as scabies, favus, mentagra, etc., require the destruction of the epizoon or epiphyte by an antidote. Others, as eczema, lichen, impetigo, lepra, etc., when at all obstinate, are treated in the *same manner* essentially, to whichever class the disease may belong. Why? Because the **principle** is the same in all—the *alterative* principle. The abnormal, perverted nutrition of the cutaneous tissue, whether it be deeply or superficially affected, is (apart from antiphlogistic or sedative treatment, called for in some cases) to be *subverted*, by a decisive change in all its conditions; and, speaking boldly, it is little matter *what* change, so it be considerable. Any means which will hurry the removal of the old diseased skin, and favor the immediate construction of a new layer, will be *curative*, whether it be only soap, water and frictions, mercurial ointment, vesication, or the actual cautery.[1] And the same principle explains and justifies the *internal* use of arsenic and mercury in the management of so many very *diverse* forms of cutaneous disease—the indications for alterative medication being the same in all.

The administration, for **long periods**, of minute doses of powerful alterative medicines, in the treatment of chronic affections which resist other management, is less common now than formerly, on account of the explosion of some old hypotheses connected with it. It is very possible that in this, as in some other medical reforms, we may have gone too far.

Agents which tend with any degree of constancy to **increase** the rate of metamorphosis of tissue in the body, are few. Mercury appears to have this effect; and its alterative power may to a considerable extent be due to this. It is well known that most of the diuretics given for the removal of dropsical accumulations (a treatment often carried to an irrational excess), increase only the **fluid** secretion of the kidneys, affecting little or not at all their *solid* excreta. But there is good reason to believe that potassa and soda, and some of their compounds, as well as iodine and mercury, do hasten the disintegration of tissue. Iodide of potassium has been shown, by Melsens, to be in this way *eliminative* of lead, laid up in some organ (probably the liver), removing it in the shape of iodide of lead.

If any possible measures, beyond attention to hygiene and repose, can benefit cases of *organic* **degeneration**, we might hope for advantage from the combination of tonics or analeptics with alteratives. Dr. Chambers (on *Digestion and its Derangements*) remarks thus:—

"In Bright's disease, I know of no treatment so advantageous as that which unites **alteratives** (that is, liquefacients of tissue) with those **restorers** of blood *par excellence*, iron and animal food."

Iodide of iron or iodide of potassium at the same time with **cod-liver oil**, may afford an example of this sort of medication in its

[1] Dr. Hughes Bennett, in the treatment of cutaneous diseases, relies mainly (London Practitioner, vol. i.) on the beneficial influences of *water* and *oil;* in affections with moist secretions, water; in those which are dry, scurfy, or scaly, oil. Of course, however, Prof. Bennett assigns *some* value to other applications, as adjuvants.

simplest form. Its object is, to favor the rapid removal of old tissue, and the formation of good new structure in its place.

Whatever produces a powerful impression, not immediately destructive upon the system, may act alteratively, and sometimes beneficially, in chronic disease.

Electricity, perseveringly used, as an alterative, in certain cases of paralysis, and other neuroses, does more good than anything else. The ancient Romans used the shock produced by the *torpedo* (electrical fish) for the cure of paralysis and gout; and the natives of Western Africa apply the *silurus* in a similar way, in baths, for the treatment of sick children. Pivati, of Venice, 1740, and after him De Haën, Winkler, Manduyt, and Nollet, employed statical electricity as a remedy. Galvani (1790) introduced new means, which have since been extensively used. Faraday discovered the induced currents in 1831.

At present, while it is clear that electricity must be capable of powerfully influencing the human system, our knowledge of its uses is far from complete. Rash experimentation with it may do harm; but all its appliances may be so graduated as to admit of the mildest and most cautious tentative practice.

Three agencies are included under the term electricity: 1. **Static** or frictional electricity, of the machine of glass and rubber. 2. **Galvanic** electricity, or the continuous current of the battery, of metals with acid solutions, etc. 3. **Faradization**, by induced and interrupted currents, electro-magnetic or magneto-electric.

Frictional electricity is least in use. It is best employed by placing the patient on an insulated stool (with glass legs or feet) and charging him from either a plate or a cylinder machine; then withdrawing the electricity by a *pointed* metallic conductor, if a mild and general effect is wanted, or by a *round* one of some size to produce sparks and a locally stimulant effect.

Dr. Arthius, of Paris, has written a work (1873) upon the therapeutic uses of statical electricity.

Galvanic electricity is developed by chemical action. A battery consists of a series of plates of two materials (copper, zinc, silver, carbon, etc.), in alternation, a liquid in contact with which acts more upon one than on the other. Daniell's and Smee's batteries are especially recommended. Althaus prefers a modification of Daniell's in which, with copper and zinc plates, a solution of sulphate of copper is used as the liquid. This will run for six months without cleaning; with cleaning, for a much longer time. The *size* of the cups determines the *quantity* of the current of electricity; the *number* of cups, its *intensity*. Quantity is especially powerful for chemical action; intensity, for overcoming the resistance of a slowly conducting medium. The *direction of the current*, through the wire or wires connecting them outside of the liquid, is, in ordinary batteries, from the copper (or platinum, silver, or carbon) to the zinc; the former being the positive and the latter the negative pole. Dr. Hammond[1] prefers the direct to the in-

[1] Quarterly Journal of Psychol. Medicine, etc., July, 1867, p. 62.

duced current. His apparatus consists of a series of plates of perforated zinc and copper or copper gauze, soldered in pairs, with flannel between the elements. They are moistened by pouring strong vinegar upon the top, so that it runs through the perforations. For faradization, Kidder's apparatus is convenient and effective.

Faradaic or induced electrical currents are usually obtained in either of two modes: 1. By galvanic electricity (from chemical change) acting upon iron; making it magnetic during the closure of the circuit, which is interrupted momentarily by a vibrating spring. A current is thus induced, in one direction at the moment of *closing*, and in the opposite at the *opening* of the connection. 2. By causing a magnet or its keeper of iron to revolve so as alternately to approach and recede from contact. A *helix* or coil of wire, wound around the magnet, will then have an induced current at the moment of approach and at that of separation. This (magneto-electricity) is more convenient than any other apparatus; but some authorities claim greater power for electro-magnetism in therapeutics. It has been shown also that the *constant* galvanic current (as of Daniell's, Grove's, Bunsen's, or Smee's batteries) has a more extended or general stimulant or alterative effect; while the *interrupted* (faradaic) current is more powerful locally. Proof of the difference between the two may be obtained by applying them in succession to the face. The continued current produces a flash of light by its influence upon the retina. The interrupted causes the muscles to contract in proportion to its force. Remak has greatest confidence in the continuous current; especially that which is constant in strength. He uses from 15 to 30 of Daniell's cells (modified), weighing 8 pounds each. He asserts that the down-running current acts most upon the sensory nerves, and the up current upon those of motion; and that while interrupted currents take effect almost alone upon the muscles, constant currents act upon the nerve-centres themselves. Hiffelsheim and Onimus have extended Remak's investigations. It has been shown (E. Weber, Matteucci, Erb[1]), that a constant current may be made to take effect upon the brain and spinal marrow. Kühne and others have also found, by the aid of the microscope, distinct action of the constant current upon organic cells and protoplasm; a change of form of the *cell* sometimes resulting, which has been called *cell-tetanus*.

Duchenne, of Bologne, asserts, as the conclusions derived from his experience, the following:—

"In man, whatever may be the direction of the currents, or the degree of vitality of the nerves they traverse, the same results are always produced when the conductors are applied to any part over the course of the nerves—namely, muscular contractions and sensations.

"Various changes in the current-direction produce no appreciable influence over the sensibility, or capability of voluntary muscular contraction, in man."

[1] Budge and Waller have reported remarkable observations upon the "centrum cilio-spinale," in relation to the action of the iris. See M. Meyer, Medical Electricity, transl. by Hammond, p. 77.

On the basis, however, mainly, of Dubois Reymond's experiments, other electricians insist that a current *towards* the centres of the body stimulates the sensory nerves, while it lessens the excitability of the motor nerves; and that a current from the centres out to the periphery stimulates motor, and acts as a sedative to sensory nerves. Pereira says, "In paralysis of sensation only, the current should be direct or centrifugal. In paralysis of motion, it should be inverse or centripetal. In paralysis of both sensation and motion, the vibrating current (faradization) is peculiarly appropriate; for by this the sensitive and motor nerves are alternately excited, while the one current promotes the restoration of the excitability, which may have been lessened by the preceding current."

Dr. Moritz Meyer[1] lays down the following as the best established facts. 1. *Electricity is a stimulus.* 2. It increases the supply of blood to the irritated parts. 3. It augments also its temperature, and tends to increase its volume. 4. It enhances the contractile energy of the vascular walls. 5. It counteracts the secondary changes occurring in inactive nerves and muscles. 6. It is capable of aiding in the restoration to nerves and muscles of their lost functional power. 7. It is capable of developing a supplementary function in muscular fibres not yet paralyzed.

Dr. George M. Beard recommends the use, in many chronic affections, of "central galvanization;" the negative pole being placed at the pit of the stomach, and the positive pole applied successively to the head, over the sympathetic and pneumogastric in the neck, and to the spine; the whole of the central nervous system being thus brought under the influence of the current.

The *precautions* needful in trying electricity as a remedial application are—

1. Always to begin with it very gently, watching carefully its effects; continuing it therefore at first but for a few minutes at once. The *hand of the operator* is the gentlest and best electrode for sensitive or irritable parts. To use it, of course the electricity must pass through the operator's body. This mode, however, is not commonly resorted to.

2. To be especially careful in its use at or near the great nerve-centres, as the brain and spinal marrow.

3. Avoid using it, even locally, during the existence of an inflammation or acute irritation of the spinal marrow or brain.

The idea which Dr. Radcliffe has especially advocated, of using galvanism, *e. g.*, in neuralgia, or convulsions, with such force as to partially or temporarily *paralyze* a disordered nerve-centre, is, I am sure, unsound in theory and very unsafe in practice. I would not think of resorting to such a measure in any conceivable case.

The affections in which electricity, in various modes of application, has been found most positively and fequently serviceable, are—*paralysis*, especially *hysterical*, *reflex*,[2] *infantile*, and *lead* palsy; *aphonia*, and *diphtheritic paralysis* of the throat; *neuralgia*, *chronic*

[1] Medical Electricity, p. 372.
[2] See Mitchell, Morehouse, and Keen upon Wounds of Nerves, etc.

rheumatism, *amenorrhœa*, *suppression of lactation*, *cancerous or other tumors*, *eczema*, *herpes*, *prurigo*.[1] In *surgery*, *galvano-puncture* is resorted to for aneurisms, etc. In treatment of *asphyxia*, *narcotic coma*, etc., its powerful stimulation is sometimes an important means of saving life.

Crussell, Spencer Wells, and Hammond report great success in causing the healing of *indolent ulcers* and *bed-sores* by mild, constant currents. Dr. Hammond's method is the following:—

"A thin silver plate, no thicker than a sheet of paper, is cut to the exact size and shape of the bed-sore; a zinc plate of about the same size is connected with the silver plate by a fine silver or copper wire six or eight inches in length. The silver plate is then placed in immediate contact with the bed-sore, and the zinc plate on some part of the skin above, a piece of chamois-skin soaked in vinegar intervening. This must be kept moist, or there is little or no action of the battery. Within a few hours the effect is perceptible, and in a day or two the cure is complete in the great majority of cases. In a few instances a longer time is required."

Hydropathy (hydrotherapy) is an example of a most valuable agent misapplied by **exclusivism**, which is always quackery. That is, it is quackery to deny the virtues of other remedies, no matter how long or well established, in extolling those of one, made the sole *panacea* of practice. Bathing, local and general, douches, and even packing in the wet sheet, are, if used with judgment, potent alterative and often sanative means. Almost hopeless chronic cases of nervous disorders, dyspepsia, chronic rheumatism, etc., may sometimes have their languid vitality aroused by the revolutionizing action of such processes. The danger is, of unprofessional and ill-judging *abuse* of an agency of such power.

Hot air-baths have lately attracted attention.

M. Fillet, 1764, and Fordyce, Blagden, 1775, and others, proved, as Chabert the "Fire King" also illustrated, that a *dry air* heat above that of boiling water can be borne by the human body with safety. Within a few years the use of the hot air bath, similar to that of the *calidarium* of the ancient Romans, has been introduced for remedial purposes. It is misnamed the "Turkish Bath," as the latter includes a *vapor*-bath, at a temperature below 100°.

Erasmus Wilson, the dermatologist, Mr. Urquhart and others, have, upon personal experience, lauded the virtues of the hot air-bath. The requisites are, a heated metallic surface (a common stove will do) to warm the air of the apartment, and an adjoining convenient water-bath, with warm or cool water, to plunge into after or alternately with the air-bath.

Mr. Urquhart thus speaks of its use in health: "When I come back to it after its absence and the use of other baths, even the best, it is like getting on the back of a thorough-bred after having to ride a cart-horse. It is of service at every moment and at all temperatures. You come in from a journey, say before dinner; you go in not heated, when it may stand at 120°; you dress at

[1] In one case, I have known it to appear to retard the progress of pulmonary phthisis for a considerable period.

that charming temperature, with streams of hot or cold water, or the tank to revel in. So, also, you may dress in the morning. My regular practice, when not requiring it for health's sake, is to go in on getting up and on going to bed, dressing and undressing there; five to ten minutes suffice to bring on the flow of perspiration. After that, a plunge in the cold water, and you come out fresh, glowing with a sense of cleanliness, health, and strength, which no other operation can convey to the body. You are then indifferent to the heat of summer and the cold of winter."

Copious perspiration, and the thorough removal of the effete cuticle, as well as of all foreign impurity from the surface of the body, are the obvious and direct effects of the hot air-bath. *Depuration* and functional balance of the excretory processes are thus promoted; while the stimulant influence of heat, so often useful in cases of depressed vitality, is obtained. Renewal of the nutrition of the skin must also be more rapid under such a process. The temperature is made to vary between 120° and 200°; 130° to 140° is a good standard.

The *diseases* in which the hot air-bath has been tried with favorable results, in cure or palliation, are, especially, acute and chronic rheumatism, lumbago, sciatica, neuralgia, gout, dropsy, catarrh, influenza, throat affections, diarrhœa, dysentery, sluggishness of circulation, disorders of the liver, scrofula, incipient phthisis, Bright's disease, ague, obstinate skin diseases, chorea, mania; also, it is said, even cholera and hydrophobia.

Hot sand-baths have been used in London by Dr. Conradi[1] and others, to promote perspiration and relieve congestion of the internal organs.

Mustard Bathing.—Dr. S. Newington, of England, ascertained by experience in his own person that the extensive and continued application of mustard to the body is a powerful tranquillizer of nervous excitement and means of restoration of the balance of a disturbed circulation. Use of the same remedy with a number of patients has confirmed its value. One mode of its application is as follows: Two handfuls of powdered mustard are tied in a cloth and placed in hot water, then squeezed in the hand until the strength of the mustard has been extracted. A thick towel, long enough to reach around the loins, is then wrung out of this infusion, wrapped round the body, and covered with a large piece of oiled silk or gum elastic cloth. Another plan is that of the mustard bath; that is, an ordinary warm bath into which have been thrown five or six handfuls of mustard.

In *maniacal excitement*, particularly, these applications have been found usefully sedative. *Sleeplessness*, from any cause, may be so treated; as well as hysteria, etc. It may be expected that such a process will be useful also in promoting reaction in cases of internal congestion; perhaps, in the chill of pernicious fever; in "spotted fever," and in the incipient collapse of cholera.

Movement-cure (*kinesipathy*) is the name for a kind of practice (Taylor) founded upon the teachings of Ling, of Sweden; con-

[1] Med. Times and Gazette, Oct. 19, 1872.

sisting of *passive exercise* of the muscles, for the purpose of improving the circulation, innervation, and reparative nutrition of diseased and enfeebled organs.

Although an elaborate system of particular movements, upon a *quasi*-physiological rationale, has been devised and adapted to each kind of chronic local or general disorder, careful examination of the treatise of an authority upon the subject convinces us that this is all *surplusage*. What remains to be true is, that, where active exercise is not practicable, systematic frictions and passive movements of all parts of the body are very useful in its stead. What is added to this by the *specialist* is, faith on the part of the patient, and perseverance in the attendant; two things which, without extraordinary processes, explain much, and account for many cures.

Under any treatment, however, we must not encourage sanguine hopes in instances of **organic degeneration**, the origin of which is so generally to be found in a failure of systemic vital power. The physician will do much for his patient, if he can persuade and instruct him to adapt his living to the actual condition of his physical resources; so that, whether his malady be Bright's disease of the kidney, diabetes mellitus, cirrhosis of the liver, or fatty or other organic disease of the heart, he may *economize* both the material and the force of his system, by such a regimen of diet, exercise, and excitement, as his state requires.

With such management, it often happens that valetudinarians live longer than those who, with sound constitutions, are less watchful against causes of disease, and less prompt in taking warning from the slightest symptoms or approaches of ill health.

Nor need we look upon the failure of medicine to arrest the process of organic degeneration as a subject of very humiliating discouragement. As death is the natural result of life, in the human organism as in every other material form, this partial death occurs, also, under **physiological laws**; and, if it be relatively premature in certain instances, we may believe that this, too, may be traced to a near or remote causation, in perfect harmony with the highest interests, moral and physical, of man.

INHALATION AND ATOMIZATION.

Although the ancient Egyptians had some knowledge of the effects of drugs whose vapors were inhaled, and Hippocrates, Galen, and other Roman physicians, as well as, later, the Arabians, so employed them, they were afterwards long lost sight of. Bennet, of London, in the seventeenth century, seems to have been the first in modern times to use inhalations systematically. The earliest proper instrumental inhaler was probably that of Dr. John Mudge, an English physician, invented and applied in 1799. St. John Long, the charlatan, used large inhalers, from which a number could breathe at once. Boerhaave and Von Swieten, in the early part, and Beddoes at the end, of the eighteenth century, employed medicated inhalations. Scudamore, in 1830, issued a work upon the subject, which had a wide circulation.

Since that time, an immense amount of experimentation has

been made, to ascertain what local effects upon the lungs and air-tubes, and what action upon the system at large, might be obtained by vapors brought in contact with the highly absorbent respiratory membrane. Most important of all, of course, was the discovery of gaseous anæsthesia by Sir Humphry Davy, and the subsequent practical application of it by Wells and Morton. Ether, chloroform, nitrous oxide, and bichloride of methylene now take their places not only as alleviators of pain during operations and in parturition, but, also, as occasionally valuable aids to the physician in medical cases. Extreme neuralgic pain is sometimes relieved by the inhalation of ether or one of the other anæsthetics. Convulsions are not unfrequently so treated; and, in those at least of a hysterical or merely irritative character, with good success.

For medical as well as surgical use, chloroform is the most prompt, quiet, and *effectual* anæsthetic. In cases of disease, it does not need to be so given as to produce the total relaxation of *profound* anæsthesia. Can its use be justified, in view of the fact that a considerable number of deaths have been traced to it?

Without space to discuss this point, I may say that observation of the use of chloroform, in a method employed by some of the surgeons of the U. S. army during the late war, has modified my previous apprehension of it. The great necessity is, as Dr. Sansom[1] has shown very fully, the *dilution* of the chloroform with abundance of air, and its gradual introduction. Most methods exclude air too much. That which I have alluded to above is, letting the chloroform fall, *drop by drop*, upon a handkerchief spread singly over the face of the patient. An instrument is used for dropping, which will allow only one drop to pass at once. I believe that, with this or any other mode of abundant dilution and slow inhalation of it, watching momentarily its effects, chloroform is safe, in an immense majority of cases. Anæsthesia from chloroform cannot with safety be produced in less than five or six minutes.

Ether excites some persons too much to be generally relied upon in medical cases. Two or three parts of ether with one of chloroform make a mixture, often used with advantage. Dr. Sansom prefers one part of chloroform to one or two of absolute alcohol. Dr. B. W. Richardson combines ether with bichloride of methylene. Nitrous oxide, although experimented upon by Davy and used by Wells before ether, has only of late come to be highly appreciated for practical use. Its applications by inhalation in disease remain to be tried and studied.

Apart from the "anæsthetics," it cannot be said that great success has ever been obtained in the *cure* of diseases by inhalation. *Palliation* of pulmonary and bronchial or laryngeal irritation, or diminution of excessive expectoration, as by simple vapor of water, tar-vapor, or that of infusion of hops, opium, etc., has been often realized. With other aims and agents, disappointment has generally predominated.

For ordinary inhalation, very simple apparatus will suffice. For instance, a wide-mouthed jar or bottle, with a cork in it; the

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[1] On Chloroform; its Action and Administration.

cork pierced by two glass tubes, one straight, and reaching to near the bottom of the bottle ; the other short, and bent outside of the cork. The bottle is to be not quite filled with the liquid (more or less heated according to its volatility) ; the bent tube not reaching its surface, the other conveying air into it from beyond the cork. Even this is not necessary, at least in the case of liquids used with water. We may employ these by pouring boiling water into a convenient vessel of any kind, the medicament being added to it, and then covering the vessel with a towel, holding the mouth and nostrils under the edge of the latter. Hops in infusion, stramonium-leaves, or laudanum, etc., may thus be used. Of laudanum, *e. g.*, twenty or thirty drops may be put into a pint of water, for a very worrying cough. *Smoking* is a primitive method of inhalation. Tobacco, so employed, sometimes relieves in asthma ; but cigars of stramonium leaves, or of paper saturated with nitrate of potassium, are more effectual in the paroxysms of the same disorder.

Recently, first by Sales-Girons, extremely minute division or *atomization* of liquids, introdued into the air-passages, has been substituted for inhalation. Under the natural fascination of novelty, and the imposing appearance presented by instrumental appliances, it is quite probable that a degree of enthusiasm has existed about it, more than will be permanent. Still it is an important addition to our means of treatment of affections of the throat, and, perhaps, of some of those of the lungs. Referring the reader to special works[1] upon it for details, I must give only the briefest account of atomization or nebulization.

The essential idea of it is, the forcing of a fine jet of liquid against a solid body or a strong current of air, so as to convert it at once into diffused spray. Bergson, for instance, employed the tubes used for *odorators*, that is, to spread perfumed liquids in the air. Two glass tubes with minute orifices are fixed at right angles to each other, so that the end of the upright tube is near and opposite to the centre of the orifice of the horizontal tube. The upright tube being immersed in the liquid to be nebulized, air is forcibly blown through the horizontal one. The current of air, passing over the outlet of the tube communicating with the liquid, rarefies the air in the latter, causing a rise of the liquid in the tube, and its very minute subdivision (atomization, nebulization, pulverization), as it escapes. Silver tubes may be used instead of glass, but they are harder to keep clean. Glass ones may be cleaned with hydrochloric acid solution, aided by a bristle to remove obstructions. The form of the tubes may be varied, so as to allow of their application to any part of the body.

Richardson's spray-producer (designed for local refrigeration) is constructed upon a similar principle. It consists of a graduated bottle, through whose cork passes a double tube ; that is, a tube within a tube. The inner one reaches to near the bottom of the bottle, below, and above near to the extremity of the outer tube. The latter has entering it, above the cork, another tube connected with "hand bellows"—*i. e.*, two elastic bags, the one nearest the

[1] See Da Costa On Inhalation.

bottle (protected by silk network) acting as an air-chamber, and the furthest one being compressed by the hand, to produce a jet of air into the bottle and tube.

Siegle devised an apparatus for the application of steam-power to atomization. The tubes being arranged upon Bergson's principle, a small boiler is connected with the horizontal one, and in the boiler steam is generated by the heat of a spirit lamp. The jet of steam from the horizontal tube nebulizes the liquid drawn up from the vertical tube immersed in a vessel containing it. Various modifications of this have been made.[1] Though the steadiness of action of the steam-apparatus must be a great advantage, for many purposes the handball atomizer is more available.

For full effectiveness of any method of inhalation in chronic or subacute cases, the patient must have the instrument at his own house, learn its management, and use it with regularity for a sufficient time. This of course must limit very much the employment of such medication.

The first inhalations should always be short, and with warm water only, to inure the patient to their use. The distance of the mouth from the tubes may vary from six inches to two feet. When prepared for it, one may inhale "medicated spray," for ten minutes at a time ; breathing deeply if we wish the liquid to reach the remoter air-passages. It should never be done after a hearty meal ; and the patient should remain in-doors for a while after the operation.

Proof has been obtained that atomized liquids inhaled do, sometimes at least, pass down into the trachea ; constantly, into the larynx. It is probable, indeed almost certain, that a certain portion may even reach the lungs. As to their application, trial has been and is now being made of this process especially in croup, diphtheria, œdema of the glottis, catarrh, chronic laryngitis, hooping-cough, asthma, pulmonary hemorrhage, and phthisis.

False membrane has been asserted by Küchenmeister, Biermer, Geiger, and others, to be dissolved, or at least removed from the throat, by inhalation of hot lime-water. Dr. Geiger's method is to make the patient breathe the vapor arising from hot water poured on unslaked lime. Lactic acid is said (A. Weber) to have the same power.

From Dr. Da Costa's monograph upon inhalation I cite the following conclusions, as indicating the present state of experience upon the subject :—[2]

"That in most acute diseases of the larynx, and still more so in acute disorders of the lungs, the value of inhalations of atomized fluids, save in so far as those of water may tend to relieve the sense of distress, etc., and aid expectoration, is very doubtful ; though in some acute affections, as in œdema of the glottis and in croup, medicated inhalations have strong claims to consideration.

[1] Gemrig, of Philada., Dr. W. Reed, of Boston, and Codman and Shurtleff, of Boston, furnish improved forms of apparatus for atomization.

[2] Op. citat., p. 40.

"That in certain chronic morbid states of the larynx, particularly those of a catarrhal kind, and in chronic bronchitis, they have proved themselves of great value.

"That in the earlier stages of phthisis, too, they may be of decided advantage, and that at any stage they may be a valuable aid in treating the symptoms of this malady.

"That their influence on such affections as hooping-cough and asthma is not satisfactorily proven.

"That they furnish a decided and unexpected augmentation of our resources in the treatment of pulmonary hemorrhage.

"That they require care in their employ; and that in acute affections we should consider whether, as they have to be used frequently to be of service, the patient's strength justifies the disturbance or the annoyance their frequent use may be."

DOSES FOR INHALATION.[1]

Alum	10 to 20 grains.
Tannin	1 to 20 "
Perchloride of iron	$\frac{1}{8}$ to 2 "
Nitrate of silver	1 to 10 "
Sulphate of zinc	1 to 6 "
Chloride of sodium	5 to 20 "
Chlorinated soda	$\frac{1}{2}$ to 1 drachm.
Chlorate of potassium	10 to 20 grains.
Chlorate of ammonium	10 to 20 "
Watery extract of opium	$\frac{1}{4}$ to $\frac{1}{2}$ "
Fluid extract of conium	3 to 8 minims.
" " hyoscyamus	3 to 10 "
Tincture of cannabis indica	5 to 10 "
Lugol's solution of iodine	2 to 15 "
Fowler's solution of arsenic	1 to 20 "
Tar-water	1 to 2 drachms.
Oil of turpentine	1 to 2 minims.[2]

HYPODERMIC MEDICATION.

Apparently upon a suggesion contained in Valleix's work on Neuralgia, Dr. Alexander Wood, of Edinburgh, in 1843, experimented successfully with the injection of anodynes under the skin of parts affected with neuralgic pain. Dr. Kursak, of Vienna, disputes priority with him. Mr. Rynd, of Dublin, followed him about a year. Local effects, only, seem to have been clearly recognized by these gentlemen. Mr. C. Hunter, in 1858, proved that general effects upon the whole system are produced, in whatever part of the body the injections are made. Since 1855, however, many medical men have studied the subject; especially Béhier, Lorent, Eulenberg, and Nussbaum, abroad, and Ruppaner in this country. The practice has now become quite common.

[1] From Da Costa.

[2] To these may be added, carbolic acid (Marcet) 1 or 2 grains, in phthisis; and lactic acid (15 to 20 drops in half an ounce of water), in croup. The last has been proposed and used by Dr. Adolph. Weber. See *Med. Times and Gaz.*, Jan. 22, 1870. Also, *nitrite of amyl*, 2 to 5 drops; in puerperal convulsions, angina pectoris, etc.

It has been amply proved that hypodermic injection of medicinal substances is ordinarily entirely safe; more rapid, certain, and exact in its effects, in proportion to the amount, than medication by the mouth; that it requires one-third or one-half of the quantity necessary when given by the stomach, and produces less complicated and generally less inconvenient results.

The medicines mostly used in this way are narcotics, sedatives, and nervine tonics. It is in diseases or symptoms affecting the nervous system that the greatest number of successful cases has been reported. Pain, most of all, is speedily conquerable by it. Hunter lays down the indications for it thus:—

"When the immediate and decided effect of the medicine is required.

"Where medicines administered by the usual methods fail to do good.

"Where the effect of a medicine is required, and the patient refuses to swallow.

"Where, from irritability of the stomach, or other cause (such as idiosyncrasy, etc.), the patient cannot take the medicine by the stomach."

The following Table is slightly modified from Hunter's:—

The injection of medicines into the cellular tissue beneath the skin may be made

- Locally with....
  1. Caustics for nævi, aneurisms, etc.
  2. Anodynes, for local neuralgia.
- Generally.
  - In Cerebral...
    - Insomnia.
    - Melancholia.
    - Mania.
    - Delirium tremens.
    - Hysteria.
    - Chorea.
    - Central neuralgia.
  - Spinal.....
    - Rheumatism.
    - Tetanus.
    - Hydrophobia.
    - Retention of urine.
    - Colic.
    - Convulsions.
    - Epilepsy.
  - and
    - Peritonitis.
    - Pericarditis.
    - Dysentery.
    - Ophthalmic surgery.
    - Malarial fever.
    - Gangrene.
    - Dysmenorrhœa.
    - Cholera.
    - Sea-sickness.
    - Cancer.
    - Ulcer of stomach.
    - Intussusception.
  - Sympathetic nerve-cases, inflammatory affections, etc.
  - As antidote...
    - For opium, belladonna, etc.
  - Anæsthetic...
    - With or after chloroform or ether in operations.

The instrument most approved is a small glass syringe, holding about half a fluidrachm, and graduated for drops or minims, with a tube for puncture, of tempered steel, or of silver with a gold

point. The end of the tube must be small and sharp, and kept very clean.[1] Graduation of the cylinder is not necessary, as it is easy to measure the amount to be taken up by it. Not much pain is usually produced; but sometimes it is quite severe. If the dose of the medicinal agent be not too large, the only danger (unless in an erysipelatous patient) is of a circumscribed inflammation. Repeated injections should not be made at exactly the same spot. In operating, draw the skin tense with the forefinger and thumb of the left hand, and pass the point of the tube (first well oiled) quickly and steadily through it. Then push in, not rapidly, the desired amount of the fluid; and withdraw it without rotating it. Avoid subcutaneous veins; the puncture of one of them may give an excessive action of the medicine.

The agents most used are salts of morphia, atropia, strychnia, and quinia. For anodyne purposes, Dr. Ruppaner prefers *liquor opii compositus*, of which one hundred drops are equal to a grain of sulphate of morphia. Many use the ordinary solution of morphia (gr. j of morph. sulph. in f℥j) or Magendie's (gr. xvj in f℥j). Doses are as follows:—

Acetate of morphia	gr. $\frac{1}{8}$—$\frac{1}{2}$
Sulphate of morphia	gr. $\frac{1}{8}$—$\frac{1}{2}$
Sulphate of atropia	gr. $\frac{1}{60}$—$\frac{1}{30}$
Muriate of strychnia	gr. $\frac{1}{24}$—$\frac{1}{8}$
Aconitia	gr. $\frac{1}{30}$
Liq. opii compos.	gtt. v—ix
Sulphate of quinia	gr. i—iv
Ergotin	gr. $\frac{1}{4}$—1.

Practitioners find it best to make always a *fresh* solution of sulphate or acetate of morphia[2] for hypodermic use. Possibly from decomposition and the growth of fungi in the liquid, old preparations are more likely to be followed by abscess. Strongly acid and strongly alkaline liquids are alike unsuitable.

Among the diseases in which palliation or relief of suffering is often important by means of this method of treatment, are especially neuralgia, hysteria, palpitation of the heart, cancer, and ulcer of the stomach. A case of the latter affection is recorded in which for weeks or months the patient was only able to retain food upon the stomach after the disposition to vomit had been allayed by a hypodermic injection of morphia.

Curative effect from anodynes so employed has been asserted in cases of delirium tremens, mania, and tetanus; from quinine (two to four grain doses) in intermittent fever.

Tentative use of the same mode of practice is justifiable in cholera,

[1] Dr. E. Cutter, of Woburn, Mass., has had made a syringe (of aluminium alloy) so compact as to be carried easily in a pocket case. This is furnished by Shepard & Dudley, William Street, New York.

[2] Anstie and some other British practitioners prefer the *acetate* of morphia, freshly prepared. Five grains of the acetate are dissolved, with a *minim* of acetic acid in a fluidrachm of hot distilled water. Two minims of this will be a dose to begin with. Vachell and White have proposed the following: Acetate of morphia, 20 grains; distilled water, 140 minims; acetic acid, 5 minims. T. & H. Smith advise meconic acid instead. Drasche, Rosenthal and Constantin Paul recommend *glycerin*, instead of water, for hypodermic injections. Adrian prefers distilled water with twenty per cent. of glycerin.

hydrophobia, poisoning (as the injection of morphia for belladonna poisoning, and the converse), violent hooping-cough (atropia), pernicious fever, spotted fever, etc.

That the operation is always without inconvenience to the patient is not true. Not only pain, but local inflammation and even suppuration may sometimes be induced. Odevaine, in India, reports three cases of tetanus following the hypodermic injection of quinine. (*Indian Med. Gazette*, April, 1871.) But many patients, suffering painful complaints, have had a hundred or more injections made in different parts of the body, without any disadvantage, and with great relief.

Sometimes a *habit* of hypodermic injection of morphia has been formed; exhibiting the same power over the will of the individual as that experienced by the opium-eater.

Hydrate of chloral is sometimes used by hypodermic and also (Bucquoy) *intravenous* injection, especially in tetanus.

TRANSFUSION OF BLOOD.

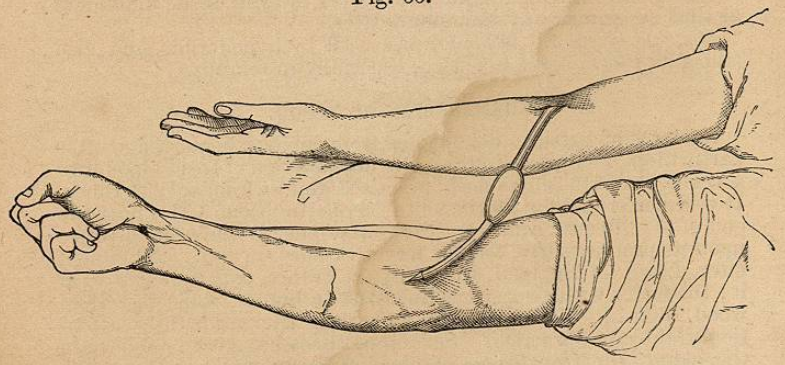
In states of extreme debility, as from copious hemorrhage after parturition or surgical injuries, the introduction of fresh blood into a vessel has been occasionally practised almost from ancient times. It was performed for the benefit of Pope Innocent VIII. near the end of the fifteenth century. Sir Christopher Wren wrote a paper upon its practicability, for the Royal Society, in 1657. Not much later, Lower in England, and Denys in France, experimented with it; the latter with two successful cases in human subjects. Harwood, Blundell, Waller, Martin, and others afterwards called attention to the same practice.[1] Several methods have been employed; the oldest, the transfusion of blood from an *artery* (seldom of a human being, a lamb being generally preferred), directly into a vein of the arm of the patient. In 1872, Prof. Esmarch performed arterial transfusion twice. *Mediate* transfusion of *venous* blood has been more often used; the blood being received into an instrument, from which it is again injected into a vein. On theoretical grounds, *defibrinated* blood has been much favored, especially in order to prevent interference with the operation by coagulation. It would appear, however, to be a sounder opinion that unwhipped natural blood, *promptly* (though not too rapidly) transfused, will better afford favorable conditions for recuperation. Introduction of air during the operation has been regarded as its chief danger; as speedy death has been ascribed to this accident in several cases. Robin and Feltz have explained this by capillary embolism. But Oré found, experimentally, that a *small amount* of air may be injected into the femoral vein of a dog without injury. While precautions are necessary to exclude air, this risk need not stand in the way of transfusion.

Altogether, it is probable that Aveling's method of *immediate transfusion from vein to vein* is the best. The instrument for this

[1] In 1861, Dr. Martin published a statement of forty-five successful instances of transfusion, out of fifty-seven cases of its performance. See *N. Y. Med. Record*, April 1, 1874. In all, 126 successful cases have been reported down to July, 1874.

consists of a small India-rubber tube, about a foot long, with a bulb at the centre; the ends being furnished with canulas for introduction into the veins. The *movement* of the blood is facilitated by pressure upon the bulb. The quantity of blood transferred has varied from four to twelve or more ounces; probably from four to eight ounces will always suffice. Béhier[1] saved the life of a woman with twenty drachms; using Moncocq's apparatus, by which, at each turn of the rack, five grammes of blood are introduced. Dr. J. W. Howe (*N. Y. Med. Record*, April 1, 1874) has found Dieulafoy's aspirator, modified for the purpose, to serve in transfusion with great convenience. Dr. B. E. Fryer, United

Fig. 55.



Dr. Aveling's apparatus for transfusion.

States Army, has added a second bulb to Aveling's apparatus, for more convenient manipulation of the blood, which requires some force of pressure to secure its transmission (*N. Y. Med. Record*, April 15, 1874). Dr. T. G. Morton (*Am. Journal of Med. Sciences*, July, 1874) reports success in four cases with the use of defibrinated blood. He has a vessel in which the blood can be kept warm, by being surrounded by hot water, while awaiting use.

The purpose of the operation is of course to sustain life until the emergency which threatened exhaustion is overpassed, and normal sanguification in the patient is renewed.

Transfusion of blood has been so far chiefly employed in cases of hemorrhage from any cause, and, in a few cases, for the collapse of cholera. Hasse, Proegler, and others, however, have resorted to it, with at least temporary advantage, in advanced phthisis.[2]

Experiments of the same kind, with lamb's blood, made at Dresden, by Drs. Oehme, Stetzner, Hirschfeld, and Bischoff, have not sustained the expectation that much benefit can be thus effected

1 *Revue Scientifique*, March 7, 1871.
2 *Phila. Med. Times*, May, 1874. See, also, *Die Lamm-blut Transfusion beim Menschen*, by Dr. Oscar Hasse, Nordhausen; *Die Transfusion des Blutes*, by Dr. Franz Gesellius; and an article by Dr. H. M. Madge, *Brit. Medical Journal*, Jan. 10, 1874.

in phthisis. Immediately after the operation, in several instances, shivering, vomiting, and even convulsions followed; a day or two later, hæmaturia. All these symptoms soon disappeared; but the patient was left with his malady about as before. It does not follow, however, that early and repeated transfusion (especially with healthy human blood) might not exert a favorable influence upon the phthisical cachexia, and thus also upon the local disease. Yet the inconvenience of its performance is likely to prevent the operation from being a frequent one, unless for extreme emergencies, in practice.

GENERAL CONCLUSIONS.

The following may, in recapitulation, be stated to be the *most general* desiderata in the management of all diseases:—

Rest;
a, in all *acute* diseases;
b, in all cases of *exhaustion.*

Balance;
a, of the *fluids*, and solids;
b, of the activity of *functions.*

Normal blood-change;
a, due removal of *excretions;*
b, absence of morbid *poisons.*

Support;
a, in all *asthenic* cases;
b, in *later stages* of sthenic cases.

THERAPEUTIC MAXIMS.

1. All **pathology** is but the **physiology** of organic **perturbations.**
2. Never **interfere** actively in disease without a distinct **object.**
3. **Act** only upon scientific **reason,** or *well-defined* **experience.**
4. Treat the **cause** of disease whenever it is **possible.**
5. **Watch** *always*, and treat, when **requisite,** the **condition** of the *patient.*
6. **Avoid,** especially, **routine** treatment according to the *names* of diseases.
7. Use no **violence** with **self-limited** diseases.

I believe that a sound "theory of medicine" may be approximated in a single paragraph, thus:—

Physiological **optimism** characterizes the aggregate tendency of all the forces of the living organism, under the influence of *life-force.* But, the *best possible* result in a given case may, from its *conditions and circumstances*, fall far **short** of *health.* Medicine, then, is to *favor or supply those conditions which, under natural laws, allow* or *promote* the **best result.**

In aiming to fulfil this duty, the art of healing must *always* depend, *in part*, upon empirical **observation** (which every branch of knowledge requires) and *in part* upon deductive **science.** But in both alike, the physician is, or should be, "*naturæ minister et interpres.*"