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.)

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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,

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[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.

α. **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*, ηλιωσις) 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. Farthermore, 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 Medicale*, 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.

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[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* (ἀποδυτήριον) 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. Lond. 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* κατακλυσμοὺς 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.

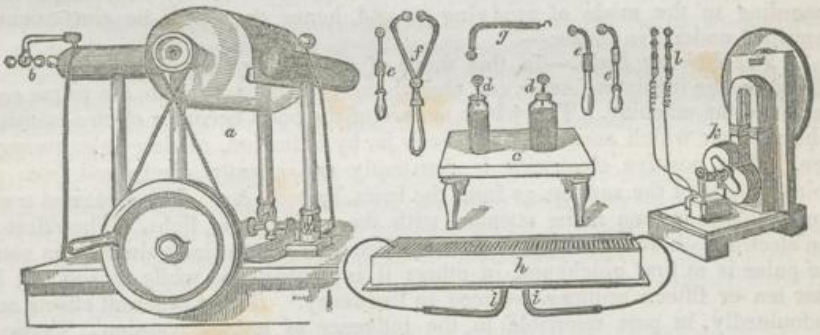
bronchial, and uterine hemorrhage. In the latter cases, the constriction of the bleeding vessels must be effected through sympathetic relations which exist between the stomach and other organs. Ice is also employed to relieve cardialgia, vomiting, and spasmodic pain of the stomach. In the latter stage 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 ὄζω, *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. IIme 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 *Mémoires 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. 1800.

[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 ueber 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*.