal.

CHAPTER X.—OF THE PARTS TO WHICH MEDICINES ARE APPLIED.

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

1. Applications to the Skin.

Medicinal applications are frequently made to the skin in order to produce local effects, as in the case of Blisters, Cataplasms, Fomentations, Lotions, Embroca-

[1] For farther information on this subject, consult Hunter's *Treatise on the Blood, Inflammation, and Gunshot Wounds*. Lond. 1794.—*Dict. des Sciences Médicales*, art. *Révulsion*, by MM. Pinel and Bricheteau.—*Dict. de Médecine*, art. *Derivatif*, by Guersent.—J. C. Sabatier, *Les Lois de la Révulsion, étudiées sous le Rapport Physiologique et Therapeutique*, Paris, 1832.

tions, &c.; and occasionally to affect remote parts of the system, as when we use Mercury. Most, if not all medicines, which influence distant organs by application to the skin, do so in consequence of their absorption; and, as the cuticle offers a mechanical impediment to this process, we generally either remove it or make use of friction.

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

1. The Enepidermic Method consists in the application of medicines to the skin, unassisted by friction; as when we employ Plasters, Blisters, Poultices, Lotions, Fomentations, Baths, &c.

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

2. The Iatraleptic Method (which has been so called from *ἰατρεύω, to cure* or *heal:* and *'αλείφω, to anoint*,) consists in the application of medicines to the skin, aided by friction. It has been termed the *epidermic method*—sometimes *anatripsologia* (from *ἀνατρίβω, to rub in;* and *λόγος, a discourse*,) and also *espongic medicine*. It was employed by Hippocrates, and other old writers; but fell into disuse, until attention was again drawn to it by Brera, Chiarenti, Chrestien, (*De la Méthode Iatraleptique*. Paris, 1811.) and others. Among the substances which have been employed in this way, are Camphor, Digitalis, Squills, Cantharides, Sulphate of Quinia, Veratria, Colocynth, Rhubarb, Opium, Belladonna, Mercury, Chloride of Gold, &c.

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

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

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

The denudation of the dermis is usually effected by a blistering plaster. When the cuticle is elevated, an opening is made into it, in order to allow the serum to

escape. The medicine is then applied to the dermis either with or without removing the cuticle. At the first dressing the transparent pellicle formed by the dermis is to be carefully removed, as it very much impedes absorption. The medicine is applied to the denuded surface, either in its pure state, in the form of an impalpable powder—or, if too irritating, it is to be incorporated with gelatine, lard, or cerate. Should any circumstances arise to lead us to fear that the quantity of the medicine applied has been too large, the mode of proceeding is the following:—Cleanse the surface immediately; make compression (as by a cupping-glass) around the denuded part, in order to prevent absorption, and apply any substance that will neutralize the effect of the medicine. Thus, Lembert has found, that two grains of the Acetate of Morphia will destroy the tetanic symptoms caused by the application of two grains of Strychnia. Musk and Camphor are said to counteract the narcotism of Morphia.[1]

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

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

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

The substances which have been used by this method are Morphia, and its Acetate, Hydrochlorate, and Sulphate, in doses of from a quarter of a grain to two grains; Strychnia, from a quarter of a grain to a grain; Aconitina, one-sixteenth to one-eighth of a grain; Extract of Belladonna, three or four grains; Sulphate of Quinia, two to six grains; Musk, six or eight grains; Tincture of Asafœtida, ten minims. Many other agents have also been employed endermically: as Digitalis, Extract of Squills, Aloes, Saffron, Bichloride of Mercury, Tartar Emetic &c.[2]

Method by Inoculation.—In connexion with the endermic method may be mentioned another mode of employing medicines; namely, the method by inoculation proposed by M. Lasargue de St. Emilion.[3] In this way Morphia has been employed to relieve topical pain. It is introduced in the part in pain by the point of a lancet. In a few minutes a papula makes its appearance and an erythematous blush.

2. Applications to the Mucous Membranes.

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

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1 Ahrensen, *Dissert. de Methodo Endermatico*. Haunia, 1836.—Reviewed in the *Brit. and Foreign Med. Review*, for April, 1838, p. 342.

2 For farther information on the endermic method, consult, besides Lembert's Essay before quoted, the article, *Endermique Méthode*, by Bouillaud, in the *Dict. de Médec. et Chirurg. pratiques;* also, some articles, by Dr. Bureaud Riofrey, in the *Continental and British Medical Review*, vol. i. pp. 66, 321, and 385; and Richter, in *Lond. Med Gaz.* Nov. 10, 1838.

3 See the *Continental and British Review*, vol. i. pp. 41 and 388; and *Lancet*, for 1836 37, vol. i. p. 826.

1. Gastro-pulmonary membrane.

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

2. Urino-genital membrane.

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

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

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

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

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

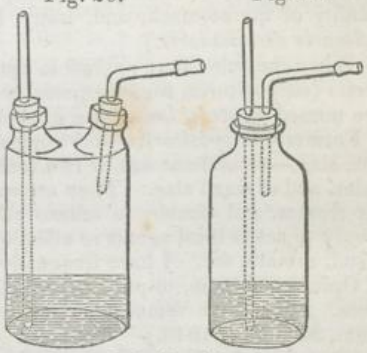
e. Aërian or tracheo-bronchial membrane.—Accidental observation, as well as experiment, has shown that medicines produce very powerful effects on the membrane lining the *trachea* and *bronchial tubes.* For the most part, applications here are made use of for local purposes, as in asthma, chronic bronchitis, phthisis, &c. though occasionally to affect the brain, the blood, the heart, &c. Dr. Myddleton[1] has advocated, in pulmonary diseases, the inhalation of substances (as Cinchona, Sulphate of Iron, Myrrh, &c.) reduced to an impalable powder. The fumes (*suffitus*) of Tar, Balsam, Resins, and other burning bodies have also been employed in these cases. Sir Alexander Crichton[2] has strongly recommended Tar Vapour; the method of using which is the following:—The Tar employed should be that used in the cordage of ships; to every pound of which half an ounce of Carbonate of Potash must be added, in order to neutralize the Pyroligneous Acid generally found mixed with the tar, the presence of which will necessarily excite coughing. The tar thus prepared is to be placed in a suitable vessel over a lamp, and to be kept slowly boiling in the chamber during the night as well as the day. The vessel, however, ought to be cleansed and replenished every twenty-four hours, otherwise the residuum may be burned and decomposed,—a circumstance which will occasion increased cough and oppression on the chest.

The inhalation of aqueous vapour (*halitus*,) either alone or with other substances, is oftentimes useful in various affections of the lungs and of the throat,

1 *A Preliminary Dissertation illustrative of a new System of Pulmonary Pathology.* Bath, 1825.
2 *Practical Observations on the Treatment and Cure of several Varieties of Pulmonary Consumption; and on the Effects of the Vapour of Boiling Tar in that Disease.* 1823.

&c. The apparatus for this purpose may be that proposed by Dr. Gairdner (*Edinburgh Medical and Surgical Journal*, vol. xix.) or Dr. Mudge's inhaler, or in the absence of these, a teapot, or basin with an inverted funnel. In many asthmatic cases the difficulty of breathing is so great, that the patient cannot close the mouth around the tube, especially if the latter be small, without exciting a sense of impending suffocation. In such instances I have found the only easy and practical method of enabling the patient to inhale is, by holding the mouth over hot water contained in a basin or tea-cup. Various narcotic and emollient herbs are sometimes added to the water, but I suspect without contributing in any way to its efficacy. The vapour of hot Vinegar, of Sulphuric Ether, of Iodine, of Camphor, and of other volatile bodies; is occasionally employed in pulmonary diseases. The vapour of Iodine may be conveniently inhaled by means of a double-necked glass-bottle (fig. 20,) into which we introduce about an inch of water, to which a few drops of the Tincture of Iodine have been added. Through one of the necks a straight glass tube passes, and dips under the surface of the water. The other neck has a short curved glass tube passing through it, by which the patient inhales. In the absence of a double-necked bottle, a common wide-mouthed bottle (fig. 21) may be used, the cork of which has two perforations, through which pass the glass tubes. Sir C. Scudamore (*Lond. Med. Gaz.* Feb. 7, 1840.) uses a saturated Tincture of Conium along with Tincture of Iodine. Chlorine gas may be inhaled in a similar manner, using a solution of the gas, or of Chloride of Lime, instead of the Tincture of Iodine. If Oxygen, or Nitrous Oxide, be inhaled, the most easy and convenient mode of effecting it is from a bladder; but for other and more complete, though more costly methods, I must refer to the works of the late Dr. Beddoes, and of the celebrated engineer, Mr. James Watt. (*Considerations on the Medicinal Uses, and on the Production of Factitious Airs.* 1796.)

Fig. 20. Fig. 21.



Inhaling Bottles.

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

g. Recto-colic membrane.—Sometimes, though less frequently than the stomach, the *rectum* is employed for the application of medicines. It has been asserted that the general susceptibility of the rectum is only one-fifth of that of the stomach, and that medicines take five times as long to operate by the former as by the latter: hence it has been said that both the dose, and the interval between the doses, should be five times as great as when applied to the stomach. But this assertion is far from being universally correct, though it may be so occasionally. Orfila asserts that those agents which operate by absorption, as Opium and Tobacco, are more active by the rectum than by the stomach; and he assigns as

a reason the greater venous absorption of the rectum, and its less digestive power. But this statement is in direct opposition to the experience of almost every practitioner. Whenever I have had occasion to employ Opium by way of enema, I always exhibit twice or three times the ordinary dose, without exciting any remarkable effects. Dr. Christison states that he has given two measured drachms of Laudanum by injection, without producing more than usual somnolency; a quantity which, if Orfila's statement were correct, would probably prove fatal.

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

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

Formerly *suppositories* were conical, or cylindrical, like a candle, and of variable size,—sometimes one or two inches long. They are now usually made globular, and of small size. They are employed to evacuate the bowels; to irritate the rectum, and thereby to relieve affections of distant organs; but more commonly to act as local agents in affections of the rectum, bladder, uterus, prostate gland, urethra, &c. I have frequently employed with great advantage a mixture of Opium and Soap, to prevent the pain of priapism during the night, in gonorrhœa. (For some remarks on Suppositories, by Dr. Osborne, see *Lond. Med. Gaz.*, March, 6, 1840.)

Clysters or *lavements* require to be considered under several points of view: *first*, in reference to the material of which they are made, and which must vary with the object for which these remedies are employed; *secondly*, with respect to the quantity of liquid used, and which will depend on the age of the patient. The average quantity for an adult is about twelve or sixteen ounces; and I believe that it is rarely proper to use more than this. I am quite sure that the practice of introducing several pints of fluid into the large intestines, with the view of exciting alvine evacuations, is bad. In the first place it often provokes the contraction of the gut, by which the injection is immediately returned; and, secondly, repeated distention diminishes the susceptibility of the part, so that the ordinary accumulation of fæcal matter no longer acts as a sufficient stimulus. Mr. Salmon (*Practical Essay on Prolapsus of the Rectum*, p. 24. Lond. 1831.) has related a case of this kind, where the patient had nearly lost all power of relieving the bowels, except by enemata or purgatives, and had produced dilatation of the rectum, in consequence of having been in the habit of introducing into the intestine two quarts of gruel twice every day. A newly-born infant requires about one fluid-ounce; a child of one to five years, from three to four ounces; and a youth from ten to fifteen, from six to eight fluid-ounces. *Thirdly*, the impulse with which the fluid ought to be thrown up, deserves attention. If too much force be used, the sudden dilatation of the gut may bring on spasmodic action of its lower part, by which the clyster will be returned. *Fourthly*, the instruments by which the injection is effected, require notice. The common pipe and bladder are too well known to require description. I am inclined to think that the most convenient, safe, and useful apparatus, is the elastic bottle and tube. Any quantity of liquid, however small, may be thrown up with the greatest ease, and without any danger of the impulse being too great. Its application is exceedingly convenient; a lusty person, by placing one foot on a stool or chair, may easily apply it without assistance; and its price is very moderate. Another form of enema apparatus

is a narrow water-proof tube, holding about a pint of liquid, about four feet long, narrower at one end, which is furnished with a common injecting pipe, and about two and a half inches in diameter at the other. The fluid being placed in the tube, the pipe is introduced into the rectum, and the apparatus held in a perpendicular direction, by which the fluid is propelled into the gut by its own gravity. This apparatus, although very simple, appears to me to be less convenient for common use than the elastic bottle, and not to be well adapted for the administration of small quantities of fluids. In the shops are sold syringes, of various forms, as enema apparatus.

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

2. Urino-genital Membrane. *a. Urethro-vesical membrane.*—Applications to the *urethra* are made only for local purposes; either in a solid form, as caustic or medicated Bougies, or in that of a liquid, as an injection: the latter is easily applied by a common syringe. Syringes of various kinds, for this purpose, are sold by Messrs. Maw, of Aldersgate Street, London.

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

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

3. Applications to the Serous Membranes.

a. Tunica vaginalis.—Irritating injections, such as Wine and Water, solutions of Metallic Salts, &c. are thrown into the cavity of the serous membrane of the testicle in hydrocele, in order to excite inflammation and the subsequent adhesion of the sides of the sac.

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

4. Applications to Ulcers, Wounds, and Abscesses.

These are employed principally to excite local effects, and sometimes, though rarely, to produce a constitutional affection. Thus it has been proposed to apply Corrosive Sublimate to wounds, with the view of causing salivation.

5. Injection of Medicines into the Veins.

(Chirurgia infusoria; Ars clysmatica nova; Infusion of medicines.)

The history of this operation is inseparably connected with that of *Transfusion*. The first experiments on infusion are said to have been performed in Germany.[1] But the first scientific examination of the operation was made by Sir Christopher Wren. (*Philosophical Transactions*, for 1665; vol. i. p. 131.) His example was followed by Boyle, Clarke, Henshaw, Lower, and others.[2]

The partisans of this method of treatment assert, that when medicines are administered by the stomach, their properties are more or less altered by the digestive powers of this viscus; and that by injecting medicines at once into the veins, we avoid this influence. This statement, however, is not accurate, since Drs. Christison and Coindet have shown that some substances are decomposed even in the blood, or at least that they cannot be recognised in this fluid. Farthermore, it has been proved that the effects are of the same general nature as when medicines are applied to the skin or stomach: thus, Tartar Emetic occasions vomiting, Senna purges, Opium stupifies, and so on. So that some of the supposed advantages of this operation have no real existence, while several objections to it exist: such as the danger of introducing air into the veins, or of throwing in too large a dose of the remedy (for a slight excess in some cases may prove fatal,) or of the occurrence of phlebitis. These, then, are sufficient reasons for not resorting to this practice, except on very urgent occasions; for example, to excite speedy vomiting when the patient is unable to swallow. Köhler (mentioned by Dieffenbach, who notices also several other analogous cases) preserved the life of a soldier, in whose throat a piece of beef tendon was sticking, by throwing a solution of six grains of Tartar Emetic into a vein of the arm: vomiting was induced, and the meat expelled. Meckel injected two grains of this salt, dissolved in water, into the veins of a woman, to restore suspended animation, from immersion in water. Lastly, cold water has been injected into the umbilical vein in cases of retained placenta. (*Brit. and For. Med. Rev.*, Jan. 1837, and Jan. 1838.)

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

[1] See Paul Scheel's work, entitled "*Die Transfusion des Bluts und Einsprützung der Arzneyen in die Adern*," Kopenhagen, 1802: Zweiter Band, 1803.

[2] For farther information on the history of this operation, consult Scheel's work, before quoted; also Dieffenbach's essay, "*Ueber die Transfusion des Bluts und die Infusion der Arzneie*, 1833: or Marx's "*Die Lehre von den Giften*," 1827 and 1829.

to, though more powerful than, those produced when these agents were administered by the stomach. To this statement, however, the Oils are an exception; for when injected into the veins in large quantities they interrupt the circulation, and produce a kind of asphyxia.

CHAPTER XI.—ON PHARMACOLOGICAL CLASSIFICATION.

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

W. Woodville, M. D. Medical Botany, 3 vols. 4to. London, 1790. A Supplement to the Medical Botany, 4to. London, 1794. [In the second edition of this work, published in 1810, the subjects were arranged according to their natural orders.—The third edition, in 1832, by Dr. Hooker and Mr. Spratt, was, in fact, the second edition with a new title and an additional volume.]

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

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

J. Stephenson, M. D. and *J. M. Churchill*, Medical Botany, 4 vols. 8vo. London, 1827–31.—2nd ed. in 3 vols., by G. Burnett, 1834–36.

Flora Medica, 2 vols. 8vo. 1827.

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

Arrangements or classifications of medicines, like those of plants,[1] may be divided into *empirical* and *rational* ones.

1. Empirical Arrangements.

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

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

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

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

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

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

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

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

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

J. A. Paris, M. D. Pharmacologia, 3rd ed. 1820. 8th edit. 1833. App. 1838.

W. Ainslie, M. D. Materia Indica, 2 vols. London, 1826.

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

[1] *Théorie Elémentaire de la Botanique*, par A. P. Decandol. Paris, 1819.

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

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

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

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

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

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

G. B. Wood, M. D. and *F. Bache*, M. D. The Dispensatory of the United States of America, 1833. 3rd. edit. 1836. 4th edit. 1839.

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

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

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

E. Winkler, Vollständiges Real Lexicon der medicinisch-pharmaceutischen Naturgeschicte und Rohwaarenkunde. Heft 1–7. 8vo. Leipzig, 1838–40.

W. T. Brande. A Dictionary of Materia Medica and Practical Pharmacy. 8vo. Lond. 1839.

2. Rational Arrangements.

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

- α. Sensible properties (colour, taste, and smell.)
- β. Natural-historical properties (external form and structure.)
- γ. Chemical properties.
- δ. Physiological effects.
- ε. Therapeutical properties.

α. Classification founded on the Sensible Qualities.

Classifications founded on the Colour, Taste, and Odour of plants are necessarily very imperfect, owing to the impossibility of defining sensations. Moreover, their use is very limited, in consequence of these properties having no necessary relation to the medicinal powers. (See p. 113.) In the best executed arrangements of this kind, the denominations of many of the classes, or orders, are objectionable;—dissimilar bodies are brought together, and similar ones separated.

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

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

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

MR. GREEVES' CLASSIFICATION.

CLASSES.	FAMILIES.	ORDERS.	EXAMPLES.
I. Inodorous and insipid	1. *Liquid*	1.	Water.
	2. *Soft*	1. Pulverescent	Creta.
		2. Unctuous	White Wax.
	3. *Hard*	1. Tough	Iron.
		2. Brittle	Antimony.
II. Inodorous and sapid	1. *Sweets*	1. Saccharine	Sugar.
		2. Amylaceous	Starch.
		3. Mucous or unctuous	Gum.
		4. Faint	Castor oil.
		5. Frugous	Tamarinds.
	2. *Bitters*	1. Mawkish	Elaterium.
		2. Astringent	Catechu and Alum.
		3. Pure bitter	Quassia.
		4. Austere	Galls.
		5. Styptic	Sulphate of Copper.
		6. Acrid	Colchicum.
		7. Salino-amare	Nitre.
	3. *Alkalines*	1.	Potash.
	4. *Acids*	1. Pure acid	Citric Acid.
		2. Saccharo-acid	Orange juice.
	5. *Salines*	1. Pure salt	Common Salt.
III. Odorous and insipid	1. *Fragrant*	1. Sweet	Yellow Wax.
		2 Aromatic	Saunder's Wood.
IV. Odorous and sapid	1. *Sweets*	1. Saccharine	Honey.
		2. Faint	Senna.
		3. Sweet-spicy	Caraway.
	2. *Bitters*	1. Mawkish	Jalap.
		2. Subastringent	Rhubarb.
		3. Bitter-spicy	Cascarilla.
		4. Sharp-bitter	Aloes.
		5. Austere	Cinchona.
		6. Subacrid	Ipecacuanha and
		7. Acrid	Copaiba. [Musk.
	3. *Acidous*	1.	Acetum.
	4. *Camphreous*	1. Camphreous aromatics	Cloves.
		2. Savoury	Pepper.
		3. Terebinthinate	Turpentine.
		4. Camphreous	Camphor.
	5. *Spirituous*	1. Vinous	Wine.
		2.	Alcohol.

β. Classifications founded on natural-historical properties.

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

1. *Of Vegetables.*

In the following works the *vegetable* substances employed in medicine are arranged according to their natural-historical properties:—

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

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

A. Richard, Botanique Médicale. Paris, 1823.

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

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

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

2. *Of Animals.*

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

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

P. L. Geiger, Handbuch der Pharmacie, 2ten Bd. 2te Hte. Heidelberg, 1829.
John Stephenson, M. D., Medical Zoology and Mineralogy. Lond. 1832.
Dr. T. W. C. Martius, Lehrbuch der pharmaceutischen Zoologie. Stuttgart, 1838.

3. *Of Vegetables and Animals.*

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

J. J. Virey, Histoire Naturelle des Médicamens. Paris, 1820.
A. L. A. Fée, Cours d'Histoire Naturelle pharmaceutique, t. ii. Paris, 1828.
A. Richard, Elémens d'Histoire Naturelle Médicale, t. iii. Paris, 1831–35.
J. Johnstone, M. D. A Therapeutic Arrangement and Syllabus of Materia Medica. 12mo. London, 1835.
E. Soubeiran, Nouveau Traité de Pharmacie théorique et pratique, t. ii. Paris, 1836. 2nde éd. 1840.

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

4. *Minerals.*

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

F. Mohs, Treatise on Mineralogy, translated by W. Haidinger. 3 vols. Edinburg, 1825.
Robert Allan, Manual of Mineralogy. Edinb. 1834.

Modern crystallographers[1] arrange crystalline forms in six groups called *systems*, each of which comprehends all those forms having axes equal in number, in length, and in direction. These six systems may be conveniently arranged in two classes.

CLASSIFICATION OF CRYSTALS.

CLASS I.

Characters.—*Geometric;* Three rectangular and equal axes. *Optical;* Refraction single. *Thermotic;* Expansion by heat equal in all directions.

☞ As the refraction of this class is single, the crystals present no rings when tested by polarized light.

SYSTEM 1.—THE REGULAR SYSTEM.

(Tessular System, *Mohs:* Octohedral System, *Miller.* Tetrahedric, Cubic, Equal-membered, or Equal-axed System.)

Characters.—Those of the class.

Forms.—The homohedral forms of this system are seven; namely, the *Regular Octohedron*, the *Hexahedron* or *Cube*, the *Dodecahedron*, the *Ikositetrahedron*, the *Triakisoctohedron*, the *Tetrakishexahedron*, and the *Hexakisoctohedron*. The hemihedral forms are five; namely,

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[1] For farther details the reader is referred to the following works:—

1. *Elemente der krystallographie, nebst einer tabellarischen Uebersicht der Mineralien nach den krystallformen*, von Gustav Rose. Zweite Auflage. Berlin, 1838. [A French translation of the first edition was published in Paris, 1834.
2. *A Treatise on Crystallography*, by W. H. Miller, M. A. F. R. S &c. Cambridge, 1839.
3. *A System of Crystallography, with its application to Mineralogy*, by John Joseph Griffin. Glasgow, 1841.
4. *Encyclopædia Metropolitana*, art. *Crystallography*, by Mr. Brooke.
5. *Tabelle über die natürlichen Abtheilungen derverschiedenen Crystallisationssysteme.* Nach Prof. C. S. Weiss, für Vorlesungen zusammengestellt und durch Figuren erläutert von Dr. J. T. C. Ratzeburg.
6. *Le Regne Minéral ramené aux Méthodes de l'Histoire Naturelle*, par L. A. Necker, tome 2. Paris, 1835.

the *Hemioctohedron* or *Tetrahedron*, the *Hemi ikositetrahedron* or *Pyramidal Tetrahedron*, the *Hemitriakisoctohedron*, the *Hemihexakisoctohedron*, and the *Hemitetrakishexadron*.

Fig. 22. Octohedron.

Fig. 23. Dodecahedron.

Fig. 24. Cube.

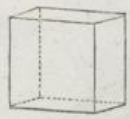
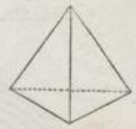


Fig. 25. Hemioctohedron or Tetrahedron.



Examples.—The following substances belong to this system:—

Bismuth.	Platinum.	Chloride of Silver.
Copper.	Silver.	Bromide of Potassium.
Gold.	Diamond.	Iodide of Potassium.
Iron.	Phosphorus.	Arsenious Acid.
Lead.	Sal Ammoniac.	Alum.
Mercury.	Chloride of Sodium.	

CLASS II.

Characters.—*Geometric;* Not three rectangular and equal axes. *Optical;* Refraction double. *Thermotic;* Expansion not equal in all directions.

☞ As the refraction of this class is double, the crystals present, in certain directions, rings when tested by polarized light.

SYSTEM 2.—SQUARE PRISMATIC SYSTEM.

(Pyramidal System, *Mohs*, and *Miller*. The 2- and 1-axed System, *Rose*. The 4-membered System.)

Characters.—*Geometric;* Axes three, rectangular; only two equal. *Optical;* Refraction double in all directions except one, (one axis of double refraction.) *Thermotic;* Expansion equal in two rectangular directions; but unequal to these in the third rectangular direction.

☞ As the crystals of this system have only one axis of double refraction, they present a single system of rings, intersected by a cross, when tested by polarized light. (See figs. 29 and 30.)

Forms.—To this system belong the *Octahedron with a Square base*, and the [*Right*] *Square Prism*.

Fig. 26. Square Octohedron.

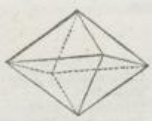
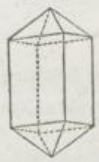


Fig. 27. Square Prism.

Fig. 28. Combination of the Octohedron and Prism.



Examples.—the following substances belong to this system:—

Calomel. | Bicyanide of Mercury. | Ferrocyanide of Potassium.

SYSTEM 3.—RHOMBOHEDRIC SYSTEM.

(Rhombohedral System, *Miller*. The 3-&-1-axed System, *Rose*.)

Characters.—*Geometric;* Axes four; three equal to one another, and placed in one plane, crossing at angles of 60°; the fourth axis differs from the others in length, and is placed perpendicular to all of them. *Optical;* Refraction double in all directions except one, (one axis of double refraction.) *Thermotic;* Expansion equal in the directions of the three equal axes, but unequal to that of those in the direction of the fourth axis.

☞ As the crystals of this system, like those of the preceding system, have only one axis of double refraction, they present a single system of rings, intersected by a cross, when tested by polarized light, as in Calcareous Spar. (See figs. 29 and 30.)

Single system of rings seen by looking through a slice of Calcareous Spar (cut penpendicular to the axis of the crystal) placed between two plates of Tourmaline (cut parallel to the axis of the crystal.)

Fig. 29. Fig. 30.

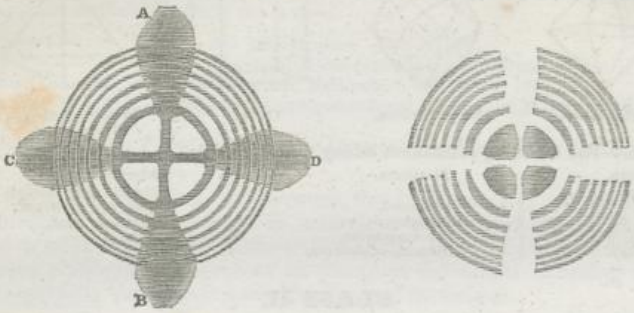
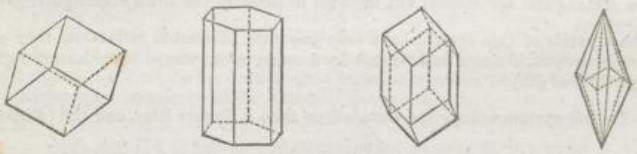


Fig. 29 is seen when the plane of the axis of the Calcareous Spar is parallel or perpendicular to the plane of polarization.
A, B, C, and D, are the arms of the black cross.
Fig. 30 is seen when the Calcareous Spar is turned 45° to the preceding positions.

Forms.—To this system belong the *Hexagondodecahedron*, the *Rhombohedron* (frequently called a Rhomboid) or *Hemidodecahedron*, the *Hexagonal Prism*, and the *Hemididodecahedron* or *Scalenohedron*.

Fig. 31. Fig. 32. Fig. 33. Fig. 34.



Rhombohedron. Hexagonal Prism. Combination of the Rhombohedron with the Hexagonal Prism. Scalenohedron.

Examples.—The following substances belong to this system:—

Antimony.	Cinnabar.	Carbonate of Zinc.
Arsenicum.	Chloride of Calcium.	Dolomite.
Plumbago.	Calcareous Spar.	Nitrate of Soda.
Ice.	Cabonate of Iron.	Hydrate of Magnesia.

SYSTEM 4.—RIGHT PRISMATIC SYSTEM.

(Prismatic System, *Miller*. The 1-&-1-axed System, *Rose*.—The 2-&-2-membered System.)

Characters.—*Geometric;* Axes three, rectangular, all of different lengths. *Optical;* Refraction double in all directions except two (two axes of double refraction.) *Thermotic;* Expansion relatively unequal in the directions of all the axes.

☞ As the crystals of this system have two axes of double refraction, a double system of rings, intersected by bands, is seen when they are tested by polarized light. (See figs. 35 and 36.)

Double system of rings seen by looking through a slice of Nitre (cut perpendicularly to the axis of the crystal) placed between two plates of Tourmaline (cut parallel to the axis of the crystal.)

Fig. 35. Fig. 36.

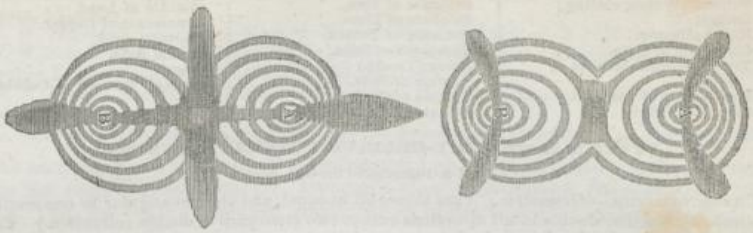
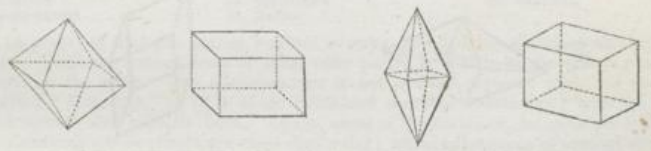


Fig. 35 is seen when the plane of the axis of Nitre is parallel or perpendicular to the plane or polarization.—Fig. 36 is seen when the Nitre is turned 45° to either of these planes.

Forms.—To this system belong the *Octohedron with a Rectangular base*, the *Right Rectangular Prism*, the *Octohedron with a Rhombic base*, and the *Right Rhombic Prism.*

Fig. 37. Fig. 38. Fig. 39. Fig. 40.



Octohedron with a Rectangular base. Right Rectangular Prism. Octohedron with a Rhombic base. Right Rhombic Prism.

Examples.—The following substances belong to this system:—

Iodine.	Carbonate of Lead.	Bisulphate of Potash.
Sulphur (native.)	Carbonate of Baryta.	Nitrate of Silver.
Pyrolusite (Binoxide of Manganese.)	Carbonate of Ammonia.	Nitrate of Potash.
White Antimony (Sesquioxide.)	Arragonite.	Bitartrate of Potash.
Bichloride of Mercury.	Sulphate of Potash.	Rochelle Salt.
Chloride of Barium	Sulphate of Magnesia.	Emetic Tartar.
Sesquisulphuret of Antimony.	Sulphate of Zinc.	Citric Acid.
Orpiment.	Sulphate of Baryta.	Morphia.
	Sulphate of Strontian.	

SYSTEM 5.—OBLIQUE PRISMATIC SYSTEM.

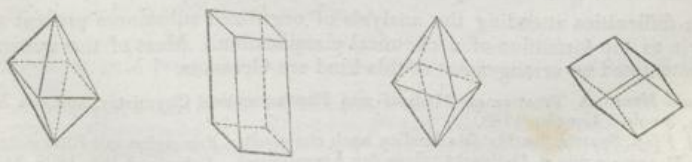
(The 2-&-1-membered System, *Rose.*)

Characters.—*Geometric;* Axes three, all unequal; two of them cut one another obliquely, and are perpendicular to the third. *Optical;* Refraction double in all directions except two (two axes of double refraction.) *Thermotic;* Expansion, in the direction of the axes, relatively unequal.

☞ As the crystals of this, like those of the preceding system, have two axes of double refraction, a double system of rings, intersected by bands, is seen, when they are tested by polarized light.

Forms.—To this system belong the *Oblique Octohedron with a Rectangular base*, the *Oblique Rectangular Prism*, the *Oblique Octohedron with a Rhombic base*, and the *Oblique Rhombic Prism.* Mr. Brooke (*Encyclopædia Metripolitana*, art. *Crystallography.*) refers the *Right Oblique-angled Prism* to this group.

Fig. 41. Fig. 42. Fig. 43. Fig. 44.



Oblique Octohedron with a Rectangular base. Oblique Rectangular Prism. Oblique Octohedron with a Rhombic base. Oblique Rhombic Prism.

EXAMPLES.—The following substances belong to this system:—

Sulphur (by slow cooling.)	Sulphate of Iron.	Acetate of Lead.
Realgar.	Sulphate of Lime.	Binacetate of Copper.
Red Antimony.	Chlorate of Potash.	Tartaric Acid.
Carbonate of Soda.	Phosphate of Soda.	Oxalic Acid.
Trona (Sesquicarbonate of Soda.)	Borax (Tincal.)	Sugar.
Bicarbonate of Potash.	Acetate of Soda.	Crystals from oil of Cubebs.
Sulphate of Soda.	Acetate of Copper.	
	Acetate of Zinc.	

SYSTEM 6.—DOUBLY-OBLIQUE PRISMATIC SYSTEM.

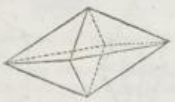
(The 1-&-1-membered System, *Rose.*)

CHARACTERISTICS.—*Geometric;* Axes three, all unequal, and oblique-angular to one another. *Optical;* Refraction double in all directions except two (two axes of double refraction.) *Thermotic;* Expansion in the direction of the axes relatively unequal.

☞ The crystals of this system present a double system of rings, intersected by bands, when they are tested by polarized light.

FORMS.—To this system belong the *Doubly Oblique Octohedron* and the *Doubly Oblique Prism.*

FIG. 45.



Doubly-Oblique Octohedron.

FIG. 46.

Doubly-Oblique Prism.

EXAMPLES.—The following substances belong to this system:—

Boracic Acid.	Sulphate of Cinchonia.
Nitrate of Bismuth.	Gallic Acid.
Sulphate of Copper.	

1. ARTIFICIAL METHOD OF LINNÆUS.—This appears to me the best place for noticing those pharmacological works in which the Linnæan artificial method of arranging plants is followed.

Car. A. Linné, Materia Medica, ed. 4a. curante *J. C. D. Schrebero.* Lipsiæ et Erlangæ, 1782.
P. J. Bergius, Materia Medica e Regno vegetabili, 2 tom. ed. 2nda. Stockholmiæ, 1782.
P. L. Geiger, Handbuch der Pharmacie, 3tte. Aufl. 2 Bde. Heidelberg, 1830.

2. METHODS FOUNDED ON THE PARTS OF ORGANIZED BEINGS EMPLOYED.—In some works the vegetable and animal substances employed in medicine are classified according to the parts used; as barks, roots, seeds, secretions, &c.

R. A. Vogel, Historia Materiæ Medicæ. Ludg. Batav. and Lipsiæ, 1758.
C. Alston, M. D. Lectures on the Materia Medica, 2 vols. London, 1770.
J. C. Ebermaier, M. D. Taschenbuch der Pharmacie. Leipzig, 1809.
N. J. B. G. Guibourt, Histoire abrégée des Drogues simples, 2de éd. Paris, 1826; 3me éd. 1836.
Dr. F. Goebel and Dr. G. Kunze, Pharmaceutische Waarenkunde. Eisenach, 1827–29.
Dr. T. W. C. Martius, Grundriss der Pharmakognosie des Pflanzenreiches. Erlangen, 1832.

γ. Classifications founded on the Chemical Constituents.

The difficulties attending the analysis of organized substances present a great obstacle to the formation of a chemical classification. Most of the writers who have attempted an arrangement of this kind are Germans.

Donald Monro, A Treatise on Medical and Pharmaceutical Chymistry, and the Materia Medica, 3 vols. London, 1788.
C. H. Pfaff, System der Materia Medica nach chemischen Principien mit Rücksicht auf. d. sinnl. Merkmale und d. Heilverhältnisse der Arzneimittel. Leipzig, 7 Bde, 1808–24.
F. A. C. Gren: Handbuch der Pharmacologie, 3te Aufl. herausgegeben von *Bernhardi* und *Buchholz*, 2 Bde. Halle u. Berlin, 1813.

F. G. Voigtels, Vollständ. System der Arzneymittellehre, herausgegeben von *Kühn*, 4 Bde. Leipzig, 1816–17.

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

G. W. Schwartze, Pharmacologische Tabellen, oder systematische Arzneimittellehre in tabellarischer Form. Leipzig, 1819–25. 2 Aufl. fol. 1833.

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

L. A. Kraus, Wissenschaftliche Uebersicht der gesammten Heilmittellehre. Götting. 1831.

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

SCHWARTZ'S CLASSIFICATION.

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

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

δ. Classifications founded on the Physiological Effects of Medicines.

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

Physiological classifications are variously formed. Those that I am acquainted with may be reduced to six groups, or classes. Thus, they may be formed:—

1. According to the General Quality of the Effects.
2. According to Brunonian Principles.
3. According to the Doctrine of Contra-Stimulus.
4. According to the Doctrine of Broussais.
5. According to Chemico-Physiological Principles.
6. According to the Part affected.

1. *According to the General Quality of the Effects.*

These arrangements are founded on the *nature*, *quality*, or *general character* of the effects; as in the following works:—

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

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

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

J. Arnemann, Chirurgische Arzneimittellehre, 6te Aufl. von A. Kraus. 1818.

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

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

J. B. G. Barbier, Traité Elémentaire de Matière Médicale, 2nde éd. 3 tom. Paris, 1824;—4e éd. 1837.

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

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

H. M. Edwards, and *P. Vavasseur*, M. D. Manuel de Matière Médicale. Paris, 1826.—English Translation, by Davis, 1831.

C. Sundelin, Handbuch der speciellen Heilmittellehre, 2 B^de. 3^te Aufl. 1833.

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

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

J. Wendt, Praktische Materia Medica. Breslau, 1830. 2^te Aufl. 1833.

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

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

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

A. Trousseau et H. Pidoux, Traité de Thérapeutique. Paris, 1^er tom. 1836; 2^nd tom. 1^re part. 1837; 2^e part. 1839.—2^e éd. 1841.

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

As examples of this kind of classification, I subjoin those of Dr. Duncan and Sundelin:—

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

External Agents act,

I. By nourishing the body ..... ALIMENTA.
  (*a*) Drink ..... POTUS.
    When they act medicinally ..... DILUENTIA.
  (*b*) Food ..... CIBI.
    When they act medicinally ..... DEMULCENTIA.

II. By evacuation ..... EVACUANTIA.
  (*a*) By the skin insensibly ..... DIAPHORETICA.
  ——— sensibly ..... SUDORIFICA.
  (*b*) By the mucous membrane
    Of the nostrils ..... ERRHINA.
    Of the lungs ..... EXPECTORANTIA.
    Of the stomach ..... EMETICA.
    Of the intestines ..... CATHARTICA.
    Of the uterus ..... EMMENAGOGA.
  (*c*) By glandular secretion
    The kidneys ..... DIURETICA.
    The salivary glands ..... SIALOGOGA.

III. By exciting the vital powers ..... STIMULANTIA.
  (*a*) Chiefly of the parts to which they are applied ..... TOPICA.
    Applied externally
      Causing redness ..... RUBEFACIENTIA.
      ——— serous secretion ..... VESICANTIA.
      ——— purulent secretion ..... SUPPURANTIA.
    Administered internally.
      CONDIMENTA when alimentary
        When acting medicinally ..... CARMINATIVA.
  (*b*) Of the system generally ..... GENERALIA.
    (*a*) Obscurely, but more durably ..... PERMANENTIA.
      Producing no immediate obvious effect ..... TONICA.
      Constricting fibres and congulating fluids ..... ASTRINGENTIA.
    (*b*) More evidently, but less durably ..... TRANSITORIA.
      Acting on the organic functions ..... CALEFACIENTIA.
      Acting on the mental fuctions ..... INEBRIANTIA.

IV. By depressing the vital powers ..... DEPRIMENTIA.
  Acting on the organic functions ..... REFRIGERANTIA.
  Acting on the mental functions ..... NARCOTICA.

V. By chemical influence on the fluids ..... CHEMICA.
  Acidifying ..... ACIDA.
  Alkalizing ..... ALKALINA.

A very cursory examination of the substances placed by the author under each of the above classes will satisfy the most superficial observer, that this classification does not, in a large number of instances, effect that which it proposes to do; namely, to arrange together "substances according to the effects which they produce in a state of health." For example, under the head of Diaphoretics and Sudorifics we have Mustard, Copaiva, Opium, Ipecacuanha, Alcohol, Antimony, Ammonia, and Mercury; among Narcotics are Opium, Nux vomica, Foxglove, Saffron, and Colchicum; in the class Sialogogues we have Horsera-

dish, Tobacco, and Mercury. Now, no one will pretend to affirm that the substances thus grouped together operate in an analogous manner on the system, or that their effects are similar.

SUNDELIN'S CLASSIFICATION.

A. Agents which lessen vitality, and which are adapted for an abnormal augmentation of it.

I. *Adynamic Agents adapted for genuine hypersthenia.*
- *a.* Agents diminishing the blood and fluids.
  1. Blood-letting.
  2. Antiphlogistic Purgatives.
- *b.* Adynamic agents in a strict sense,—Temperants.
- *c.* Agents which abstract heat.

II. *Relaxants adapted for abnormal tension of fibres and for augmented irritability and sensibility.*
- *a.* Oleaginous substances.
- *b.* Mucilaginous, Amylaceous, and Albuminous substances.
- *c.* Saccharine substances.

B. Alterative agents adapted for an alteration of vitality.

I. *Resolvents adapted for an alteration of Vitality from material causes.*
- *a.* Solvents.
- *b.* Absorbents.
- *c.* Liquefacients.
- *d.* Irritant resolvents.
- *e.* Strengthening resolvents.
  1. Excitants.
  2. Tonics.

II. *Evacuants adapted for Retentions.*
- *a.* Emetics.
- *b.* Purgatives.
- *c.* Emmenagogues.
- *d.* Diuretics.
- *e.* Diaphoretics.
- *f.* Diaphoretico-diuretics, or the so-called purifiers of the blood.
- *g.* Cutaneous irritants.
- *h.* Anthelmintics

III. *Alteratives adapted for altered Sensibility and Irritability.*
- *a.* Narcotics adapted for hyperæsthesis and convulsability.
  1. Depressing agents.
  2. Excitants.
  3. Resolvents.
  4. Acrids.
  5. Bitter poisons.
  6. Metallic substances.

C. Agents which augment vitality, and are adapted for apparently or actually lessened vitality.

I. *Irritants adapted for torpid debility.*
- *a.* Resolvents.
- *b.* Drastics.
- *c.* Acrids.

II. *Strengthening Agents adapted for true debility.*
- *a.* Animating, analeptics.
- *b.* Exciting - animating agents.
- *c.* Exciting - strengthening agents.
  1. Carminatives.
  2. Aromatic herbs.
  3. Powerful Excitants.
  4. Balsamics.
  5. Irritating Excitants.
  6. Empyreumatic agents.
  7. Spices.
  8. Exciting irritants.
- *d.* Tonics.
  1. Consolidating agents.
  2. Tonic Bitters.
  3. Astringents.
  4. Antiseptics.
  5. Exciting Tonics.

2. *According to Brunonian Principles.*

Some physicians have classified the articles of the Materia Medica in accordance with *Brunonian principles*. I have already mentioned that Brown regarded all medicines as stimulants; that is, as agents causing excitement. But he supposed some of them to produce less excitement than is requisite for health; and, therefore, to be the remedies for sthenic diathesis: hence they were termed *Debilitating* or *Antisthenic*. On the other hand, some agents give more excitement than suits the healthy state; and are, therefore, the remedies for the asthenic diathesis. These he called *Stimulant* or *Sthenic*. (*The Works of Dr. John Brown*, vol. ii. p. 205. 1804.) The following pharmacological works are based on Brunonian principles:[1]—

Versuch einer einfachen practischen Arzneimittellehre. Wien. 1797.

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

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

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

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

[1] *Encyclopädisches Wörterbuch der medicinischen Wissenshaften*, 3 Bd. art. *Arzneimittellehre.*

F. Wurzer, Grundriss der Arzneimittellehre. Leipzig, 1808.
J. H. Müller, Handbuch der Lebens-und Arzneimittellehre. Leipzig, 1809.
J. A. Neurohr, Versuch einer einfachen praktischen Arzneimittellehre. Zweite Aufl. Heidelberg, 1811.
K. Schöne, Praktische Arzneimittellehre für Aertze und Wundärze nach den Grundsätzen der Erregungstheorie. 2d Bde. Berlin, 1815.

3. *According to the Doctrine of Contra-Stimulus.*

I have already (see p. 142.) given a sketch of this doctrine, as well as an outline of the classification adopted in the following work:—

G. Giacomini, Trattato filosofico-sperimentale dei Soccorsi Terapeutici, 4 vols. 8vo. Padova, 1833–36.

Andral, (*Dict. de Méd. et de Chirurg. pratiq.* art. *Contre-Stimulant.*) who quotes Fanzago, Tommasini, and Gozzi, says, that the Italians divide medicines into two classes, *dynamics* and *irritants*. The first comprehends those agents which augment or depress excitability,—stimulants and contra-stimulants; the second includes mechanical and chemical agents.

4. *According to the Doctrine of Broussais.*

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

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

5. *According to Chemico-Physiological Principles.*

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

K. F. Burdach, System der Arzneimittellehre, 1807–9. 3 Bde. 2te Aufl. 1817–19. Leipzig.
C. H. C. Bischoff, Die Lehre von den chemischen Heilmitteln, oder Handbuch der Arzneimittellehre. 3 Bde. 1825–31. Bonn.—[I have given a sketch of this classification in the *London Medical Gazette*, vol. xvii. p. 164.]
W. Grabau, M. D., Chemisch-physiologisches System der Pharmakodynamik. 1er Theil Kiel, 1837. 2er Theil Kiel, 1838.

6. *According to the Part affected.*

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

J. L. Alibert, Nouveaux Elémens de Thérapeutique et de Matière Médicale, 5me éd. 3 t. Paris, 1826.—[I have given a sketch of this classification in the *London Medical Gazette*, vol. xvii. p. 165.]
Dr. Granville, Medical and Physical Journal, for April, 1822, vol. xlvii.
J. Eberle, M. D., A Treatise on Materia Medica and Therapeutics, 2d ed. Philadelphia, 1824;—3d edit. 1825.
Ph. F. W. Vogt, Lehrbuch der Pharmakodynamik. 2 Bde 2te Aufl. 1828;—3te Aufl. 1832.
Dr. Michaelis, Encyclopädisches Wörterbuch der Medicinischen Wissenshaften. Art. Arzneimittel. Berlin, 1829.

EBERLE'S CLASSIFICATION.

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

VOGT'S CLASSIFICATION.

Vogt makes three classes of medicines: the first including those agents which specially affect the *sensibility* of the body, the second containing those which alter the *irritability* of the system, and the third embracing those agents which influence what he calls the *vegetation* of the body—that is, the organic functions; namely, nutrition and reproduction.

	ORDERS.	DIVISIONS.
Class 1. *Medicines operating specially on the nervous system, and particularly used as nervous agents*	1. Medicines which limit the vital manifestation of the nervous system (*Narcotica*)	1. Opium and its allies. 2. Nux Vomica, and medicines similar to it. 3. Hydrocyanic Acid, and vegetables allied to it. 4. Belladonna, and medicines similar to it.
	2. Medicines which exalt and strengthen the vital manifestations of the nervous system (*Nervina*)	1. Nervinia volatilia (Ammonia, Musk, &c.) 2. Nervino-alterantia antispasmodica (Ipecacuanha, Copper, Zinc, Bismuth &c.)
Class 2. *Medicines operating specially on irritable life*	1. Weakening (*Antiphlogistica,*) as the Neutral Salts, Cold, &c.	
	2. Medicines which heighten and strengthen the vital manifestations of the irritable system	1. Excitantia volatilia (as Camphor, Mints, &c.) 2. Tonica. 3. Antiseptica (Acids, Chlorine, &c.)
Class 3. *Medicines operating specially on the vegetative* [organic] *system, and which are particularly used in diseases of vegetation* [nutrition and reproduction]	1. Medicines operating specially on the secreting and excreting system	1. Heat. 2. Gummi-Resinosa, Balsamica, and Resinosa. 3. Resolventia (Acrids, Mercury, Antimony, Sulphur, Alkalis, Iodine, &c.)
	2. Medicines which specially operate on the formative process	1. Aromata (Pepper, Pyrethrum, Nutmegs, &c.) 2. Nutrientia.

ε. Classifications founded on Therapeutical Properties.

The curative and remedial powers of medicines are not absolute and constant, but relative and conditional; so that we have no substance which, under every circumstance, is a remedy for a particular disease. This will explain why no

modern author has attempted to classify remedies according to their therapeutical properties. Such a classification, if attempted, must be an arrangement of diseases, and an enumeration of the medicines which experience had found frequently, though not invariably, beneficial for each. On this principle, an *Index of Diseases and of Remedies according to the opinions of the ancient Greeks, Latins, and Arabs*, has been given in the following work:—

J. Rutty, M. D., Materia Medica antiqua et nova, repurgata et illustrata, 4to. Rotterodami, 1775.

Strictly speaking, therefore, there are no substances to which the term *Specifics* (*specifica qualitativa*, Hufeland[1]) can be properly applied. Yet it cannot be denied that there are many medicines which are particularly appropriated to the cure of certain diseases, or to the relief of particular symptoms; experience having shown that they more frequently give relief than other agents. As examples I may refer to the use of Mercury in syphilis, Sulphate of Quinia in ague, Arsenious Acid in lepra, Sulphur in the itch, and Hydrocyanic Acid in vomiting. Moreover, I cannot admit that any satisfactory explanation has yet been given of the *modus medendi* of many of these agents. The relief obtained in constipation by the use of Senna, and in pain by that of Opium, is explicable by reference to the known physiological effects of these substances. But the benefit procured in venereal diseases by Mercury, in ague by Sulphate of Quinia, &c. cannot be accounted for by reference to any known physiological effects which these substances produce, and our use of them, therefore, is, at present, empirical. It cannot, however, be doubted that had we a more intimate acquaintance with, and precise knowledge of, the action of remedies, the therapeutical properties of medicines would no longer appear incomprehensible and mysterious.

Though no systematic therapeutical classification has, to my knowledge, been attempted by modern authors, yet in some recent works several therapeutical classes have been admitted; especially in the following:—

F. Foy, M. D., Cours de Pharmacologie, 2 tomes. Paris, 1831.—[His class of Specifics includes Antisyphilitics, Antipsorics, Febrifuges or Antiperiodics, Antiscrofulous medicines, and Anthelmintics.]

J. H. Dierbach, M. D. Die neuesten Entdeckungen in der Materia Medica. 2te Ausg. 1er Band. Heidelberg und Leipzig, 1837.

CHAPTER XII.—ON THE PHYSIOLOGICAL CLASSES OF MEDICINES.

I have already (p. 167.) expressed my opinion that, in the present state of our knowledge, a physiological classification of medicines cannot be satisfactorily effected. It is principally on this ground that I have thought it advisable, in the following pages, not to follow any attempted arrangement of this kind in describing the substances used in medicine. It, however, appears to me advisable to precede the account of medicines individually, by some notice of the more important groups which they form when arranged on physiological principles.

Medicines may be arranged physiologically on two principles;—according to the parts or organs which they affect, or according to the nature or quality of the action which they set up. But to the exclusive adoption of either principle, obstacles almost insurmountable oppose themselves. These mainly arise from the difficulty experienced in discriminating between the primary and secondary effects of medicines.

In a classification of medicines according to the parts or organs affected, it would be found, I suspect, that four-fifths of our Materia Medica might be placed in one class, under the denomination of medicines affecting the nervous system (cerebral, true spinal, and ganglionic systems;[2]) while in a classification strictly

[1] *Lehrbuch der allgemeinen Heilkunde*, S. 194. 2te Aufl. Jena, 1830.

[2] See some remarks on the therapeutics of these systems, in Dr. Marshall Hall's work *On the Diseases and Derangements of the Nervous System*, pp. 36, 113, and 129.

founded on the nature or quality of the action which they induce, most of our medicines would belong to the class of alteratives.[1]

Class 1. Medicamenta Cerebro-spinantia.—Cerebro-spinants.

(Narcotics, *Auctorum.*)

Definition.—Medicines which produce or prevent sleep, or which affect the intellectual functions, sensation, or the irritability of the muscular fibres, I denominate *Cerebro-spinants*, because they affect the functions of the cerebro-spinal system (cerebral and true spinal systems of Dr. Marshall Hall.)

Physiological Effects.—The only essential physiological property which these agents possess in common, is that of specifically affecting the cerebro-spinal system. In other respects they present a considerable diversity of operation,—though they are so mutually related that we cannot with propriety place them in separate classes.

Cerebro-spinants differ among themselves with regard to both their topical and remote effects. The *topical* effect of Opium is that of a very slight benumbing agent; Aconite causes numbness and tingling; Conia occasions local paralysis; Tobacco, Foxglove, &c. operate on the alimentary canal as acrids; Alcohol and the Metallic Cerebro-spinants are caustics. In their *remote* effects we observe the same want of uniformity. Alcohol renders the pulse fuller and more frequent; while Foxglove reduces its power and frequency. Opium causes constipation, while Tobacco relaxes the bowels. Lastly, in the modifications occasioned in the functions of the cerebral and spinal system, we observe an equal diversity of operation.

Considered with regard to their effects on the cerebro-spinal system, these agents may be arranged in ten orders, as follows:—

Order 1. Convulsives (*Tetanics.*) *Agents which augment the irritability of the muscular fibre, and in large doses occasion convulsions.*—This order includes Strychnia, Brucia, and all substances which contain one or both of these alkalis; as Nux Vomica, St. Ignatius's Bean, Snake-wood, (*lignum colubrinum,*) the *Upas Tieuté*, and probably the Tanghin poison. These agents are principally employed in torpid or paralytic conditions of the muscular system, under regulations which will be pointed out hereafter.

Order 2. Paralysers. *Agents which cause paralysis of voluntary motion, and lessen the irritability of the muscular fibres.*—This order contains Conia, an alkali procured from Hemlock; and which, considered physiologically, would appear to be the remedy for augmented irritability of the muscles, as in Tetanus and Hydrophobia.

Order 3. Benumbers. *Agents which cause topical numbness* [*paralysis of the sentient nerves?*] *and muscular weakness.*—Monkshood, and its alkali Aconitina, occasion numbness and tingling in the parts to which they are applied. They give rise to a feeling analogous to that produced, on the return of sensation, after the removal of pressure upon a nerve, and which is commonly denominated "pins and needles." When swallowed, they also occasion muscular weakness. As they diminish feeling, they are adapted for the relief of neuralgia.

Order 4. Convulsive Stupefacients, acting rapidly and suddenly, (*Epileptifacients?*) *Agents which cause sudden loss of intellect, sensation, and volition, and usually occasion convulsions.*—This order includes Hydrocyanic Acid, the Cyanides of Potassium and Zinc, Bitter Almonds and their Volatile Oil, and the Cherry-laurel and its Volatile Oil and Distilled Water. The narcotic gases (Carbonic Acid, Sulphuretted Hydrogen, &c.) when inhaled, belong to this order. In celerity of effect, and rapidity with which they prove fatal, no agents exceed, and few equal, the poisons of this order. The sudden loss of sensation and of consciousness, with violent convulsions, which are the characteristic effects of this order, constitute also the essential symptoms of an epileptic paroxysm: they also sometimes occur from the loss of large quantities of blood. The analogy between these three conditions (*i. e.* hydrocyanic poisoning, epilepsy, and the effect of hemorrhage) is farther shown by the fact that the symptoms of all are relieved by Ammonia. As therapeutical agents, hydrocyanic acid and its allies prove exceedingly useful in certain painful affections of the stomach, unaccompanied by inflammation.

Order 5. Convulsives which cause Delirium followed by Sleep or Stupor. *Agents which, in moderate doses, act as cardiaco-vascular stimulants, and exhilarate;*

[1] Medicines may augment, lessen, or alter vital action. See p. 140.

in excessive doses cause confusion of head and impaired volition, followed by delirium, convulsions, and insensibility.—This order was contrived to include Camphor.

ORDER 6. PARALYZING, PUPIL-CONTRACTING STUPEFACIENTS (*Narcotics; Apoplectifacients?*) *Agents which lessen feeling, and the irritability of the muscular fibres, and cause contraction of the pupils, and paralysis of voluntary motion, and sleep or stupor.*—Opium and its alkali Morphia constitute the type of this Order, to which, probably, Lactucarium also belongs. In small doses they usually excite the vascular system, check the mucous secretions of the alimentary canal, and promote sweating. In larger doses they lessen sensation, diminish the irritability of the muscular fibre (when fatal doses have been taken actual paralysis precedes death,) cause contraction of the pupils, and occasion sleep or stupor. The apoplectic condition thus induced is denominated *narcotism*. In therapeutics, these agents are used—

a. To check profuse mucous secretion of the gastro-intestinal membrane.
b. To promote sweating.
c. To diminish augmented irritability of the muscular system (spasm or convulsion.) When thus used they are termed *antispasmodics*.
d. To relieve pain. In this case they are called *anodynes* (from α, privitive, and οδυνη, pain,) or *paregorics* (from παρηγορεω, to soothe or alleviate.)
e. To procure sleep. When thus used they are denominated *hypnotics* (υπνωτικος, from υπνος, sleep,) or *soporifics* (from *sopor*, a deep sleep, and *facio*, I make.)

ORDER 7. INEBRIATING, PARALYZING STUPEFACIENTS (*Inebriants; Intoxicants.*) *Agents which produce a peculiar disorder of the intellect, called inebriation or intoxication, impair volition, and, when used in excess, occasion paralysis of voluntary motion, and stupor.*—Alcohol, Wine, and Ether, belong to this Order, which is closely allied to the preceding one. The agents composing it are remarkable for their exciting influence over the cardiaco-vascular system, and for the peculiar form of intellectual disorder which they occasion, but which varies somewhat in different persons. By long-continued use, alcohol gives rise to the disease termed *delirium tremens*, which is characterized by wakefulness, delirium, and tremor. The substances of this group are employed in medicine principally as excitants and stimulants.

α. *Protoxide of Nitrogen* should, perhaps, constitute a subdivision of this order. When inhaled it causes exhilaration, temporary delirium, and blueness of the lips. Stupor is sometimes produced by it.
β. *Indian Hemp* (*Cannabis indica*) should form either another subdivision, or, perhaps, a distinct order. It causes a very agreeable kind of delirium, augmented appetite, venereal excitement, and impaired volition, followed by insensibility, during which the patient retains any position in which he may be placed. Its effects, therefore, simulate catalepsy.[1] (*Cataleptifacient?*)

ORDER 8. DELIRIFACIENTS[2] WHICH DILATE THE PUPIL AND PARALYZE THE THROAT. *Agents which cause dilatation of pupil, obscurity of vision, dysphagia, aphonia, and delirium, terminating in stupor.*—Belladonna, Stramonium, and Hyoscyamus, belong to this order. They cause dilatation of pupil, obscurity of vision or actual blindness, dryness of the throat, difficulty or entire loss of power of deglutition, aphonia or difficult articulation, weak pulse, fainting, and delirium, followed by sopor or lethargy. Convulsions are not constant. These effects have been compared to the symptoms of hydrophobia. Spasmodic difficulty of breathing, and angina pectoris, have been alleviated by these agents. Belladonna is employed to dilate the pupil, and to allay neuralgic pain.

ORDER 9. NAUSEATING, CARDIACO-VASCULAR SEDATIVES, WHICH OCCASION TREMBLING AND WEAKNESS OF MUSCLES AND CONFUSION OF INTELLECT.—*Agents which produce nausea, sometimes vomiting and purging, weakness and irregularity of pulse, syncope, impaired vision, giddiness, and confusion of ideas. Paralysis, convulsions, delirium, and stupor, are occasional symptoms.* Foxglove and Tobacco belong to this group.

ORDER 10. METALLIC CEREBRO-SPINANTS. *Metallic substances having a local chemical action, and which affect the functions of the true spinal system.*—This order is a very heterogeneous one, and admits of several subdivisions.

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[1] *On the Preparations of the Indian Hemp, or Gunjah (Cannabis indica,) their Effects on the Animal System in Health, and their Utility in the Treatment of Tetanus and other Convulsive Disorders.* By W. B. O'Shaughnessy, M. D. Calcutta, 1839.
[2] From *delirium* and *facio*, I make.

α. PLUMBEOUS CEREBRO-SPINANTS. The preparations of Lead occasion colic and paralysis. From their constringing effects on the capillary vessels they have been termed *astringents*.

β. MANGANESIC CEREBRO-SPINANTS.—According to Dr. Coupar (*British Annals of Medicine*, Jan. 13th, 1837, p. 41.) they occasion paraplegia without colic or tremor.

γ. MERCURIAL CEREBRO-SPINANTS.—By long-continued use, in small doses, mercurials occasion paralytic tremor (*tremor mercurialis*,) and ultimately convulsive agitation of the limbs. (*Choreafacients?*)

δ. ANTISPASMODIC METALLIC CEREBRO SPINANTS.—This group includes the Preparations of Arsenic, Bismuth, Copper, Silver, and Zinc. Their influence over the true spinal system is shown by their remedial influence in epilepsy and chorea (whence their denomination of *antispasmodics*,) as well as by the cramps or convulsions or paralysis which they occasion when taken in poisonous doses. In small doses they sometimes cure ague and other periodical maladies, and have, in consequence, been termed *tonics*. This group corresponds very nearly to that called by Vogt (*Lehrbuch der Pharmakodynamik*. Bd. 1. S. 269. 2te Aufl. Giessen, 1828.) *nervino-alterantia*. Arsenic, when swallowed in an excessive dose, sometimes occasions narcotism.

LOCALITY AND QUALITY OF THE ACTION OF CEREBRO-SPINANTS.—Those cerebro-spinants which occasion lesions of the mental functions, of sensibility, or of volition, or which prevent or produce sleep, affect the cerebrum or cerebellum.

These lesions put on a great variety of forms. Mania, delirium, inebriation, erroneous perceptions or judgments, and stupor or coma, are morbid conditions of the mental faculties. Pain, numbness, tingling, loss of feeling, spectra, impatience of light, impaired vision, amaurosis, &c. are disordered conditions of sensibility. Paralysis (cerebral) of voluntary motion is a lesion of volition, one of the cerebral functions.

Those cerebro-spinants which either augment or lessen the irritability of muscles, affect the true spinal system.

Spasm or convulsion is the result of an augmentation of the irritability of muscles. If the influence of the true spinal marrow over the muscles be destroyed, the muscles are no longer irritable. This state which may be denominated spinal paralysis, or paralysis of irritability, must not be confounded with cerebral paralysis, or paralysis of voluntary motion. (See Dr. Hall's paper on this subject in the *Medico-Chirurg. Trans.* vol. xxii. [vol. iv. N. S.] p. 191.)

Mr. Grainger (*Observations on the Structure and Functions of the Spinal Cord.* Lond. 1837.) has shown that the centre of the true spinal system is the gray matter of the true medulla oblongata and medulla spinalis. From this centre proceed the incident excitor and the reflex motor nerves.

The affection of either the cerebral or true spinal systems induced by cerebro-spinants, may be primary or secondary; for these two systems are so mutually related, and have such an influence over each other, that if one be disordered, the other readily becomes implicated.

Thus convulsions arise from a lesion of the true spinal system; yet it is well known that they frequently attend diseases of the encephalon. The "cause," observes Dr. Hall, "appears to be either irritation or counter-pressure: the former may act through the medium of the nerves distributed to the membranes,—as the recurrent of the trifacial of Arnold,—as in epilepsy induced by a spicula of bone; the latter is illustrated by the case of meningitis, by Dr. Abercrombie, in which the anterior fontanelle became prominent; pressure upon it induced convulsion." (*On the Diseases and Derangement of the Nervous System*, p. 97. Lond. 1841.) On the other hand, affections of the true spinal system may induce lesion of the cerebral faculties. Thus convulsion may, by stopping respiration, cause coma.

Attempts have been made to localize more precisely the action of cerebro-spinants, but without much success. Thus Flourens[1] says that Opium acts specifically on the cerebral lobes; that Belladonna, in a limited dose, affects the tubercula quadrigemina, and in a larger dose the cerebral lobes also; that Alcohol, in a limited dose, acts exclusively on the cerebellum, but in a larger quantity, it

[1] *Recherches expérimentales sur les Propriétés et les Fonctions du Système Nerveux dans les Animaux vertébrés*, pp. 254, 258, 261, and 262. Paris, 1824.

affects also neighbouring parts; and, lastly, that Nux Vomica more particularly affects the medulla oblongata.

It cannot be doubted, that most of the peculiarities which attend the operation of individual cerebro-spinants arise from different parts of the nervous centres being unequally affected by different agents.

Great difficulty attends all attempts made to ascertain the nature of the changes which cerebro-spinants induce in the nervous centres. This arises, in part, from the fact, that similar symptoms attend dissimilar affections of these parts.

Thus *coma* may be induced by compression of the cerebrum, or by loss of blood. *Delirium* may arise from irritation of the cerebrum, or from loss of blood. *Convulsions* may be produced by irritation, or lesion of the medulla oblongata and spinalis, or by loss of blood. *Paralysis* may arise from lesion of the encephalon, destructive injury of the medulla oblongata or spinalis, and loss of blood.

Alterations in the quantity or quality of the blood supplied to the different parts of the cerebral and true spinal systems, are probably the primary causes of the changes which cerebro-spinants induce in the condition of the functions of these systems. By long-continued use of these agents, slight chemical changes may, perhaps, be induced in the nervous tissue (see p. 121.)

Augmented arterial action, or venous congestion, sometimes attends the operation of cerebro-spinants. Flourens (*Op. cit.*) declares that Opium, Belladonna, Alcohol, and Nux Vomica, give rise to phenomena resembling those which attend mechanical lesions of the parts on which he asserts these agents operate (see above;) and farthermore he states, that in birds it is possible to observe, through the cranium, changes of colour [some alterations in the vascular condition of the parts] which these agents effect in the brain.

Cause of Death.—In general, the immediate cause of death, in cases of poisoning by the cerebro-spinants, is an impediment to respiration or circulation. Thus, the process of respiration may be stopped by a paralytic or a spasmodic condition of the respiratory muscles, or by closure of the larynx; and the circulation of blood may cease in consequence of paralysis of the heart. These are obvious and readily understood causes of death. But in some cases the cerebro-spinants appear to destroy life in some other way. Thus, Hydrocyanic Acid injected into the veins kills within a few seconds, without stopping the action of the heart, which continues to beat for some minutes after the chest has been laid open. Now in such cases, it appears to me, that the death is too rapid to be fairly ascribable to the stoppage of respiration,—nor can it be referred to cessation of the heart's action.

α. *Paralysis of the muscles of respiration.*—In some cases the respiratory muscles do not receive their proper supply of nervous energy, in consequence of which respiration is performed with increasing difficulty, until, ultimately, asphyxia is produced. The failure of the excito-motor power, in these instances, arises from the action of the poison on the true spinal system.[1] This kind of death is caused by Opium, and sometimes by Diluted Hydrocyanic Acid. If the body be opened immediately after death, the heart is found beating, oftentimes with considerable force, and for some minutes. These are the cases in which it has been proposed to prolong life by artificial respiration until the effect of the poison has passed off. The proposition is not supported merely by its ingeniousness and plausibility, but by experience. The following is a case in point, related by Mr. Whateley, and quoted by Dr. Christison:—(*Treatise on Poisons*, p. 680. 3d. ed.) A middle-aged man swallowed half an ounce of crude Opium, and soon became lethargic. He was roused from this state by appropriate remedies, and his surgeon left him; but, the poison not having been sufficiently discharged, he

[1] Dr. Marshall Hall (*On the Diseases and Derangements of the Nervous System*, p. 63) gives the following

Table of the System of the Respiratory Nerves.

I. *The Excitors.*	II. *The Centre.*	III. *The Motors.*
1. The Trifacial,	The Medulla Oblongata.	1. The Spinal Accessory,
2. The Pneumogastric,		2. The Intercostal,
3. The Spinal,		3. The Diaphragmatic,
		4. The Lower Spinal, &c.

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

β. Convulsions or spasm of the respiratory muscles.—Another cause of death brought on by cerebro-spinants is spasm of the respiratory muscles, whereby the function of the respiration is stopped, and asphyxia produced. In such cases the reflex action is augmented. We have an example of this mode of operation in death by Strychnia, Brucia, and the substances containing these alkaloids.

γ. Closure of the larynx.—When an attempt is made to inspire pure Carbonic Acid, as well as some other gases, the larynx spasmodically closes, and death results from asphyxia. In a case of complete insensibility from intoxication related by Mr. Sampson, (*Medico-Chir. Trans.* vol. xx. p. 46.) the comatose state was thought to arise, not from apoplexy, "but from torpor of the brain, in consequence of that organ being imperfectly supplied with blood not duly oxygenated; for the shrill tone and extreme difficulty of respiration showed the existence of collapse of the glottis, and imperfect transmission of air into the lungs, which might be accounted for by a paralyzed state of the eighth pair of nerves and recurrent branches." Tracheotomy was performed, and with complete success; in about half an hour the respiration was regular and easy through the wound.[1]

δ. Paralysis of the heart.—In some instances the immediate cause of death appears to be paralysis of the heart; for the heart ceases to beat before respiration has stopped,—as when the Alcoholic Extract of Aconite is applied to wounds in dogs. If the chest be opened, the heart does not contract as usual when irritated by a needle. The infusion of Tobacco appears to kill dogs and cats by paralyzing the heart. In the case of poisons acting in this way, it has been proposed to stimulate the heart by slight galvanic shocks, in order to avert the fatal termination. Even acupuncture has been advised, if the patient appeared *in articulo mortis*. Bretonneau (Bayle, *Travaux Thérapeutiques*, t. i. p. 432.) has repeatedly punctured the brain, heart, lungs, and stomach of young dogs, without the least inconvenience; and Carraro[2] has successfully tried this practice on animals in a state of asphyxia.

ACTIVE PRINCIPLES.—A considerable number of the vegetable cerebro-spinants owe the whole or part of their activity to *an organic alkali*. The cerebro-spinants belonging to the Almond tribe yield *hydrocyanic acid*. Lastly, *volatile oil* is, in some cerebro-spinants, the active principle.

1. ORGANIC OR VEGETABLE ALKALIS; OR THE ALKALOIDS.—These substances are peculiar to vegetables. As the juices of the plants in which they reside are acid, it is evident that the vegetable alkalis must exist in them in the form of salts. The method of extracting them is not uniform; but for the most part they may be procured by boiling the substances containing them in water acidulated with hydrochloric acid, and neutralizing the filtered decoction with ammonia, lime, or magnesia, by which the organic alkali is precipitated, and is to be subsequently purified, which is usually effected by dissolving it repeatedly in alcohol.

Most of the organic alkalis are solid, inodorous, and crystallizable; *e.g.* Morphia and Cinchonia. Some are pulverulent, as Veratria. Conia is liquid at ordinary temperatures, volatile, and highly odorous. All are combustible. They have an alkaline reaction on vegetable colouring matter, and unite with acids to form salts; but their saturating power is very low

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[1] Dr. Marshall Hall (*op. supra cit.* p. 280) designates this operation as "one of the *most splendid achievements of modern surgery*." He considers the case to have been one of "paralysis of the pneumo-gastric nerve and of the dilator muscles of the larynx;" and that the same condition occurs, not only in intoxication, but probably in other cases of coma, as in that of apoplexy, of epilepsy, from opium, &c. He gives the following

TABLE OF THE CLOSURE OF THE LARYNX.

I. *The Excitor.*	II. *Centre.*	III. *The Motor.*
The Superior Laryngeal.	The Medulla Oblongata.	The Inferior Laryngeal or Recurrent.

[2] *Expériences sur des animaux asphyxiés et ramenés à la vie par l'acupuncture du cœur*, in Bayle, *op. cit.* t. i. p. 495.

(*i. e.* their atomic weights are very high.) The alkalis with which we are best acquainted are only slightly soluble in water; but, in general, they readily dissolve in boiling alcohol, and some of them separate in a crystalline state from this liquid as it cools. Their taste is for the most part bitter; that of some is also acrid. Tannic acid unites with them to form tannates, which usually are very slightly soluble only in water. Hence the infusion of galls (which contains this acid) is employed for detecting the alkaloids, and as an antidote in poisoning by them. Iodic acid, in excess, precipitates several of them; but is decomposed by Morphia, iodine being set free. Concentrated nitric acid reddens Morphia and Brucia, and gives a yellow tinge to Narcotina; but a green one to Aricina. Bichloride of Mercury precipitates the hydrochlorates of some of these alkaloids, forming, with them, double salts. The sulphates, nitrates, hydrochlorates, and acetates of the alkaloids, are generally soluble in water. Ammonia and Magnesia decompose their solutions, and precipitate the alkaloid. Carbazotic acid causes yellow precipitates with solutions of Quinia, Cinchonia, Brucia, Strychnia, Codeia, and Oxycanthina; but not with Morphia, Narcotina, Veratria, Solanina, Conia, and Emetina. (See Mr. Kemp's paper in the *London Medical Gazette*, for April 24, 1840.) If chlorine gas be passed through a solution of Disulphate of Quinia, and Ammonia be subsequently added, an emerald-green liquor is obtained. If Morphia, in the place of the Quinia, be similarly treated, a dark-brown colour results. (Dr. Meeson [by mistake printed Roper,] in *London Medical Gazette*, vol. xi. p. 320.)

The constituents of all the organic alkalis, are *carbon*, *hydrogen*, *nitrogen*, and *oxygen*. In each equivalent of the alkali there is only one equivalent of nitrogen.

The organic alkalis operate powerfully on the animal economy. Some of them are energetic cerebro-spinants; as Morphia and Strychnia: some are acrids; as Veratria; while others are tonic, as Quinia and Cinchonia.

2. Hydrocyanic Acid.—The properties of this acid will be described in a subsequent part of this work. Though readily obtained from the bitter almond, and other substances of that tribe, it does not exist in them ready formed; but is produced by the mutual reaction of amygdalin, emulsin, and water.

3. Volatile Oil.—The general properties of the volatile oils will be described under the head of Stimulants. Tobacco and Hops owe part of their medicinal properties to volatile oil. Camphor may be regarded as a concrete volatile oil.

Class 2. Stimulantia.—Stimulants.

(Excitants; Incitants; Calefacients.)

Definition.—An agent which increases the vital activity of an organ is termed a *stimulant* (from *stimulus*, a goad or spur,) or some time an *incitant* (from *incito*, to incite or spur on,) or *excitant*. Those which, by exciting the nervous and vascular systems, affect all the organs or functions, are termed *general stimulants;* while others, which influence one or two organs only, are called *local stimulants*. Those which excite the parts to which they are applied are denominated *irritants*.

The distinction to be made between the vital stimuli and the medicinal agents called stimulants (special stimuli,) has been already pointed out. (See p. 141.)

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

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

They are closely related to some other classes, especially to cerebro-spinants, tonics, and evacuants. Thus, Alcohol and Ether are, at the same time, stimulant and narcotic; Myrrh, Cascarilla, and the Ferruginous Compounds, possess both stimulant and tonic qualities; lastly, several of the stimulants are sudorific, diuretic, emmenagogue, &c.

The division of stimulants into groups, founded on the parts or organs which

they respectively affect, has been already noticed. (See p. 141.) I shall here arrange them into five orders, founded partly on their chemical properties, and partly on their physiological effects.

ORDER 1. CONDIMENTARY STIMULANTS.—This order contains those stimulants which are employed as condiments. They contain a volatile oil, to which they owe their remedial and condimentary uses. The action of many of them is principally limited to the alimentary tube. They form the three sub-orders, or groups, as follows:—

α. This group, called by Dr. Duncan (*Supplement to the Edinburgh Dispensatory*, p. 229.) *volatile pungent stimuli*, contains the *alliaceous* and *siliquose stimulants*. The alliaceous stimulants are Garlic, the Onion, and the Leek, which are obtained from the natural order *Liliaceæ*. The siliquose stimulants are Mustard, Horse-radish, Scurvy-grass, and Cardamine, which are procured from *Cruciferæ*. Most of the substances composing this group contain, or yield, an acrid volatile oil (composed of *carbon*, *hydrogen*, *nitrogen*, *oxygen*, and *sulphur*,) to which they owe their medicinal qualities. Several of them are employed as condiments. In medicine, we use Mustard as a rubefacient and emetic; Horse-radish as a masticatory; and Garlic as a stimulating expectorant. From their beneficial effects in scurvy, the substances of this group have been denominated *anti-scorbutics*.

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

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

Spices are distinguished from the last group of stimulants by their more agreeable flavour; by their greater acridity; by their less tendency to occasion nausea; and by their more powerful agency in promoting the assimilation of substances reputed difficult of digestion. Both groups, however, yield condiments. (See pp. 98 and 114.)

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

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

ORDER 2. RESINOUS STIMULANTS.—All the stimulants of this order contain resin. Some (*resins*) of them, indeed, consist almost solely of it. Others (*oleo-resins*) contain also volatile oil. A third group (*balsams*) contains benzoic acid and resin. A fourth group (*gum-resins*) consists of gum, resin, and volatile oil. As these groups differ not

only in their chemical composition, but also to a certain extent in their effects and uses, they will require separate examination.

α. Resins (*resinæ.*)—Under this head I include Elemi, Mastic, and Guaiacum, obtained, the first two from *Terebinthaceæ*, the last from *Zygophyllaceæ*. They exude either spontaneously or from incisions made in the stems of the plants yielding them. Common resin (called *rosin*) obtained as a residue in the distillation of the Turpentines, may, in regard to its chemical and medicinal qualities, be placed in the same group with the natural resins. The local action of resins is irritant: applied to the skin they produce rubefaction, and when swallowed in large doses, occasion heat of stomach, nausea, vomiting, or even purging. Their constitutional effects are those of stimulants. Thus they occasion thirst, quicken the pulse, raise the temperature of the surface, and promote the secretions, especially of the skin and kidneys. Elemi and mastic are rarely employed in medicine: their effects are analogous to the Turpentines, but much milder. Guaiacum is used as a stimulant and sudorific.

β. Oleo-resins (*oleo-resinæ; liquid resins; balsams devoid of benzoic acid; terebinthinates.*)—These are oleo-resinous, semi-liquid, or glutinous juices, which flow spontaneously, or by incisions, from various vegetables, especially those belonging to the orders *Coniferæ*, *Terebinthaceæ*, and *Leguminosæ*. Their liquidity or semi-liquidity, their odour, and most of their medicinal activity, are owing to the volatile oil which they contain, and which may be procured from them by distillation. From the true balsams they are distinguished by not yielding benzoic acid. They have a strong odour, which, in some, is very fragrant,—in others, so peculiar as to be taken as the type of certain odours under the name of terebinthinate. Those oleo-resins, employed in medicines, are the Turpentines, Copaiva, and Opobalsamum (commonly termed Mecca Balsam.) Their taste is hot and acrid. They are all local irritants, causing rubefaction when applied to the skin; some of them giving rise to active inflammation. When swallowed they occasion more or less irritation of the alimentary canal, according to the dose in which they are taken; the symptoms being epigastric heat, loss of appetite, nausea, or even vomiting; and, sometimes, when the quantity swallowed is large, griping or purging. Their constitutional effects are thirst, dryness of the mucous membranes, increased frequency and fulness of pulse, and great heat of skin, frequently accompanied with sweating. They exercise a stimulant influence over the urinary organs, which is manifested by uneasiness in the regions of the kidneys, increased desire of passing the urine, heat in the urethra, and sometimes strangury and bloody urine. Under the influence even of small doses the urine acquires a remarkable odour; which, when any of the Turpentines have been taken, is that of violets. The mucous membranes generally are stimulated, and have their secretions diminished by the oleo-resins. By repeated use they sometimes cause a cutaneous eruption. In large doses Oil of Turpentine causes an affection of the nervous system, which will be noticed hereafter.

The oleo-resins are principally employed in medicine to relieve diseases of the mucous membranes, especially the urino-genital mucous membrane. Thus they are employed, and with great benefit, in gonorrhœa, leucorrhœa, gleet, and chronic catarrh of the bladder. In chronic pulmonary catarrhs they are sometimes advantageously employed; but not unfrequently prove injurious, as Dr. Fothergill (*Medical Observations and Inquiries*, vol. iv. p. 231.) has shown. Oil of Turpentine has been used in neuralgia, against tapeworm, in puerperal peritonitis, and in other cases to be mentioned hereafter.

γ. Balsams (*balsama naturalia: balsams containing benzoic acid.*)—The term balsam was formerly applied to all liquid vegetable resins, as well as to many pharmaceutical preparations. But to avoid confusion, the French chemists confine the term balsam to vegetable substances composed of resin and benzoic acid, with more or less volatile oil. But as this would exclude Copaiva and some other substances popularly called balsams, most of the German chemists retain the old acceptation of the term, and divide balsams into those which do, and those which do not, contain this acid.

Balsams (under which term I include those only which contain benzoic acid) are solid, soft, or liquid substances, according to the quantity of volatile oil which they contain: they have an aromatic, usually agreeable, odour, and a warm, acrid taste. They dissolve in alcohol; and the solution, when mixed with water, becomes milky, owing to the deposition of resin. By sublimation, as well as by other methods, they yield benzoic acid. Those employed in medicine are Benzoin, Styrax, Tolu, Peruvian Balsam, and Liquidambar. They are obtained from the orders *Styraceæ*, *Leguminosæ*, and *Balsamaceæ*. They owe the principal part of their medicinal activity to the contained benzoic acid. The liquid balsams (of Styrax and Peru) are sometimes applied to chronic indo-

lent ulcers, to allay pain, to improve the quality of the secreted matter (*detergents,*) and to promote cicatrization (*epulotics* or *cicatrisantia.*) Taken internally the balsams act as stimulants; their operation being principally directed to the mucous membrane of the air-passages; on this account they are termed expectorants, and are employed in chronic catarrhs. MM. Trousseau and Pidoux (*Traité de Thérapeutic*, t. i. p. 467.) assert, from their own experience, that "there are few substances in the materia medica so powerful in combating chronic pulmonary catarrhs and old laryngeal inflammations as the balsams." In chronic inflammation of the larynx, whether accompanied or not by ulceration, balsamic fumigations are more serviceable than the internal exhibition of the balsams. The air of the patient's chamber may be impregnated with balsamic vapours by placing a little Benzoin or Tolu on some live coals, and allowing the vapour to escape into the room: or the patient may inhale the vapour of boiling water to which a drachm or two of the balsams have been added.

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

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

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

Order 3. Ammoniacal, Empyreumatic, and Phosphoric Stimulants.—This order contains Ammonia and its salts, the Empyreumatic Oils, Phosphorus, Musk and Castoreum. It is termed by Vogt (*Lehrbuch der Pharmakodynamik*, Bd. i. S. 184. 2te Aufl. Giessen, 1828.) *volatile nervines* (*nervinia volatilia.*) All the substances of which it is composed agree in producing a primary and specific effect on the nervous system, the energy and activity of whose functions they exalt. According to Vogt, (*Op. cit.* Bd. i. p. 186.) the more volatile the remedy the more it increases the *activity* of the nervous functions, and the more fixed the more it raises their *energy*. Thus, according to the same writer, the preparations of ammonia raise the activity more than the energy of these functions; the empyreumatic oils somewhat less; musk still less; while castoreum increases the energy of the functions principally. However, I shall hereafter show that the last-mentioned remedy really possess very little power.

These remedies act as excitants to the organs of circulation, increasing the force and frequency of the pulse, augmenting the warmth of skin, and promoting diaphoresis. On account of the latter effect they have been termed *diaphoretica calida.*

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

Order 4. Camphoraceous Stimulants.—This order includes Camphor, Serpentary, Contrajerva, Valerian, the Oil of Cajuputi, &c. It corresponds with that division of *vola-*

tile excitants called by Vogt *ætherio-oleosa;* it is a less perfect group than any of those already mentioned. To a certain extent it agrees in its effects with the last-mentioned: thus it specifically stimulates the nervous system, increases the activity of the vascular system, and produces diaphoresis. Its effects, however, are much less powerful, are not so speedily produced, nor are they so fleeting. Some of these (for example, Serpentary and contrajerva) are serviceable in low nervous fevers; others are used in spasmodic diseases, as Valerian in epilepsy.

Order 5. Alcoholic Stimulants.—This order is the *spirituosa* of Vogt. It comprehends Alcohol, Wine, and Ether, already mentioned under the head of Cerebro-spinants. Their effects and uses will be fully described in a subsequent part of this work.

Active principles.—*Volatile oil, resin* and *benzoic acid*, are the active principles of a considerable number of stimulants.

1. Volatile Oil (*oleum volatile*, vel *æthereum*, seu *essentiale.*)—Volatile oil is found in both the inorganized and organized kingdoms of nature: it is most common in vegetables. Petroleum and Naphtha are examples of volatile oil in the mineral kingdom. Among animal substances Castoreum may be referred to as containing it. It is found in various parts of vegetables—as in the cortical parts of their stems, in Cinnamon and Cassia; in their rhizomes—as in Ginger and *Acorus Calamus;* in the root—as in Valerian and Horse-radish; in the leaves—as in Buchu, *Labiatæ*, and *Myrtaceæ;* in buds—as in the bulbs of Garlic and Onions; in the flower—as the Rose, Lavender, and Clove; in fruits—as the Orange; and *Umbelliferæ;* and sometimes, though very rarely, in the seeds—as in the Nutmeg. From these different parts it is occasionally obtained by pressure, but more commonly by distillation. Thus Oil of Lemons is procured by pressure, Oil of Turpentine by distillation. Several volatile oils are obtained by the decomposition of organic substances. Oil of Bitter Almonds is one of the products of the mutual reaction of amygdalin, emulsin, and water.

The volatile oils may be solid or liquid, at ordinary temperatures; when solid they are crystalline. They may be lighter or heavier than water; their sp. gr. varying from 0·627 to 1·094. (L. Gmelin, *Handbuch der theoretischen Chemie*, 2er Ed. S. 351. 1829.) They may be coloured or colourless; if the former, the tint is various in different oils. All the essential oils have a strong odour, and a hot acrid taste. They are easily volatilized by heat; are combustible, in consequence of the large quantity of carbon and hydrogen which they contain; and are decomposed by chlorine, iodine, bromine, and the acids. Some of them (as the Oil of Turpentine) combine with hydrochloric acid. They are very slightly soluble only in water. The *distilled waters* of the Pharmacopœia are saturated solutions of them. If the oils be previously rubbed with sugar they dissolve more readily in water. The mixtures or compounds of volatile oils and sugar are called *elæosacchara*. According to the Prussian Pharmacopœia they are composed of one drop of oil and a scruple of sugar. Volatile oils dissolve readily in alcohol, ether, pyroxilic spirit, and naphtha, and easily mix with the fixed oils and resins.

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

In regard to ultimate composition the volatile oils may be divided into three classes: 1st, some of them are *hydro-carbons;* that is, are composed of carbon and hydrogen only—as the Oils of Turpentine, Juniper, Savin, Lemon, and Bergamot: 2dly, some are *oxy-hydro-carbons;* that is, they consist of oxygen, hydrogen, and carbon: as the oils of Lavender, Anise, Mint, and Rosemary: 3dly, some are *Azoturetted* or *Sulphuretted*, and contain no less than five ingredients; namely, carbon, hydrogen, oxygen, sulphur, and nitrogen; as the Volatile Oil of Mustard. It is remarkable that all the volatile oils which contain carbon and hydrogen only, have the same ultimate composition (10 C + 8 H;) or, at least, they consist of the same elements in the same relative proportion.

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

2. Resin (*resina.*)—This is rarely found in the mineral kingdom, or in animal substances; but is common in vegetables. In the latter it exists almost invariably, if not universally, in combination with volatile oil, from which, perhaps, it may be formed by the action of the oxygen of the air. It is a transparent or partially opaque, hard, soft, or elastic solid; coloured or colourless; lighter or heavier than water, its sp. gr. varying from 0·93 to 1·2; (Gmelin, *op. supra cit.*) fusible and combustible. It is a bad conductor of electricity, and becomes negatively electrical by friction. As commonly met with it is odorous, but probably, if completely

deprived of volatile oil, would be inodorous. Its taste is usually more or less acrid; sometimes bitter, and, occasionally, is not perceptible. It is not soluble in water, though some resins form hydrates with this liquid. It is soluble in ether and volatile oil, and frequently more or less so in alcohol; and on the addition of water to the alcoholic solution, the resin is thrown down as a white powder, which gives a milky appearance to the fluid.

Most resins possess acid properties; that is, they redden litmus, and combine with alkalis and other metallic oxides. This is the case with the two resins (*Pinic* and *Sylvic acids*) of which Colophony is composed; as well as the resin of Copaiva (*Copaivic acid*;) of Guaiacum (*Guaiacic acid*;) of Gamboge (*Gambogic acid*,) &c. The salts formed by the union of resins with alkalis, or other basic substances, are called *resinous soaps*. The *sapo-guajacinus* and *sapo jalapinus* of the Prussian Pharmacopœia, as well as the *savon de térébinthine* (*Starkey's soap*) of the French Codex, are soaps of this kind, and will be noticed hereafter.

The resins are composed of *carbon*, *hydrogen*, and *oxygen*.[1] Some of them, (*e. g.* Turpentine and Copaiva resins,) appear to be oxidized essential oils. It is not improbable that the first degree of oxygenation of the volatile oils forms resins insoluble in cold alcohol, while the most oxygenated are soluble in this liquid.

Class 3.—Medicamenta Tonica.—Tonics.

(Corroborants.)

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

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

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

Tonics are closely connected with stimulants; and on many occasions, the so-called tonic substances act really as stimulants. Thus in weak but irritable subjects just recovering from a protracted state of fever, Sulphate of Quinia will frequently act both as a local irritant and stimulant, and produce nausea, vomiting, furred tongue, a febrile state of system, headach, &c. In fact, the two classes (tonics and stimulants) mutually approach and gradually pass the one into the

[1] Professor Johnston has published a series of elaborate papers *On the Constitution of the Resins*, in the *Philosophical Transactions* for 1839 and 1840.

other, and several substances may with equal propriety be arranged under either.

Tonics are also closely related to the cerebro-spinants. Several of the vegetable bitter tonics especially affect the cerebro-spinal system (for example, Quassia;) while some of the cerebro-spinants, (as Strychnia,) in very small doses, act as tonics. Moreover, the beneficial influence of some of the vegetable tonics (as Cinchona) in intermittent diseases, should probably be referred to the specific effects of these agents on the nervous system. And, in the same way, we ought to explain the power of tonics to increase the tone of the muscular system; for it appears from Dr. Marshall Hall's experiments, (*On the Diseases and Derangements of the Nervous System*, p. 78. Lond. 1841.) that one function of the true spinal system is to give tone to the muscles.

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

Tonics may be arranged in orders or groups, as follows:—

Order 1. Simple Bitters.—This order includes those vegetable tonics which possess bitterness with little or no astringency; and which have been termed *bitters*, (*amara*,) or sometimes *pure* or *simple bitters* (*amara pura* seu *simplicia*.) To this group are referred Quassia and Simaruba, obtained from the order *Simarubaceæ;* Gentian, American Calumba, (*Frasera*,) Chirayta, Common Centaury, and Buckbean, from *Gentianaceæ;* Calumba and *Pareira brava* from *Menispermaceæ;* and *Cetraria islandica*, from *Lichenaceæ*. The latter is a *mucilaginous* or *demulcent tonic*. These remedies are employed to promote the appetite and assist digestion in atonic and enfeebled conditions of the stomach; as general tonics in feebleness and debility of the whole system, and especially of the muscles; as antiperiodics in intermittent diseases; and as anthelmintics. Their beneficial operation in expelling intestinal worms has been referred to their poisonous influence over these parasitical animals, but ought perhaps rather to be ascribed to their improvement of the condition of the alimentary canal, and to the removal of those states which favour the production of these beings. The power which they possess of retarding the acetous fermentation may, perhaps, contribute to their beneficial operation in some dyspeptic cases accompanied with acidity and flatulence.

Order 2. Pure Vegetable Astringents.[1]—This order comprehends those vegetable tonics which possess considerable astringency with little or no bitterness. These are the *pure astringents* (*astringentia pura*.) In this group are contained Oak-bark and Nut-galls, from the order *Cupuliferæ;* Uva ursi, from *Ericaceæ;* Catechu and Logwood, from *Leguminosæ;* Rhatany, from *Polygalaceæ;* Tormentilla, from *Rosaceæ;* the Pomegrante-rind, from *Myrtaceæ;* Bistort, from *Polygonaceæ;* and to these may be added Kino. These agents are principally remarkable for causing local contraction and corrugation (or astriction) of the tissues. They contract and give greater density to the muscular fibres; diminish the caliber of the blood-vessels and exhalants, and thereby check hemorrhage, (whence their denomination of *styptics*,) and diminish secretion and exhalation when applied to mucous membranes or other secreting surfaces. In the mouth

[1] For some observations on the distinction between astringency and bitterness, see Percival's *Essays*, vol. i. 2d edition. London, 1772.

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

Order 3. Astringent Bitters.—This order contains those vegetable tonics which possess both bitterness and astringency in an eminent degree; it may, therefore, be denominated *astringent bitters*. It includes Cinchona-bark, from *Cinchonaceæ;* Spigelia, from *Spigeliaceæ;* Elm-bark, from *Ulmaceæ;* and Willow-bark from *Salicaceæ*. It combines the effects of both bitters and astringents, and is by far the most important group of the class, since it contains Cinchona-bark, the most powerful of the vegetable tonics.

Order 4. Aromatic Bitters.—This order contains the *aromatic bitters*, which possess bitterness, with an aromatic flavour (derived from the presence of volatile oil,) and, in some cases, astringency likewise. This group contains Wormwood and Elecampane, from the order *Compositæ;* Cascarilla, from *Euphorbiaceæ;* Angustura-bark, from *Rutaceæ;* and Hops, from *Urticaceæ*. They possess the combined properties of aromatics and bitter tonics, and are, therefore, useful where these are indicated.

Order 5. Acid Tonics.—This order contains the *acid tonics;* namely, the Mineral Acids, to which, perhaps, may be added Alum. These, taken in the dilute state, allay thirst, promote the appetite and digestive process, and augment the secretion of urine. By continued use, they reduce the heat of the body; diminish the fulness and quickness, but increase the firmness, of the pulse; check the cutaneous and pulmonary exhalation and secretion; and heighten the general tonicity of all the fibres and organic tissues. If their employment be continued for too long a period, the digestive functions become much disturbed, chronic inflammation of the mucous lining of the alimentary canal is set up, accompanied with wasting and disorder of the whole system. They are employed as cooling and temperant means in fevers, especially of the hectic kind, and likewise as tonics. They are useful adjuncts to some of the bitter infusions.

Order 6. Metallic Tonics.—This order consists principally of the Preparations of Iron. These combine tonic and stimulant properties, and will be noticed hereafter.

Active Principles.—The active principles of the vegetable tonics are *vegetable alkalis, non-alkaline crystalline substances* analogous to the alkaloids, certain *vegetable acids*, and the substance called *extractive*.

1. Vegetable Alkalis.—Quinia, Cinchonia, and Aricina, are tonic vegetable alkalis. The general properties of this class of substances have been already examined. (See p. 181.)

2. Non-alkaline Neutral Crystalline Principles.—Salicine, Quassine, &c. have some analogy to the vegetable alkalis, but are too imperfectly known to permit any general account of them to be given.

3. Certain Tonic Vegetable Acids.—*Tannic*, *Gallic*, and *Catechuic Acids*, appear to possess tonic properties.

a. Tannic acid (acidum tannicum.)—As this substance is employed in medicine, it will be described in a subsequent part of this work. It will be sufficient, therefore, here to state, that its presence in the astringent tonics is shown by the whitish, or yellowish-white, precipitate (*tanno-gelatin,*) which infusions of these substances form with a solution of isinglass, and by the blue precipitate (*pertannate of iron*) which they give on the addition of a perferruginous salt. It also causes precipitates (*tannates*) with the vegetable alkalis.

β. Gallic acid (*acidum gallicum.*)—The properties of this acid are very similar to those of tannic acid. From this circumstance, as well as from the fact that gallic acid is easily produced by the action of air on tannic acid, it is difficult to prove whether certain vegetable substances contain both these acids, or only tannic acid. Gallic acid agrees with tannic acid in producing a deep blue colour with the persalts of iron, but it does not precipitate gelatine or the vegetable alkalis. Though obtained from several vegetables, yet it probably either does not exist in many of them, or is present in very small quantities only: it is to be regarded, in most cases, as a product rather than an educt. Thus, though nutgalls yield one-fifth of their weight of gallic acid, Pelouze thinks that, originally, they contain none of it, but that what is procured is obtained by the action of atmospheric air on the tannic acid. Taken internally, in small doses, gallic acid causes no inconvenience. It has been given in the dose of from fifteen to thirty grains, against the *Tænia Solium*, but without any benefit. Swallowed to the extent of twenty-four grains, it gave rise to a sweetish taste and a slight feeling of internal heat, but no other symptom. (Chevallier, in the *Dictionnaire des Drogues simples et composées*, t. i. p. 93. Paris, 1827.)

γ. Catechuic Acid.—This is a constituent of several vegetable astringents; as Catechu, Gambier, &c. It probably constitutes the essential part of the substance called by Pelletier *red cinchonic*. It produces a green colour with the salts of iron, but does not occasion any precipitate in a solution of gelatine. Its physiological effects have not been ascertained.

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

Class 4.—Medicamenta Emollentia—Emollients.

(Demulcents.)

Definition.—Agents which diminish tone or insensible contractility of the living tissues to which they are applied, and thereby cause relaxation and weakness, are denominated *emollients* (from *emollio*, I soften.)

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

The constitutional effects of emollients are for the most part those of nutrients, not of medicines; though the continued use of some is said to diminish the tone or vigour of the system generally—an effect ascribed by Barbier (*Traité Elémentaire de Matière Médicale*, t^e^ ii. 2^nde^ éd. Paris, 1824.) to their absorption and local action on all the fibres of the body. This statement, however, is unsupported by fact in the case of gum, starch, sugar, gelatine, albumen, and some other principles.

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

Emollients may be arranged in the following orders:—

Order 1. Aqueous Emollients.—This order contains Water, the principal and most important substance of the class. In order, however, that it may act as an emollient, it must have a certain temperature; for neither very cold nor boiling water has any emollient effect. Dr. Cullen fixes 62° F. as the lowest temperature at which this fluid can be emollient; and observes, that the greater its warmth the greater will be its emollient power, provided that pain or scalding be not produced. Aqueous vapour is, for two reasons, more emollient than liquid water: in the first place, it penetrates the organic tissues more powerfully; and, secondly, a greater degree of heat can be applied by it than by liquid water. Dr. Cullen was doubtful whether advantage could be gained by any addition made to water.

Order 2. Mucilaginous Emollients.—This group has been subdivided into the pure mucilaginous emollients (as Gum Arabic, Tragacanth, Mallow, Marsh-mallow, &c.,) the sweets (as Figs,) the bitters (as *Cetraria islandica*, Coltsfoot, and Sarsaparilla,) and the oily (as Linseed, Sweet Almonds, Poppy seeds, &c.)

Order 3. Amylaceous Emollients.—This order includes starchy or farinaceous substances; as Wheaten Flour, Oatmeal, Barley, Arrow-root, Sago, Tapioca, ordinary Starch, &c.

Order 4. Saccharine Emollients.—This order consists of the saccharine substances; as ordinary Sugar, Honey, Liquorice, &c.

Order 5. Oleaginous Emollients.—This order includes the waxy, fatty, and oily substances; such as the animal fats, &c. (as Lard, Mutton, Suet, Butter, Wax, and Spermaceti,) and the vegetable oils (as Olive, Almond, Sesami, Palm, Poppy, Linseed, &c.)

Order 6. Albuminous Emollients.—This includes the White and Yelk of Eggs, and Milk. Saliva and gastric juice are employed on the continent for medical purposes.

Order 7. Gelatinous Emollients.—This order comprehends the gelatinous substances; as Gelatine in its pure form, Isinglass, Hartshorn shavings, &c.

Active Principles.—*Water* and *oily substances* are, perhaps, the essential emollient principles. For though *gum*, *starch*, *sugar*, *albumen*, and *gelatine*, are termed emollient principles, they do not act as such unless water be present. The properties of these principles will be described in other parts of this work.

Class 5.—Medicamenta Refrigerantia.—Refrigerants.

(Temperants.)

Definition.—Medicinal substances which diminish the temperature of the body when it is preternaturally increased, are denominated *refrigerants* (from *refrigero*, I cool,) or *temperants* (from *tempero*, I moderate.)

Physiological Effects.—The only agent which in all cases reduces animal heat, is cold, used in the form of ice, cold air, cold baths, cold lotions, cold drinks, &c. Their agency is obvious: they abstract heat, and thereby lower the intensity of the vital movements, diminish vascular action, and reduce the calorific functions. (See p. 57.) But there are certain medicinal substances which, by continued internal use, allay febrile heat, and usually promote the secretions, though they have no power of diminishing the ordinary or healthy temperature, and to these the term refrigerant is usually applied. How they act is not completely understood. Dr. John Murray (*A System of Materia Medica and Pharmacy*, 5th ed. vol. i. p. 508. Edinb. 1828.) thought they furnished oxygen to the system, and in that way prevented so large a quantity of it being consumed in the process of respiration,—an explanation borne out by the observations of Mr. Spalding and Dr. Fyfe, (*Annals of Philosophy*, vol. iv. p. 334. Lond. 1814.) that vegetable diet reduces the consumption of oxygen gas in respiration.

Refrigerants may be arranged in two orders, as follows:—

Order 1. Acidulous Refrigerants.—This order consists of the mineral and vegetable (Sulphuric, Hydrochloric, Acetic, Citric, Tartaric, &c.) acids, as well as the acid or super-salts (Alum and Bitartrate of Potash.) To the same order also belong certain acidulous fruits (as Oranges, Lemons, Mulberries, Tamarinds, Prunes, fruit of the Dog-rose, &c.,) and herbs (as Wood Sorrel, Common Sorrel, Lettuce, &c.,) and Acid Whey (*serum lactis acidum.*)

Order 2. Saline Refrigerants.—This order includes certain neutral salts; namely, the Nitrate and Chlorate of Potash.

Active Principles.—*Acids* and the *Alkaline Salts* are the active principles of this class.

Class 6. Medicamenta Evacuantia.—Evacuants.

(Vito-secerning Agents, *Nutall;* Vital Agents which operate on the secerning system, *A. T. Thomson.*)

Definition.—Agents which provoke a discharge by some emunctory, are termed *evacuants* (from *evacuo*, I evacuate or make void.)

Physiological Effects.—As evacuants promote secretion, their action on the secreting organs must be that of excitants; and, when carried too far, is followed by inflammation. They are employed to restore natural secretion, the diminution or stoppage of which has arisen from torpor, or deficient vascular activity of the secreting organ. But their secondary effect is exhaustion; and thus these agents, having a weakening or depressing influence on the system, are employed as antiphlogistics, and are denominated contra-stimulants or hyposthenics by the supporters of the doctrine of contra-stimulus. (See p. 142.) They diminish the quantity of circulating fluid; and hence they are obviously indicated in plethora. By their depressing influence over the vascular system, as well by their power of unloading the blood-vessels, they indirectly promote absorption; and are, in consequence, used in dropsical cases to hasten the removal of the effused fluid. I have already alluded (pp. 47 and 155) to the mutual influence which the secretions have over each other,[1] and which constitutes what has been denominated the *antagonism* of the secretions. In therapeutics we sometimes take advantage of this and excite the secretion of one organ, with the view of diminishing that

[1] "Since all secretions, inasmuch as they extract certain ingredients from the blood, produce a change in its composition, no one secretion can be altered in quantity or quality without disturbing the balance which exists between all in their action on the blood; hence, the increase of one secretion gives rise to the diminution of another." (Müller's *Physiology*, by Baly, vol. i. p. 473.)

of another. Moreover, we frequently employ evacuants as revulsives (see p. 153.) to relieve local determinations of blood to parts remote from those on which the evacuant operates. Thus purgatives are employed in affections of the head. Some of the milder evacuants, which gently and moderately promote the action of two or more secreting organs, are beneficially employed in chronic diseases under the name of *alteratives*, or *purifiers of the blood*. The agents called *resolvents* (as Mercury, Iodine, and the Alkalis,) and which are used to combat visceral and glandular enlargements, augment the activity of the secreting organs.

Modus Operandi.—In a considerable number of cases evacuants exert a topical, stimulant, or irritant influence over the organs whose secretions they augment. In some instances we apply them directly to the part on which we wish them to act; as in the case of Errhines, Masticatories, and Cathartics (usually.) In other instances, the active principle of the evacuant is absorbed, circulates with the blood, and is thrown out of the system by the secreting organ, whose activity it augments. It is probable, therefore, in this case, that the increased secretion arises from the local stimulus communicated to the secreting vessels by the evacuant (or its active principle) in its passage through them. The operation of the Turpentines and Copaiva on the mucous surfaces, and of many diuretics on the kidneys, is readily accounted for in this way.

Active Principles.—*An acrid principle* is found in a considerable number of the medicines of this class. The *salts of the alkalis* operate as evacuants.

Acrid Principles:—*Acrids* are organic substances which irritate or inflame living parts with which they are placed in contact, independently of any known chemical action. They were formerly supposed[1] to owe their activity to a peculiar proximate principle, which was denominated the *acrid principle of plants* (*principium acre plantarum;*) but modern chemistry has shown that there is no one constituent of organic substances to which this term can be exclusively applied; but that many dissimilar principles agree in possessing acridity. Thus acrid substances are found among *acids* (e. g. Crotonic, Ricinic, and Gambogic,) *vegetable alkalis* (e. g. Veratria and Emetia,) *neutral crystalline matters* (e. g. Elaterin,) *volatile oils* (e. g. Cantharadin, and the Oils of Mustard, Garlic, and Rue,) *resins* (e. g. the resins of Euphorbium and Mezereon,) and *extractive matter* (e. g. Colocynthin.) The acrid matter of some plants (e. g. of Ranunculus) has not yet been isolated. This arises from the facility with which it becomes decomposed.

Sub-class 1. Liquefacientia.—Liquefacients.

(Verflüssigende Mittel, *Sundelin.*)

Definition.—Medicinal agents which augment the secretions, check the solidifying, but promote the liquifying, processes of the animal economy, and which, by continued use, create great disorder in the functions of assimilation, may be termed *liquefacients* (from *liquefacio*, I liquefy.)

Practitioners must have long felt the want of some term which should indicate the physiological action of Mercury, Antimony, Iodine, the Alkalis, and other medicinal agents employed as resolvents. To supply this desideratum I have adopted, in the absence of a better, the word Liquefacient.

Physiological Effects.—Liquefacients promote secretion and exhalation generally. Thus Mercurials augment the secerning functions of the mucous follicles of the mouth, the salivary glands, the alimentary canal, the liver, the kidneys, and the skin; and it is probable that they also increase the secretions of the pancreas and the exhalation from the pulmonic surface. Antimonials, Iodine, and the Alkalis, exert a similar, though not equally powerful, influence over the same organs. So that in their effects on these parts, liquefacients correspond with the ancient *panchymagogues* (from παν, all; χυμος, juice; and αγω, I drive away,) or medicines which were supposed to purge away all sorts of humours.

They also check solidifying, while they promote liquefying, processes in the

[1] See the *Principles of Modern Chemistry systematically arranged* by Dr. F. C. Gren., translated from the German, vol. i. p 428. Lond. 1800.—Also Gura, *De Principio Plantarum acri.* Halæ, 1791.

animal economy; and on this account I have ventured to name them *liquefacients*, a term which corresponds nearly with the phrase *verflüssigende Mittel*, used by Sundelin.[1] Thus these agents soften and loosen textures, and assist the removal of adhesions and exudations. This effect is best seen after the use of mercurials, the action of which, observes Dr. Farre,[2] "is positively anti-phlegmonous. If it be pushed far enough, it produces an effect the exact reverse of the phlegmonous state, namely, the erythematous inflammation; the tendency of which is to loosen structure, while that of phlegmonous inflammation is to bind texture." Under the influence of Mercury the gums become spongy, the intestinal and pulmonic membranes softened, (Ferguson's *Essays*, p. 216.) and deposites of coagulable lymph (as in Iritis) are removed. The beneficial effects of Mercurials, Antimonials, Iodine, Alkalis,[3] &c. in promoting the resolution of visceral and glandular inflammation, and in relieving active congestion, may be ascribed to this anti-phlegmonous action referred to by Dr. Farre. These agents are opposed to the exudation of plastic or coagulable lymph (hence they check union by adhesion,) and to the formation of false membranes. During their use, visceral and glandular enlargements and indurations, thickening of membranes (as of the periosteum,) and morbid, but non-malignant, growths of various kinds, are sometimes observed to get softer and smaller, and ultimately to disappear. Dr. Ashwell (*Guy's Hospital Reports*, No. I. 1836.) graphically describes indurations, and hard tumours of the uterus, as having "melted away" under the influence of Iodine. In hepatization of the lungs, the solid matter, deposited in the air-cells, is often absorbed, and the cells rendered again permeable to air, by the use of Mercury. It is on account of the influence of liquefacients in checking phlegmonous inflammation, obviating its consequences, and promoting the removal of enlargements, indurations, &c. that they are frequently denominated *resolvents* (from *resolvo*, I loosen or dissolve.) Lastly, the long-continued use of liquefacients gives rise to a considerable disorder of the functions of assimilation.

A course of Mercury, it is well known, produces paleness or blanching; an effect which Dr. Farre (Ferguson's *Essays*, p. 216.) ascribes to the diminished number of red globules of the blood. A prolonged use of this mineral gives rise to other symptoms of cachexy. The long-continued employment of Alkalis appears to induce a scorbutic cachexy.[4] Iodine causes a morbid state, which has been termed *iodism*.

Our acquaintance with the extent of the order of liquefacients is too limited to enable us to group them for any useful purpose. As a provisional arrangement of them I suggest the following:—

Order 1. Mercurial Liquefacients.
Order 2. Antimonial Liquefacients.
Order 3. Iodic Liquefacients.
Order 4. Alkaline Liquefacients.
Order 5. Saline Liquefacients, including probably Sal Ammoniac, Common Salt, Chloride of Barium, &c.

Order 6. Sulphurous Liquefacients, comprehending Sulphur, and the Alkaline Sulphurets.

Modus Operandi.—The resolvent operation of medicines of this order is usually explained by referring it to an augmented activity of the absorbents. But this explanation is imperfect, and does not account for all the phenomena. The effect is ascribable to a change in the nutrition of the parts affected. My friend, Dr. Billing, (*First Principles of Medicine*, pp. 69, 70, 4th ed. Lond. 1841.) is of opinion that "Mercury and Iodine remove morbid growths by starving them,

[1] *Handbuch der speciellen Heilmittellehre*, Bd. i. S. 180, 3te Aufl. Berlin, 1833.
[2] *Essays on the most important Diseases of Women*, by Robert Ferguson, M. D. Part i. p. 215. Lond. 1839.
[3] Mascagni, in the *Memorie della Societa Italiana delle Scienze*. Modena, 1804.—Also Negri, in *Lond. Medical Gazette*, vol. xiv. p. 713.
[4] See Huxham's *Essay on Fevers*, pp. 48 and 308. 3d edit. 1757.—See also Dr. Burrows's *Gulstonian Lectures* in the *London Medical Gazette*, vol. xiv.

which they effect by contracting the capillaries." But I conceive there must be something more in the influence of these remedies than a mere reduction in the quantity of blood supplied to the affected parts. The enlargements which these agents remove are not mere hypertrophies; their structure is morbid, and they must, in consequence, have been induced by a change in the quality of the vital activity; in other words, by morbid action. Medicines, therefore, which remove these abnormal conditions, can only do so by restoring healthy action,—that is, by an alterative influence. By what force or power they are enabled to effect changes of this kind must, for the present at least, be a matter of speculation. Müller (*Physiology*, by Baly, vol. i. p. 363.) thinks it is by affinity. "They produce," he observes, "such an alteration in the composition of the tissues, that the affinities already existing are annulled, and new ones induced, so as to enable the vital principle—the power which determines the constant reproduction of all parts in conformity with the original type of the individual—to effect the farther restoration and cure; the Mercury itself does not complete the cure."

Sub-class 2. Diaphoretica.—Diaphoretics.

(Sudorifica; Diapnoïca.)

Definition.—Medicinal agents, which promote cutaneous transpiration, are denominated *diaphoretics* (from διαφορεω, I transpire,) *sudorifics* (from *sudor*, sweat, and *facio*, I make,) or *diapnoïcs* (from διαπνοη, perspiration.)

The terms *diaphoretic* and *diapnoïc* have been used to designate substances which augment the insensible perspiration; while the word *sudorific* indicates a substance increasing the sweat or sensible perspiration. But insensible perspiration and sweat differ in their physical conditions only,—the former being the vaporous, the latter the liquid state of the same fluid. Hence, there can be no essential difference between diaphoretics and sudorifics, and I, therefore, use the terms synonymously.

Physiological Effects.—The agents which, under certain circumstances, augment cutaneous exhalation, are both numerous and heterogeneous. External heat, assisted by the copious use of diluents, constitutes an important and powerful means of promoting sweating. Whenever a large quantity of fluid is taken into the system, the excess is got rid of by the kidneys, the skin, and the lungs; and if we keep the skin warm, as by warm clothing, or the use of hot air or hot vapour-bath, (See pp. 47, 50, and 52.) the action of the cutaneous exhalants is promoted, and sweating results; but if the skin be kept cool, the kidneys are stimulated, and the greater part of the liquid passes off through them. Friction, exercise, and all agents which excite vascular action, have a tendency to promote sweating. The sudden and temporary application of cold, as in the affusion of cold water, (See p. 60.) sometimes proves sudorific by the reaction which it occasions. Lastly, many medicinal agents, acting through the circulation, cause sweating. The latter are the substances which are usually indicated by the word sudorific or diaphoretic.

Diaphoretics are relative agents; they succeed only in certain states of the body. Moreover, for different conditions, different diaphoretics are required. They constitute an exceedingly uncertain class of remedies, with regard both to the production of sweating and to the advantage to be derived therefrom. Dr. Holland (*Medical Notes and Reflections*, p. 52. Lond. 1839.) suggests that when benefit follows the use of diaphoretic medicines, it is often ascribable, not to their direct influence on the exhalant vessels, but to other changes which they excite in the system, of which sweating is to be regarded rather as the effect and proof than as the active cause.

The operation of diaphoretics is promoted by the exhibition of large quantities of warm mild diluents, and by keeping the skin warm. Moreover, they are more effective when given at bed-time, since there appears to be greater disposition to sweating during sleep than in the waking state. The exhibition of diu-

retics should be avoided during the operation of diaphoretics, as they appear to check the operation of the latter. The same rule has been laid down with regard to purgatives; but it is well known that perspiration is often the consequence of hypercatharsis.

Diaphoretics may be arranged in seven orders, as follows:—

Order 1. Aqueous Diaphoretics.—Under this head are included not only simple Water, but Gruel, Whey, and Tea. These, when assisted by external warmth, often prove very effective diaphoretics, even when used alone, while to all the other groups they are valuable adjuvants; and in no cases are they injurious.

Order 2. Alkaline and Saline Diaphoretics.—The salts of the alkalis are frequently used to promote perspiration. Acetate and Carbonate of Ammonia, Alkaline Citrates and Tartrates, Sal Ammoniac, and Nitrate of Potash, are employed for this purpose in fevers.

Order 3. Antimonial Diaphoretics.—The liquefacient operation of Antimonials has been already referred to. Diaphoresis is one of its consequences. We use this group of diaphoretics in febrile and inflammatory cases. It is preferred to the opiate diaphoretics when there is inflammation or congestion of the brain, or a tendency to either of these conditions.

Order 4. Opiate Diaphoretics.—Opium and its alkali Morphia have a remarkable tendency to produce sweating. The former is often used as a diaphoretic, commonly in the form of Dover's Powder, when no disorder of the brain exists; and especially when an anodyne is indicated. When the stomach is very irritable, an opiate diaphoretic is preferred to an antimonial one. In rheumatism, and slight catarrhs, Dover's Powder proves highly serviceable. In diabetes and granular disease of the kidneys, it is the best sudorific we can use, especially when conjoined with the warm bath.[1] Opium and Camphor form a serviceable sudorific compound when the surface is cold, as in Cholera.

Order 5. Oleaginous and Resinous Diaphoretics.—This group includes a large number of substances, some of which owe their activity to volatile oil, as the Labiatæ and the Lauraceæ (*e. g.* Sassafras and Camphor;) others to resin, as Mezereon and Guaiacum; while some contain both oil and resin, as Copaiva and the Turpentines. The substances of this order possess stimulant properties. They probably act locally on the cutaneous vessels through the blood; for some of them (*ex.* Copaiva) can be detected by their odour in the perspiration, and they occasionally excite a slight eruption on the skin. The diaphoretics of this group are useful in chronic rheumatism, secondary syphilis, and chronic cutaneous diseases.

Order 6. Alcoholic Diaphoretics.—Alcohol and Wine augment cutaneous exhalation.

Order 7. Ipecacuanha.—I believe the diaphoretic property of Ipecacuanha to be considerably less than is commonly supposed. Dover's Power owes its power of producing sweating almost exclusively to the Opium which it contains.

Modus Operandi.—Dr. Edwards (*De l'Influence des Agens Physiques sur la Vie.* Paris, 1824.) has shown, that cutaneous transpiration is effected in two ways,—by a physical action or evaporation, and by an organic action or transudation. *Evaporation*, or the physical action, is the consequence of the porosity of bodies, and takes place equally in the dead and living state. It is influenced by the hygrometric states of the surrounding air, by its motion or stillness, by its pressure, and by its temperature. Thus, dryness, agitation, and diminution of the weight of the air, increase it. *Transudation*, or the organic action of transpiration, is a vital process, effected by minute spiral follicles or sudoriferous canals, and depends essentially on causes inherent in the animal economy, although it may be influenced to a certain extent by external agents. Thus, elevating the temperature of the surrounding air, preventing its frequent renewal, and covering the patient with warm clothing, are means which promote the organic, but check the physical, action of transpiration. Diaphoretics affect the transudation or the vital process. They probably affect the exhalants in one or both of two ways;—by increasing the force of the general circulation,—or by specifically stimulating the cutaneous vessels.

Sub-class 3. Diuretica.—Diuretics.

Definition.—Medicines which promote the secretion of urine are denominated *diuretics* (from διὰ, *through;* οὖρον, the *urine;* and ῥεω, *I flow.*)

[1] See Dr. Osborne's paper in *The Dublin Journal of Medical and Chemical Science*, Jan. 1834.—Also Dr. Christison, *On Granular Degeneration of the Kidneys.* Edinburgh, 1839.

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

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

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

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

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

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

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

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

By augmenting the secretion of urine we diminish the quantity of blood in the blood-vessels, and thus create thirst, and promote absorption from the serous cavities. Hence, diuretics are commonly resorted to in dropsical complaints; but they are most uncertain in their operation. Moreover, when they increase

the quantity of urine, their influence on the effusion is not always curative. In dropsy, attended with albuminous urine, and which arises from granular degeneration of the kidneys, diuretics have usually been considered objectionable, on account of their stimulant influence over the kidneys. Dr. Christison, (*On Granular Degeneration of the Kidneys*, pp. 138, 149, and 160.) however, thinks the distrust has been carried too far, and asserts, that they "do not increase the coagulability of the urine in the early stage: in many instances they seem to diminish it." He also suggests that the irritation set up by the diuretic may be of a different kind to that of the disease; and that the one may not possibly increase,—nay, perchance, may diminish, the other. In relieving the effusion and the coma, he thinks them serviceable, and prefers Digitalis and Cream of Tartar to other agents of this order.

Diuretics may be arranged in the following groups :—

Order 1. Aqueous Diuretics.—Aqueous drinks promote diuresis indirectly, when the skin is kept cool, as I have before mentioned.

Order 2. Saline Diuretics.—This order consists principally of the Vegetable Salts of the Alkalis; especially Bitartrate and Acetate of Potash. These undergo partial digestion in the system, and are converted into carbonates. Hence, they communicate an alkaline quality to the urine. Their supposed influence in the respiratory process has been before alluded to. (See p. 134.) To this order also belong Nitrate and the Carbonates of the Alkalis.

Order 3. Sedative Diuretics.—To this order belong Digitalis and Tobacco, whose power of reducing the force and frequency of the heart's action has been already referred to. (See p. 178.) The diuretic effect has been referred, by Dr. Paris, (*Pharmacologia*, p. 179, 6th ed.) to their sedative operation. For as the energy of absorption is generally in the inverse ratio of that of circulation, it is presumed that all means which diminish arterial action must indirectly prove diuretic, by exciting the function of absorption.

Order 4. Bitter Acrid Diuretics.—To this order belong Squills, Colchicum, and Common Broom. These agents, in an over-dose, readily occasion vomiting. They owe their activity to an acrid principle, which probably operates, through the circulation, on the renal vessels as a local stimulant or irritant, and in this way proves diuretic. According to my own observations, Common Broom less frequently fails to prove diuretic than most other agents of this class.

Order 5. Oleaginous Acrid Diuretics.—To this order belong Juniper, Turpentine, Copaiva, and Cajuputi. The volatile oil probably operates through the blood on the kidneys, as a topical stimulant. Cantharidin, the active principle of Cantharis vesicatoria, is of the nature of volatile oil, and operates in the same way.

Order 6. Acid Diuretics.—The diluted Acids frequently prove diuretic.

Order 7. Alcoholic and Etherial Diuretics.—Dilute Spirit and Nitric Ether are diuretics.

Order 8. Alkaline Diuretics.

Modus Operandi.—I have referred to the *modus operandi* of diuretics in speaking of the Orders; and, in a former part of this work, (See p. 125.) I have given a list of the substances which have been detected either unchanged, or more or less changed, in the urine.

Sub-class 4. Errhina.—Errhines.

Definition.—*Errhines* (from εν, *in* and ρις, *the nose*) are medicines which produce an increased discharge of nasal mucus. Substances which excite sneezing are denominated *sternutatories* (*sternutatoria*) or *ptarmics* (from πταιρω, *I sneeze.*)

Physiological Effects.—All the substances employed as errhines, or sternutatories, are applied to the nose. The liquefacients, when administered by the stomach, augment the secretion of the pituitary membrane as well as of all other secreting organs; and I have several times remarked the increased discharge of mucus from the nose of patients under the influence of Iodide of Potassium, and have detected the smell of Iodine in their handkerchiefs, so that I believe the

particles of this substance are thrown off by the mucous membrane of the nose, as well as by other secreting organs.

Most foreign matters when applied to the pituitary membrane promote its secretion, and frequently also occasion sneezing. The latter is a reflex action of the true spinal system; the excitor or incident nerve, by which the impression is conveyed to the medulla oblongata, is the nasal branch of the trifacial nerve. Sugar and the Labiate plants, when reduced to powder, operate as very mild errhines. Euphorbium, Veratrum, and more especially the alkali Veratria, are the most powerful of the order. Tobacco is intermediate. Absorption readily takes place from the pituitary membrane, and I have several times experienced the constitutional effects of Tobacco (such as nausea, giddiness, depression of the muscular power, and disorder of the mental functions,) from the use of the moist snuffs (Rappees.) The continued employment of snuff injures the sense of smell and alters the tone of the voice. In syphilitic affections of the nose, and where there is a disposition to nasal polypus, the frequent use of errhines may perhaps be injurious. Errhines have been principally employed to relieve chronic affections of the eyes, face, and brain; for example, chronic ophthalmia, amaurosis, headach, &c. They can only be useful on the principle of counter-irritation.

Schwilgué (*Traité de Matière Médicale*, t. ii. p. 298.) enumerates the following purposes for which sneezing is excited: to excite respiration when this function is suspended; to promote the expulsion of foreign bodies accidentally introduced into the air-passages; to occasion a general shock at the commencement of dangerous diseases which we wish at once to suppress; to augment the secretion of nasal mucus, and of tears; to favour the excretion of mucus collected in the nasal sinuses; to rouse the action of the encephalon, of the senses, of the uterus, &c.; and to stop a convulsive or spasmodic state of the respiratory apparatus. We should not, however, forget that the concussion occasioned by sneezing is not always free from dangerous results, especially in plethoric habits, and persons disposed to apoplexy, or affected with hernia, prolapsus of the uterus, &c.

The Errhines may be arranged in the following groups:—

Order 1. Mechanically-irritating Errhines.—To this order Sugar and other inert substances belong.

Order 2. The Labiate or Aromatic Errhines.—Sage, Marjoram, Lavender, and other Labiate plants, form mild snuffs when reduced to powder. They are seldom used singly or alone.

Order 3. Cerebro-spinant Errhines.—To this order belongs Tobacco, which constitutes the basis of ordinary snuff.

Order 4. Acrid Errhines.—Euphorbium, Veratrum, and Asarum, belong to this order.

Order 5. Inorganic Errhines.—Common Salts, Sal Ammoniac, and Subsulphate of Mercury, belong to this group.

Sub-class 5. Sialogoga.—Sialogogues.

Definition.—Medicines used to augment the salivary discharge are denominated *sialogogues* (from σιαλον, the saliva; and αγω, I convey or drive out.)

Physiological Effects.—Sialogogues are of two kinds: some act topically, others by specific influence over the salivary organs. This, therefore, is the foundation for arranging them in two groups or orders.

Order 1. Local Sialogogues.—These are sialogogues which are applied to the mouth. When used in a soft or solid state they are called *masticatories* (*masticatoria*, from *mastico*, to *eat* or *chew*.) They act on the mucous follicles of the mouth and the salivary glands. Most solid or soft bodies, when chewed increase the flow of saliva: thus Wax and Mastic produce this effect. Acrids, however, as Horse-radish, Mezereon, Pellitory of Spain, and Ginger, possess this property in an eminent degree.

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

As the saliva is generally swallowed, masticatories do not confine their action to the mouth, but excite likewise the stomach. Peron (*Voyage aux Terres Australes.* Paris.) was convinced that he preserved his health, during a long and difficult voyage, by the habitual use of the Betel; while his companions, who did not use it, died mostly of dysentery. For habitual use, and as mere sialogogues, mucilaginous and emollient masticatories might be resorted to, but we find that acrids of various kinds have always been preferred. Masticatories, as therapeutic agents, have been principally used either as topical applications, in affections of the gums, tongue, tonsils, salivary glands, &c. or as counter-irritants in complaints of neighbouring organs, as in earache, rheumatism of the pericranium, affections of the nose, &c. The stronger masticatories, as Mustard and Horse-radish, excite an increased discharge of nasal mucus and tears, as well as of saliva and mucus of the mouth.

Order 2. Specific or Remote Sialogogues.—Several substances have had the reputation of producing salivation or ptyalism by internal use. Of these the preparations of Mercury are the only ones on which much reliance can be placed, and even they sometimes disappoint us. The preparations of Gold, of Antimony, and of Iodine, occasionally have this effect. The continued use of the Hydrocyanic or Nitric Acid has, in several instances, produced salivation. In poisoning by Foxglove the same has been observed. Lastly, nauseants increase the secretion of saliva. Mercurials are given in certain diseases to excite ptyalism, and in some cases it is necessary to keep up this effect for several weeks. It is not supposed that the salivation is the cause of the benefit derived, but it is produced in order that we may be satisfied that the constitution is sufficiently influenced by the medicine.

Sub-class 6. Expectorantia.—Expectorants.

Definition.—Medicines which promote evacuations from the bronchia, trachea, and larynx, are denominated *expectorants* (from *expectoro*, I expectorate.)

Physiological Effects.—In the healthy state, the liquids secreted or exhaled by the aërian membrane are got rid of by evaporation and absorption. But when from any circumstance the balance between the two processes of production and removal is destroyed, and an accumulation of mucus takes place, nature endeavours to get rid of it by coughing. Hence some have applied the term expectorant to irritating substances (as Chlorine gas, the vapour of Acetic or of Benzoic acid, &c.,) which, when inhaled, produces coughing, as well as an augmentation of secretion. "We provoke cough," says Schwilgué, (*Traité de Matière Médicale*, tom. ii. p. 296.) "to favour the expulsion of foreign bodies introduced from without into the aërian tube, and especially of liquids; we have recourse to it to favour the expectoration of mucus, of membraniform concretions, and of pus, which have accumulated in the aërian passages, whenever the local irritation is not sufficiently great.

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

which, when taken internally, are supposed to affect the aërian membrane in a specific manner, and are beneficially employed in chronic catarrhs. Such are the Balsams, the Oleo-resins, the Fœtid Gums, Squills, &c. Many of the substances which give relief in chronic pulmonary complaints, do not promote, but check, the secretion of bronchial mucus: as the Sulphate of Zinc,—to which Begin (*Traité de Thérap.* t. ii. p. 561.) adds the Balsams. Yet these agents are usually classed with expectorants; and Dr. Paris (*Pharmacologia.*) makes one class of expectorants to consist of "medicines which diminish the inordinate flow of fluid into the lungs, and render the expectoration of the remainder more easy." In fact, it appears to me that a large majority of the agents used under the name of expectorants, in bronchial and pulmonary affections, are substances which modify the vital activity of the aërian membrane by an alterative influence, and that expectoration is by no means an essential effect of their operation. This appears to be particularly the case with Antimonials, Senega, and Ipecacuanha. Of all classes of the Materia Medica, none are more uncertain in their action than expectorants.

The following is a provisional arrangement of the substances most commonly used as expectorants:—

Order 1. Vapours or Gases used as Topical Expectorants.—Chlorine and Ammoniacal Gases; the Vapours of Iodine, of Water, of the Volatile Oils, of Tar, of Benzoic and Acetic Acids; and the Smoke of Tobacco and Stramonium.

Order 2. Stimulating, Resinous Expectorants.—This order includes the Fœtid Gums, the Oleo-resins, and the Balsams.

Order 3. Nauseating Expectorants, as Emetic Tartar, Ipecacuanha, Squills, Garlic, and Senega.

Modus Operandi.—Several of the so-called expectorants become absorbed, and are recognisable by their odour in the breath; as some of the Oleo-resins, Garlic, and Asafœtida. It is probable, therefore, that their influence over the bronchial membrane is by a topical action. Emetina and Emetic Tartar have, according to Magendie (*Formulaire.*) and Orfila, (*Toxicologie Générale.*) a specific influence over the lungs, and the lungs of animals killed by these substances are said to present traces of inflammation.

Sub-class 7. Emetica.—Emetics.

(Vomitoria.)

Definition.—Medicinal agents used for the purpose of provoking vomiting are called *emetics* (from εμεω, I vomit,) or *vomits*.

Physiological Effects.—Usually within twenty or thirty minutes after taking an emetic, a general feeling of uneasiness and nausea comes on. The pulse becomes small, feeble, and irregular; the face and lips grow pale; a distressing sensation of relaxation, faintness, and coldness of the whole system is experienced; the saliva flows copiously from the mouth; the eyes lose their lustre; and the whole countenance appears dejected. These symptoms, which constitute the first stage of vomiting, continue for a variable period, and are followed by the ejection of the contents of the stomach. As soon as actual vomiting commences, the general phenomena are altered: the pulse becomes frequent and full, the temperature of the body increases, and a sweat breaks out on the face and other parts. During the act of vomiting, in consequence of the pressure made on the abdominal aorta, and the interruption to the circulation through the lungs, from the impeded respiration, the blood returns with difficulty from the head, the face swells and becomes coloured, the conjunctiva is turgid and red, the jugular veins are gorged, and tears burst from the eyes. The violent straining is often attended with pain in the head and eyes, and with the involuntary expulsion of

the urine and fæces. The matters vomited vary according to circumstances: they may consist of the alimentary substances, bile, &c. contained in the stomach and duodenum previous to the exhibition of the emetic; of the fluids collected by the action of the emetic; and, lastly, of the emetic itself. Sometimes striæ of blood are observed, which usually come from the pharynx. The number of vomitings, and the ease with which they are effected, are liable to considerable variation, arising from the state of the digestive organs, the temperament of the patient, the state of the cerebral functions, &c. When the vomiting has entirely ceased, the patient feels languid, oppressed, and drowsy, and the pulse becomes weak and slow: the exhaustion is sometimes so great as to be attended with fatal consequences. A case of this kind is alluded to by Dr. Paris, (*Pharmacologia*, vol. i. p. 163, 6th ed. 1825.) in which an emetic was imprudently given to a patient in the last stage of phthisis, with the intention of dislodging the pus with which the lungs were embarrassed: syncope was produced, from which the patient never recovered. Among other occasional ill consequences of vomiting may be mentioned comatose affections, uterine or pulmonary hemorrhages, hernia, abortion, suffocation, prolapsus of the uterus, rupture of the abdominal muscles, &c. These effects are produced by the violent muscular exertions, which attend the act of vomiting. They suggest cautions as to the use of emetics. Thus, in apoplexy, and some other cerebral affections, or when a tendency thereto exists; in pregnancy, especially when miscarriage is threatened; in prolapsus uteri, hernia, aneurism, &c. the danger to be apprehended from emetics is obvious. The concussion which they excite sometimes dislodges gall-stones.

The intensity and duration of the different stages of vomiting have no necessary relation to each other. Thus the Sulphates of Zinc and Copper excite speedy vomiting, with but little nausea;—and are, therefore, preferred as emetics in narcotic poisoning. Tobacco and Tartarized Antimony, on the other hand, produce great nausea and depression of system. Hence, when the depressing effects of emetics are required, as in inflammatory and other diseases, we employ the last-mentioned emetic. (See p. 154.)

The irritation produced by the exhibition of emetics gives rise to an increased secretion from the mucous follicles of the stomach and duodenum; as is shown by the thick, filamentous, and viscid matters frequently ejected. We infer, also, that the action of the exhalants must be increased, inasmuch as persons who have taken only a few spoonsful of emetic liquids sometimes bring up a very considerable quantity of fluid. Darwin mentions a man who vomited six pints of liquid, although he had only swallowed one. Bile is frequently thrown up, either alone or mixed with other fluids; but we must not infer from this that it had existed in the stomach previous to the exhibition of the emetic, for bile is not ordinarily rejected in the first efforts, but only in the subsequent vomitings; and the quantity increases in proportion to the length of time the vomiting continues. Emetics promote the secretion of bile, and probably of the pancreatic juice also. We presume that they likewise augment absorption during the stage of nausea, previously to the act of vomiting, and when the force of the circulation is reduced.

The number of medicinal substances employed as emetics being but few, little benefit can attend any attempt to classify them. There are, however, two modes of arranging them; either into *vegetable emetics* and *mineral emetics;* or into, first, those which seem to possess a specific power of exciting vomiting (as Emetic Tartar,) since they induce it, not only when contained in the stomach, but also when thrown into the veins or otherwise introduced into the circulation (*specific emetics*,)—and secondly, those (as Mustard) which create vomiting only when taken into the stomach (*topical emetics.*[1])

[1] For an account of the uses of emetics consult Dr. Fothergill's Inaugural Dissertation," "*De Emeticorum Usu in variis Morbis tractandis.*" Edinb. 1736.—An English translation of this is published in his *Medical Works*, by J. C. Lettsom, M. D. Lond. 1784.

Modus Operandi.—Vomiting is a reflex spinal act. It may be excited by touching the fauces, velum pendulum palati, &c. In this case the excitor nerve is the trifacial, the branches of which are distributed to these parts. Tickling the back part of the pharynx excites an act of deglutition.[1] Irritation of the stomach, and upper part of the intestines, also produces vomiting. In this case, the pneumo-gastric and splanchnic nerves act simultaneously, according to Müller, (*Physiology*, by Baly; vol. i. p. 509.) in transmitting the irritation. Emetic Tartar causes vomiting, both when taken into the stomach, and when injected into the veins. As its operation is probably alike in both cases, it becomes a question whether, when introduced into the stomach, it must be first taken up into the circulation before it can cause an act of vomiting;—or, when injected into the veins, it acts on the parts engaged in the act of vomiting through the medium of their blood-vessels? I believe the latter is the more probable explanation; because, in the first place, we know that ordinary gastric irritation, where absorption is out of the question, will excite vomiting;—and, secondly, because Müller has found, that lacerating with a needle the nervous splanchnicus of the left side, in the rabbit, will produce contraction of the abdominal muscles. If this opinion be correct, emetics, when introduced into the stomach, affect the medulla oblongata through the excitor nerves (the pneumo-gastric,) and the contraction of the muscles necessary to the act of vomiting, is effected by the reflex nerves (the spinal nerves to produce the expiratory efforts, and, according to Dr. Hall, the pneumo-gastric to close the larynx, and open the cardia.) When, however, the emetic is introduced into the circulation, it is doubtful "whether its more important action is upon the organs from which the nervous energy for the movements of vomiting are derived, or upon the organs of motion themselves." (Müller, *op. supra cit.* p. 510.)

The mechanism of the act of vomiting is too exclusively a physiological subject to permit any observations on it in this place. I must refer to the works of Müller and Dr. M. Hall for information concerning it.

Sub-class 8. Cathartica.—Cathartics.

(Purgatives.)

Definition.—Medicines which produce alvine evacuations are denominated *Cathartics* (from καθαιρω, I purge.)

Physiological Effects.—Cathartics cause alvine evacuations by increasing the peristaltic motion of the intestines and by promoting secretions from the mucous lining. The milder purgatives, however, operate principally by their influence on the muscular coat of the intestines; while the stronger ones stimulate the mucous follicles and exhalants, and give rise to liquid evacuations. These are denominated *Hydragogues* (from ὑδωρ, water; and αγω, I drive off.) Some of them create nausea, faintness, occasionally vomiting, colicky pains, abdominal tenderness, and tenesmus. The more violent ones, if given in an over-dose, produce inflammation of the alimentary canal[2] characterized by violent vomiting and purging, abdominal pain and tenderness, cold extremities, and sinking pulse. These are denominated *Drastics* (from δραω, I am active.) Emollient or demulcent drinks (as barley water, gruel, and broth) are taken to favour their safe operation. As the intestinal surface consists of about 1400 square inches,[3] from the whole of which secretion and exhalation are going on, it is obvious that purging

[1] Dr. Marshall Hall, *On the Diseases and Derangements of the Nervous System*, p. 103. A feather, introduced into the throat to excite vomiting, has, by being pushed too far down, been actually swallowed, without causing vomiting.

[2] The deaths from the use of Morison's Pills are referrible to this. The active ingredient of these medicines is gamboge (see *Lond. Med. Gaz.* vol. xiv p. 672 and 759; vol. xvii. p. 357, 415, and 623; vol. xviii. p. 75 and 927; vol. xix. p. 976.)

[3] This measurement has been calculated from the statements as to the length and diameter of the intestines in Meckel's *Manuel d'Anatomie générale, descriptive et pathologique.* Traduit par J. A. L. Jourdan et G. Breschet. Paris, 1825.

offers a very powerful means of diminishing the quantity of the fluids of the body; and accordingly we find that some cathartics, especially Elaterium, cause very copious watery discharges; and their employment is followed, as might be expected, with thirst and augmented absorption from the serous cavities, so that they sometimes reduce or even remove dropsical swellings. The more violent purgatives promote the discharge of bile and pancreatic liquor, by the irritation they produce at the termination of the ducts which pour these secretions into the alimentary canal.

A distinction is usually made in practice between *cooling* and *warm* purgatives. By the former are commonly meant saline purgatives which, while they cause purging, without having any tendency to excite inflammation, are supposed to have a refrigerant influence over the system, and are adapted for febrile and inflammatory cases. By the latter are meant the more violent cathartics, which are presumed either to quicken the pulse, or at least to excite the abdominal vascular system, and, therefore, are considered to be less fitted for febrile cases.[1]

Cathartics may be conveniently arranged in five groups or orders, as follows:—

Order 1. Laxatives or Lenitives.—This group contains the *mild cathartics*, such as Manna, Cassia pulp, Tamarinds, Prunes, Honey, Bitartrate of Potash, and the fixed Oils (as Castor, Almond, and Olive oils.) These very gently evacuate the contents of the intestinal canal, and usually without causing any obvious irritation, or affecting the general system. Manna, however, is apt to occasion flatulence and griping. Laxatives are employed in any cases where we wish to evacuate the bowels with the least possible irritation, as in children and pregnant women; in persons afflicted with inflammation of any of the abdominal or pelvic viscera, with hernia, prolapsus of the womb or rectum, piles, or stricture of the rectum; and after surgical operations about the abdomen and pelvis.

Order 2. Saline, Antiphlogistic, or Cooling Cathartics.—This order is composed of the *saline* purgatives, such as the Sulphates of Soda, Potash, and Magnesia, &c. They increase the peristaltic motion of the alimentary canal, and augment the effusion of fluids by the exhalants of the mucous surface, thereby giving rise to watery stools. They do not appear to possess the power of inflaming the intestinal tube, nor of heating the general system. They are adapted for febrile disorders, inflammatory affections, plethoric conditions, &c.

Order 3. Milder Acrid Cathartics.—This order includes Senna, Rhubarb, and Aloes. These are more active substances than any of the preceding. They are acrids and stimulants, but their local action is not sufficiently violent to cause inflammation. Senna is employed where we want an active, though not very acrid or irritant, purgative. Rhubarb is administered in relaxed and debilitated conditions of the alimentary canal, on account of its tonic properties. Aloes is used in torpid conditions of the large intestines, and in affections of the head. It is usually considered objectionable in piles and diseases of the rectum.

Order 4. Drastic Cathartics.—This group comprehends the *strong acrid purgatives;* such as Jalap, Scammony, Black Hellebore, Gamboge, Croton oil, Colocynth, and Elaterium. These, when swallowed in large doses, act as acrid poisons. They are employed as purgatives in torpid conditions of the bowels; as hydragogues in dropsical affections; and as counter-irritants in affection of the brain. They are objectionable remedies in inflammatory and irritable conditions of the alimentary canal.

Order 5. Mercurial Cathartics.—The principal of these are the Hydrargyrum cum Cretâ, the Pilula Hydrargyri, and Calomel. We employ them as alterative purgatives, and to promote the hepatic functions. As they are uncertain in their operation, they are usually combined with, or followed by, other purgatives.

Modus Operandi.—The more powerful cathartics are acrids or local irritants. Some of them (*e. g.* Gamboge) operate almost solely in this way; for they do not excite purging except when they are introduced into the alimentary canal, and they easily excite vomiting when swallowed. But most of the drastics

[1] An anonymous writer, in the *London Medical Gazette*, vol. iv p. 139, contends that Aloes is not a warm purgative, though usually considered to be so.

exert, in addition, a specific influence over the alimentary canal, so that they excite purging when injected into the veins, or when applied either to the serous membranes or cellular tissue. Senna, Castor and Croton oils, Black Hellebore, Colocynth, and Elaterium, operate in this way. This circumstance, therefore, favours the notion that they act, in part at least, by absorption.

That the purgative principles of some carthartics are absorbed, is quite certain. Gamboge, Rhubarb, Sulphate of Potash, and Oil of Turpentine, have been detected in the blood. Senna, Rhubarb, and Jalap, communicate purgative qualities to the milk. The colouring matters of Cassia pulp, Rhubarb, Senna, and Gamboge, have been recognised in the urine.

Some cathartics act also as diuretics,—as Bitartrate of Potash and Gamboge. Dr. Christison (*On Granular Degeneration of the Kidneys*, p. 150. Edinburgh, 1839.) observed, that where diuretics have been given for some time without effect, he has frequently seen their action brought on "by a single dose of some hydragogue cathartic,—such as Gamboge." The resinous particles, in their passage out of the system through the renal vessels, probably acted as topical stimulants.

Cathartics probably act, in part at least, by a reflex action of the ganglionic system. Müller (*Physiology*, by Baly, vol. i. p. 511.) observes, that galvanizing the splanchnic nerve or the cœliac ganglion, gives rise to a generally increased activity to the peristaltic movements, while division neither of the pneumo-gastric nor of the sympathetic nerve, puts a stop to them. This appears to show that the splanchnic nerve is concerned in propagating the irritation set up by cathartics. The tenesmus occasioned by some cathartics is a reflex action of the true spinal system.

Different parts of the alimentary canal are unequally affected by different cathartics. Thus, Aloes is remarkable for its action on the large intestine; moreover, many of the drastic cathartics,—as Gamboge, Colocynth, Savin, and Black Hellebore,—create more irritation in the large, than in the small, intestines; and Orfila (*Toxicologie Générale.*) mentions, that in animals killed by these substances, he found the stomach and rectum inflamed, while the small intestines were healthy. In some cases, perhaps, this may be ascribed to the rapidity with which these agents pass through the small intestines, and on their longer continuance in the stomach and rectum; but the same appearance has been noticed when these cathartics have been applied to the cellular texture of the thigh.

According to Liebig,[1] concentrated saline solutions have a physical, as well as a medicinal, action. They extract water from the coats of the stomach, and thereby create thirst. Part of the solution, thus becoming diluted, is absorbed; but the greater portion enters the intestines, dilutes the solid matters, and thus acts as a purgative.

Sub-class. Emmenagoga.—Emmenagogues.

Definition.—Medicines which excite or promote the catamenial discharge are termed *emmenagogues* (from εμμηνια, the menstrual discharge, and αγω, I drive away.)

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

[1] *Organic Chemistry in its Application to Agriculture and Physiology*, edited by Lyon Playfair, p. 334. Lond. 1840.

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

The substances usually regarded as specific emmenagogues are, for the most part, medicines which, when taken in large doses, act as drastic purgatives. Such are Savin, Black Hellebore, Aloes, Gamboge, &c. They excite the pelvic circulation, give rise to a sensation of bearing down of the womb, especially in females disposed to procidentia uteri, increase uterine hemorrhage, or the menstrual discharge, when given during these conditions,—and when administered in chlorosis or amenorrhœa, sometimes bring on the catamenia. Savin is decidedly the most emmenagogue of all the drastics just mentioned. The most effectual mode of obtaining its uterine influence is by exhibiting its oil.

Substances that irritate the urinary organs also evince a stimulant influence over the uterus. I have known abortion produced by Cantharides given as an emmenagogue.

Rue is a reputed and popular emmenagogue. It possesses cerebro-spinant properties, and has on several occasions produced mis-carriage.

Madder was a favourite emmenagogue with the late Dr. Home, (*Clinical Experiments*, p. 422, 2d ed. Lond. 178.) who declared it to be the strongest and safest known. The Fetid Gums and Castoreum have also been supposed to possess a similar property. The Chalybeates are exceedingly valuable remedies in uterine obstructions, attended with an anæmic condition of system. Mercurials, by their liquefacient properties, promote the secretion of the uterus in common with that of other organs.

Ergot of Rye possesses an unequivocal influence over the uterus. But it rather promotes uterine contractions than the menstrual function; though it has, on many occasions, been successfully employed in amenorrhœa.

Sub-class 10. Cholagoga.—Cholagogues.

(Xolotics or Bilitics, *Nuttall*.)

Definition.—Medicines which promote the discharge of bile into the alimentary canal are denominated *Cholagogues* (from χολη, bile, and αγω, I drive off.)

Physiological Effects.—It is probable that most, if not all, drastric purgatives increase the secretion and excretion both of bile and pancreatic juice, by irritating the opening of the ductus choledochus in the duodenum; just as certain substances, taken into the mouth, provoke an increased discharge of saliva by irritating the mouths of the salivary ducts. Graaf (Barbier, *Traité Elément. de Mat. Méd.* t. iii. p. 1252, 2nde éd.) says, that if a purgative be administered to a dog, and when it is beginning to operate, the abdomen be laid open, the bile and pancreatic juice will be observed flowing into the duodenum.

The term cholagogue, however, has been more particularly applied to substances which have been supposed to have a specific influence in promoting the secretion or excretion of bile. Mercury, Aloes, and Rhubarb, have been considered to possess this property. The Alkalis are believed, by some, to render the biliary secretion more copious and thinner.

Class 7. Ecbolica.—Ecbolics, or Contractors of the Uterus.

(Abortiva; Amblotica; Acceleratores Partûs.)

Definition.—Medicines which excite uterine contractions, and thereby promote the expulsion of the contents of the uterus, are called *ecbolics* (from εκβολιον, a medicine which expels the fœtus.)

PHYSIOLOGICAL EFFECTS.—Some medicines excite the vascular system of the uterus, as Savin and other Drastic Purgatives. These promote the menstrual discharge, and are, therefore, denominated emmenagogues. But their is another class of agents which excite muscular contractions of the uterus, and, therefore, are adapted for expelling substances (as the fœtus, hydatids, clots of blood, &c.) contained in the uterine cavity. These are the Ecbolics. The only unequivocal agent of this class is Ergot, which appears to operate on the uterus by a reflex action, and will be fully noticed hereafter. Probably the ergot of all grasses acts in the same way. A similar property has been ascribed to Borax.

CLASS 8. ACIDA.—ACIDS.

(Antalkalina.)

DEFINITION.—Acid medicines which, by repeated use, produce a chemical change in the fluids, have beed formed into a separate class under the name of *Acids*.

PHYSIOLOGICAL EFFECTS.—The Mineral Acids, when concentrated, decompose the organic tissues (see p. 122.) Swallowed in this state they are corrosive poisons. When sufficiently diluted they cease to be corrosive, though they still exert a chemical influence. Thus, when applied to the skin, they harden the cuticle by uniting with its albumen; and when applied to the mucous surface they produce astriction, and a slight whitening of the part (from their chemical influence.) The diluted Mineral and Vegetable Acids, when swallowed in moderate doses, at first allay thirst, sharpen the appetite, and promote digestion. They check preternatural heat, (See p. 192.) reduce the frequency of the pulse, lessen cutaneous perspiration, frequently allay the troublesome itching of prurigo, operate on the solids as tonics, (See p. 189.) and frequently prove diuretic; (See p. 198.) at the same time that they alter the quality of the urine, which they generally render unusually acid. The milk acquires a griping quality, and the bowels are usually slightly relaxed. Under their long-continued use, the tongue becomes pale and coated with a whitish but moist fur, the appetite and digestion are impaired, while griping and relaxation of bowels, with febrile disorder, frequently occur. If their use be still persevered in, they more deeply injure the assimilative processes, and a kind of scorbutic cachexy is established.

Acids are used as caustics, as refrigerants, as tonics, as diuretics, as antalkalines, as antilithics, and to check sweat and pruriginous itching.

CLASS 9. ALKALINA.—ALKALINE MEDICINES.

(Antacida.)

DEFINITION.—Alkaline medicines, which by repeated use produce a chemical change in the fluids, have been formed into a distinct class, under the name of *Alkalina*.

PHYSIOLOGICAL EFFECTS.—The alkalis in a concentrated form are powerful caustics, and when swallowed act as corrosive poisons. From their solvent action on the organic tissues, they have a softening influence even in the dilute form, and, in consequence, are saponaceous to the touch. When taken into the stomach, in the diluted state, they destroy the acid condition of the alimentary canal, and slightly augment secretion. They become absorbed, act as diuretics, and at the same time alter the quality of the urine, to which they communicate an alkaline reaction. By repeated use they operate as liquefacients. (See p. 193.) Their long-continued employment gives rise to great disorder of the assimilative organs, and a condition analogous to that of scurvy is induced. (See p. 194.) In such cases it is said that the blood drawn from a vein does not coagulate on cooling. Alkalis are used as escharotics, as antacids, as resolvents, as antiphlogistics, (See p. 194.) as diuretics, and as antilithics.

Lithontriptics; *Antilithics.*—Medicinal agents which effect the solution or disintegration of urinary calculi within the body, are denominated *Lithontriptics* (from λιθος, a stone, and τριβω, I rub or wear out, or destroy.) The long-continued action of large quantities of simple water on urinary calculi is capable apparently of disintegrating, and in some cases of dissolving them.[1] This fact deserves especial notice, since it points out the propriety of aiding the operation of the most powerful lithontriptics by the copious use of water. The medicinal agents, which readily dissolve these concretions out of the body, belong to the two preceding classes, Acid and Alkaline substances. Thus the phosphates readily dissolve in hydrochloric and nitric acids,—while alkaline solutions are solvents for uric acid. But the introduction, by injection, into the bladder of either acid or alkaline solutions, sufficiently strong to exert much chemical influence over calculi, would be attended with dangerous irritation of the vesical coats. And, if we exhibit them by the mouth, they undergo important changes in passing through the system, so that by the time they reach the bladder their chemical influence, as solvents, is in a great measure, if not wholly, destroyed. Yet it cannot be denied that at times they have appeared to give considerable relief, and to act as real lithontriptics. But Dr. Prout (*On the Nature and Treatment of Stomach and Urinary Diseases.* Lond. 1840.) asserts that urine, when in a perfectly healthy condition, is one of the most universal as well as powerful solvents we possess for urinary deposites; and as it contains no free and uncombined alkaline or acid ingredient, he concludes that lithontriptics "are to be sought for among a class of harmless and unirritating compounds, the elements of which are so associated as to act at the same time with respect to calculous ingredients, both as alkalis and acids." At present no substance of this kind is known, but the solutions of the supercarbonated alkalis, containing a great excess of carbonic acid, approach the nearest to them; and the mineral waters of Vichy,[2] which have long been celebrated in calculous affections, are natural solutions of this kind. The operation of these waters is not confined apparently to their solvent effects; for they possess also a disintegrating power: that is, they disturb "the attraction, both cohesive and adhesive, by which the molecules of calculi are held together, so as to render them brittle and easily broken into fragments."

Class 10. Topica.—Topical Remedies.

Definition.—External remedies, which are used on account of their topical influence, have been formed into a distinct class, under the name of *topica.*

Physiological Effects.—This class is a very heterogeneous one, and contains substances which possess a very dissimilar mode of operation. On this, as well as on other grounds, objections may, with great propriety, be made to its admission in a physiological arrangement; and the only apology I can offer for it is that of convenience.

Topical remedies may be conveniently arranged in six orders, as follows:—

Order 1. Caustica. *Cauteria Potentialia.*—Topical agents, which disorganize by a chemical action, are called *caustics* (from καιω, I burn.) The stronger ones, as Potassa fusa, are called *escharotics*, or *erodents;* the milder ones, as Sulphate of Copper, *cathereticsy* or *cauterants.* The general action of these has been already noticed. (See p. 122.) Some of the substances used as caustics (as Arsenious Acid) become absorbed, and produce constitutional symptoms.

The substances used by surgeons as caustics may be arranged in suborders thus:—

Suborder 1. Concentrated non-metallic Acids.—As Sulphuric, Nitric, Hydrochloric, Phosphoric, and Acetic Acids.

Suborder 2. Alkalis.—Potassa fusa, Liquor Ammoniæ, and Quicklime.

Suborder 3. Metallic Compounds.—A considerable number of these are used, viz.—

α. Oxides; as Binoxide of Mercury and Arsenious Acid.

β. Chlorides; as the Sesquichloride of Antimony, Chloride of Zinc, and Bichloride of Mercury.

γ. Oxysalts; as Nitrate of Silver, Sulphate and Acetate of Copper.

Caustics are employed for various purposes, the principal of which are the fol-

[1] Chevallier, *Essai sur la dissolution de la gravelle et des calculs de la vessie.* Paris, 1837.—Also *Lond. Med. Gaz.* vol. xx p. 431.

[2] Ch. Petit, *Quelques considérations sur la nature de la goutte et sur son traitement par les eaux de Vichy.* Paris, 1835.—*Nouvelles observations de guérisons de calculs urinaires au moyen des eaux de Vichy.* Paris, 1837.

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

Order 2. Topical Stimulants.—These are remedies employed to augment the vital activity of the parts to which they are applied. When they produce irritation or inflammation, they are called *Irritants*. If they be organic substances, and cause local irritation, independently of any known chemical agency, they are denominated *Acrids*. (See p. 193.)

Suborder 1. Cutaneous Stimulants. *Rubefacients*, *Vesicants*, and *Suppurants*.—These are agents which, when applied to the skin, cause redness, and sometimes vesication and suppuration. The milder ones, such as Friction and Warm Fomentations, stimulate the skin temporarily, without producing actual inflammation. The stronger ones, such as Mustard and Cantharides, excite active inflammation. Those that cause the exhalation of a thin serous fluid beneath the cuticle, are called *vesicants* or *epispastics*: Mustard, Euphorbium, Mezereon, Acetic Acid, Ammonia, and Cantharides, are of this kind; while Tartar Emetic, and some other substances, which produce a secretion of pus, are denominated *suppurants*. The medicines of this class are employed as counter-irritants in various diseases. Their *modus medendi* has been before investigated. (See p. 153.)

Suborder 2. Ulcer Stimulants.—Surgeons employ a variety of topical applications to wounds and ulcers, for the purpose of augmenting or altering the vital activity of the part. Those which promote healthy suppuration are called Digestives (*Digerentia* seu *Digestiva*,) as the *Ceratum Resinæ*. Those which are supposed to promote cicatrization are denominated Epulotics (*Epulotica*, from επουλοω, I cicatrize,) or *Cicatrisantia*, as *Ceratum Calaminæ*. Under the name of Detergents (*Detergentia*) are included substances which cleanse wounds, ulcers, &c., and comprehend various kinds of agents; some of which, however, are topical stimulants.

Order 3. Astringents and Desiccants.—Agents which, by their affinity for fibrine and albumen, constrict fibres and coagulate albuminous liquids, are denominated *Astringents*. When employed to check hemorrhage, they are called *Styptics*. The vegetable astringents have been already noticed: (See p. 188.) they owe their activity to Tannic Acid. A considerable number of mineral substances act as astringents when used in a dilute form,—such as Sulphate of Copper, Nitrate of Silver, Chloride of Zinc, Sulphate of Iron, Acetate of Lead, Alum, &c. In a concentrated state, the same agents are caustics. Some substances, when applied to secreting and exhaling surfaces, check secretion and exhalation, and cause dryness of the parts, but have scarcely any corrugating power on the solids,—as the Oxide of Zinc. These may be termed *Desiccants*.

Order 4. Benumbers.—Certain cerebro-spinants are employed as topical anodynes in neuralgia. For example, Aconite, Belladonna, and Opium. (See page 178.)

Order 5. Antiseptics and Disinfectants. *Antipestifera; Antiputrescents*.—Agents which prevent or are opposed to putrefaction, are called *Antiseptics* (from αντι, against, and σηπτος, putrid.) Those which destroy miasmata, are denominated *Disinfectants* (from *dis*, which signifies separation, and *infect*.)

Putrefaction, properly so called, is a process peculiar to dead organic matter; and means which check or prevent it, act by a physical or chemical agency, and are the *true antiseptics*. They constitute what Guersent (*Dictionnaire de Médecine*, art. *Antiseptique*.) denominates *physical antiseptics*. Warmth, air, and water, are the most powerful agents in promoting putrefaction; and their exclusion, therefore, are among the most effective antiseptic means. Thus, Cold, a Vacuum, and Desiccation, are good conservators of dead organic matters. Alcohol, Sirup, Fats, and Volatile Oils, are antiseptics: all act by excluding air, and some of them (*e. g.* Alcohol) likewise by abstracting water from the organic mat-

ter. Another class of antiseptics are chemical agents, which form with the organic matters new compounds less susceptible of decay. Saline and metallic solutions, and chlorine, act in this way.

Certain diseases were formerly denominated putrid, and were supposed to depend on a putrescent or decomposed condition of the solids and fluids, characterized by the loose texture of the crassamentum, petechiæ, and an offensive condition of the excretions. Remedies which relieved this state were called antiseptics. Guersent denominates them *physiological antiseptics*. But the alterations which are observed in the characters of the solids and of the blood in the above maladies, have no apparent analogy with those which attend the putrefaction of dead animal matters; and accordingly modern pathologists have rejected the doctrine of putrescency of the fluids. Liebig[1] has endeavoured to revive the old notion; but, though his reasoning is ingenious, it is to me any thing but satisfactory, as I have before (p. 123) remarked. The subject is foreign to the objects of this work, and moreover is too extensive to be farther discussed here; but I may remark, in conclusion, that if the effects of the poisons of small-pox, plague, syphilis, and decomposing organic matters on the human frame, be denominated fermentation or putrefaction, the meaning of these terms must undergo very considerable alteration and extension.

Disinfectants, I have already stated, are agents which destroy miasmata (both odorous and inodorous.) Their action is chemical. Chlorine, the Hypochlorites, and Nitrous and Nitric Acids, act either by oxidizing or dehydrogenizing miasmatic matters. The late Dr. Henry (*Philosophical Magazine and Annals of Philosophy*, for January 1832, vol. xi. pp. 22 and 205.) has apparently shown, that infectious matter of certain diseases (as scarlatina) is either dissipated or destroyed by a temperature not below 200° F.; and he, therefore, suggested, that infected clothing, &c. may be disinfected on this principle, for he found that neither the texture nor colour of piece goods and other articles of clothing were injured by a temperature of 250° F. Quicklime absorbs carbonic acid and sulphuretted hydrogen[2] gases, and perhaps other noxious matters. It is, therefore, occasionally useful as a disinfectant; and is employed in the form of wash for the walls of buildings. Ventilation is the most important disinfecting process. To disguise unpleasant odours, fumigations with the Balsamic Resins, Camphor, Cascarilla, and Brown Paper, are sometimes resorted to.

Order 6. Cosmetics.—Agents used for the purpose of preserving or restoring the beauty, are denominated *Cosmetics* (*cosmetica*, from κοσμεω, I adorn.)

The preparation of these substances is usually left to chemists, perfumers, and hair-dressers; but the principles on which they are employed come under the consideration of the medical practitioner.

Cosmetics are employed to improve the appearance of the skin, the hair, and the teeth. Hence, we make a three-fold division of them:—

α. Cutaneous Cosmetics.—Cosmetics are applied to the skin, to soften or harden the cuticle, and to improve the colour and clearness of the complexion.

Alkaline, Oleaginous, and Saponaceous substances, and soft Water, cleanse and soften the skin. The Alkali acts by its solvent power on the cuticle; Oil has a mechanical influence. Almond and Spanish Soaps, Milk of Roses, and Cold Cream, are the favourite softeners of the skin. Almond Powder is used for a similar purpose.

Diluted Acids, most Saline substances (as Alum) and Alcohol, harden the skin. The acids act by combining with the albumen of the cuticle, and the salts operate, probably, in the same way. The hardening influence of alcohol is connected with its power of coagulating albumen. Hard water indurates by the earthy salts which it holds in solution.

A solution of Bichloride of Mercury in Bitter Almond Emulsion (about gr. j. ad f℥j.) has long been a favourite face wash: it constitutes Gowland's lotion. Bichloride of Mercury, it

[1] *Organic Chemistry in its Application to Agriculture and Physiology*. Edited by Lyon Playfair, Ph. D. London, 1840.

[2] Chlorine and the Hypochlorites are the most effective agents for destroying sulphuretted hydrogen, which, according to Professor Daniell, is the miasmatic matter of the Western coast of Africa. (See p. 83; also, *London Medical Gazette*, July 1841.)

is well known, unites with albumen, and hardens animal tissues. Bitter Almonds are mentioned by Celsus (Lib. vi. cap. 5.) as remedies for ephelides (freckles.) Withering (*An Arrangement of British Plants*, vol. iii. p. 754, 7th ed. Lond. 1830.) recommends, as one of the safest and best cosmetics, an infusion of Horse-radish in cold milk.

Face-paints are used to give an artificial colour to the skin: Carmine to communicate a red, and starch-powder a white tint, can produce no injurious effect on the constitution; but the white metallic compounds—viz. Trisnitrate of Bismuth, Carbonate of Lead, and White Precipitated Mercury—are dangerous, as they are liable to become absorbed. Trisnitrate of Bismuth, probably the least injurious of the three compounds just mentioned, has caused spasmodic trembling of the muscles of the face, ending in paralysis. (Vogt, *Pharmakodynamik*, Bd. i. S. 288. 2te Aufl.)

β. Hair Cosmetics.—Cosmetics are applied to the hair to render it smooth, glossy, and disposed to curl,—to stain it,—to promote its growth,—and sometimes to destroy it.

An excellent pomatum for rendering the hair smooth and glossy, is composed of Olive or Almond Oil ℥ij., and Spermaceti ʒiij. It may be variously scented.

Various substances have, at different times, been recommended for preventing the fall, and promoting the growth, of the hair; but the efficacy of most of them is doubtful. As alopecia, or baldness, arises from various and different causes, it is evident that no one agent can under all circumstances, prove successful. When the cause is not obvious, the part should be shaved (if any hair be present,) and topical stimulants applied, to augment vascular activity. A solution of some Volatile Oil (Rosemary or Thyme,) in Rectified Spirit, used as an embrocation, has, at times, appeared to me to be serviceable. Dupuytren (*London Medical Gazette*, vol. xv. p. 848.) employed an ointment composed of ten parts of Tincture of Cantharides (prepared by digesting one part of cantharides in ten parts of rectified spirit,) and ninety parts of Hog's-lard.

Depilatories are used to remove superfluous hairs. Lime and Orpiment (Sesquisulphuret of Arsenicum) are the constituents of most of them. Plenck's *pasta epilatoria* consists of one part Orpiment, twelve parts Quicklime, and ten parts Starch, made into soft paste with water. The hair being previously cut close, the paste is applied, and, as soon as the mass is dry, the part is to be washed with water. (Phœbus, *Handbuch der Arzneiverordnungslehre*, 2er Th. S. 78, 3tte Ausg. 1840.) As orpiment is a dangerous application, especially when the skin is abraded, depilatories are sometimes formed without it. Rayer[1] gives the following formula for one:—Lime, ℥j.; Carbonate of Potash, ℥ij.; Charcoal powder, ʒj.

Hair Dyes have been in use from the most remote periods of antiquity. Medea (Beloe's Translation of Herodotus, vol. i. p. 382. Lond. 1825.) is said to have been acquainted with the art of dying the hair black. Paulus Ægineta[2] gives several compositions for effecting the same purpose. Various powders, pastes, and liquids, are sold in the shops as hair dyes. Some (as *Orfila's Hair Dye*) are mixtures or compounds of powdered Litharge (oxide of lead) and Lime, in about equal weights, or a little excess of the first ingredient. The mixture is made into a paste with hot water or milk, and applied to the hair for four or five hours, the part being covered (with oil-skin, or, in the absence of this, I have known a cabbage-leaf used,) to keep the mixture moist. The water causes the Oxide of Lead to unite with the Lime, forming a plumbite of lime. The lime is useful by removing the fatty matter, while the oxide of lead, reacting on the sulphur contained in the hair, forms a black sulphuret of lead. Others (as *Spencer's Hair Dye*) consist of a solution of Nitrate of Silver; which, however, is objectionable, since it is apt to stain the skin. Hair stained with this salt blackens by exposure to the light, partly by the reduction of the silver and partly by the formation of a black sulphuret of silver. When an immediate effect is required, a solution of Hydrosulphuret of Ammonia is applied to the hair after the Nitrate of Silver, by which the black sulphuret of silver is instantaneously formed. *Hewlett's Hair Dye* is of this kind. Other formulæ for hair dyes have been published. (*Journal de Chimie Médicale*, tom. ii. p. 250, 2nde Sér.) Paulus Ægineta mentions the bark of Green Walnuts. A leaden comb is frequently used for a similar purpose. The lead uniting with the sulphur of the hair, forms the black sulphuret. Dyed hair, especially that stained with nitrate of silver, is dry and crisp. The detection of stained hair is sometimes an object of medico-legal research.[3] Lead may be recognised in hair by boiling the latter in nitric acid, and applying the tests for lead to the nitric solution. To detect silver, the hair must be treated with chlorine, to form chloride of silver, which is soluble in ammonia. From the ammoniacal solution the chloride may be precipitated by nitric acid, and its nature ascertained by the usual means.

γ. Teeth Cosmetics.—Cosmetics are applied to the teeth to cleanse them, improve their colour, and destroy unpleasant odour.

Dentifrices are usually powders. Tooth powders require to have a certain degree of hardness or grittiness, to enable them to remove the foreign matters adherent to the teeth, but not

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[1] *A Theoretical and Practical Treatise on the Diseases of the Skin*, Eng. Transl. p. 1219, Lond. 1835.

[2] *The Medical Works of Paulus Ægineta, the Greek Physician*, translated into English, by F. Adams, Esq., vol. i. pp. 237 and 366. Lond. 1834.

[3] Devergie, *Médecine Légale*, t. ii. p. 931. Paris, 1836; and Dr. Cummin, *Lond. Med. Gaz.* vol. xix. p. 215.

sufficient to injure the enamel. Pumice powder is rather too gritty for frequent use. Employed occasionally (say once in six or eight weeks) it is very serviceable. Though generally repudiated as a dentifrice, I find it is commonly used by dentists for cleaning teeth. Charcoal and Cuttlefish bone powder are good detergents. Chalk is somewhat too soft. Ratanhy, Cinchona, and Catechu, are useful astringents. Myrrh is employed partly for its odour. All insoluble powders, however, are more or less objectionable, since they are apt to accumulate in the space formed by the fold of the gum and the neck of the tooth, and thus present a coloured circle. Many tooth-powders are coloured red with Bole Armeniac, to render this circle invisible. The soluble substances which may be used as tooth-powders are Sulphate of Potash, Phosphate of Soda, Bitartrate of Potash, and Common Salt.

Disinfecting and decolourizing tooth-powders, washes, and lozenges, owe their efficacy to Chloride of Lime, and are used to destroy the unpleasant odour of the breath, and restore the white colour of the teeth when stained by tobacco,[1] &c. Thus, one part of Chloride of Lime may be added to twenty or thirty parts of Chalk, and used as a decolourizing tooth-powder. A disinfecting mouth-wash is prepared by digesting three drachms of Chloride of Lime in two ounces of Distilled Water; and, to the filtered solution, adding two ounces of Spirit, to which some scent (as Otto of Roses) has been added.

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[1] *Journal de Chimie Médicale*, t. iii. p. 494; and t. iv. p. 28.