

application has consisted in transverse transmission of galvanism through the brain, using a current of sufficient intensity merely to cause slight giddiness, a faint metallic taste, and barely perceptible flashes of light.

Galvanization of the brain and of the cervical sympathetics is one of the measures to be resorted to in *acute active or passive congestion of the brain*. *Wakefulness*, when not reflex in origin, and when dependent simply on the state of the vascular supply, is often relieved by galvanization of the brain. Insomnia may be dependent on either active or passive congestion. In the first case a *continuous* current of moderate intensity should be passed through the superior ganglion of the sympathetic—the positive pole being placed in the auriculo-maxillary fossa, the negative on the seventh cervical vertebra; in the second case a mild current should be transmitted transversely through the brain, and be slowly interrupted.

To promote absorption of the clot in cases of *cerebral hæmorrhage*, and to relieve the *collateral œdema in embolism* of the cerebral arteries, very mild galvanic currents may be employed. Caution is necessary, however, in employing galvanism in such cases. Strong currents and lengthened applications may do serious mischief; but the author believes, with Remak, that judicious application of galvanism will be useful. The immediate effects of the embolism, or of the hæmorrhage, should be allowed to subside before commencing the use of electricity, and, if there be much headache and vertigo, the greatest circumspection will be necessary.

In *hemiplegia* the constant current may be applied to the brain, for the purpose of improving its nutrition, and the faradic or induced current to the muscles, to prevent wasting and loss of function from disuse. If the temperature of the paralyzed parts is lowered, the skin discolored and roughened, the muscles weak and flabby, much improvement in all these particulars will follow faradization. Large electrodes, well moistened, should be used, and all the muscles should in turn be made to contract—one pole being placed over the motor nerve, the other over the bellies of the affected muscles. In cases of hemiplegia, when the nutrition of the skin and muscles has been improved to the extent which faradization can accomplish, no advantage can accrue from further persistence in the applications. In faradizing the muscles in a case of hemiplegia, a current of just sufficient intensity to cause contractions should be used. Tetanic cramps fatigue the muscles, and are harmful. The so-called “late rigidity”—the muscular contractions which ensue after a time in hemiplegia, and which occur chiefly in the forearm and hands—is best treated by a continuous current to the contracted flexors, and an interrupted or faradic current to the relatively weaker extensors.

In recent affections of the spinal cord, as a rule, electricity is not

indicated. In *chronic myelitis, syphilitic diseases of the meninges*, after a course of suitable specific treatment, and in some of the sequelæ of *acute meningitis*, much good may be accomplished by the galvanization of the spine and the paralyzed muscles. The wasting of the affected muscles may be arrested and their nutrition raised to the normal, and the paralysis of the sphincters may, in many cases, be relieved. When the electro-contraction of the muscles is not impaired, and when they have not wasted, no good is to be accomplished by stimulating them with the electrical current.

That very troublesome disorder, *spinal irritation*, with its extensive irradiations of nerve-pain, is much benefited by an inverse galvanic current, according to Hammond, and this observation I have been enabled to confirm by my own experience. *Hysterical paralysis* of the extremities, accompanied or not with anæsthesia or hyperæsthesia, should be treated by galvanization of the spine and faradization of the muscles.

In *paralysis from lead* (dropped wrist), the muscles may be so far atrophied as not to respond to faradization, but may react when stimulated by a slowly-interrupted galvanic current. When this condition exists, the interrupted galvanic current must be first employed, and the cure be completed by the faradic current when the muscles are so far improved as to react to the latter.

The best example of a *peripheral paralysis* is that of the *muscles of the face*, from disease or injury of the facial nerve. From exposure to cold, or disease of the ear, or traumatic injury, the nerve is damaged, and the muscles to which it is distributed are paralyzed. In accordance with the law already given, such muscles do not respond to the faradic current, but do react to galvanism. The positive pole is placed over the *pes anserinus*, or on the mastoid process, and the negative is made to pass over the peripheral expansion of the nerve, so that all the muscles innervated by the nerve are brought into action. A current of sufficient intensity to induce muscular contraction must be employed. As in the case of other peripheral paralyses, after a time the affected muscles recover their power of response to faradism, when this form of current may be used to complete the cure. If the nerve has not been irremediably damaged, and if the paralysis has not existed so long that the electro-contraction is lost in consequence of atrophic degeneration of the muscles, a cure of facial paralysis may be effected by a persistent use of electricity.

Certain of the ocular paralyses, as of the *third, fourth, and sixth nerves*, are often cured by electricity (interrupted galvanic current). It is necessary, in order to obtain a successful result, that the remedy be employed in suitable cases. When these paralyses are dependent on cerebral tumors, syphilitic gummata, exostoses, etc., electricity can not be expected to cure; but the parietic state of the muscles, left after the removal of the gummata, may be promptly relieved by galvaniza-

tion. The functional states of the above-mentioned nerves, of which paralysis may be a symptom, will certainly be cured by electricity. Faradism may sometimes succeed when galvanism fails in these cases (Althaus).

Cases of *aphonia*, when dependent on paralysis of the vocal cords, are sometimes cured by a single application, and few, indeed, resist the proper use of galvanism. The larynx may be faradized externally; the recurrent laryngeal may be galvanized by placing one rheophore over its trunk and the other over the larynx, or, what is better, an intra-laryngeal electrode (Mackenzie's) may be used.

Paralysis of the bladder and of the *sphincter ani*, even when symptomatic of spinal affections, may be greatly benefited, and the condition of the patient rendered much more comfortable, by an interrupted galvanic or faradic current applied by suitable insulated electrodes. Idiopathic cases of these affections may be cured in this way. *Constipation*, due to atony of the muscular layer of the large intestine, can be overcome by the same means. An insulated electrode is introduced into the rectum, and a large sponge-covered rheophore, well moistened, is passed over the abdomen so as to bring every part of the large intestine within the circuit.

The failure of respiration in *opium narcosis* can be most successfully obviated by faradization of the muscles of respiration. A strong faradic current is one of the most effective means of causing uterine contractions in cases of *post-partum hæmorrhage*.

In certain of the "*myopathies of spinal origin*," but not in all of them, electricity gives excellent results. The most decidedly curative results are obtained in *infantile paralysis*. The electrical treatment should be begun early, but after the subsidence of all inflammatory symptoms. Good results may be looked for if the electro-contractility of the muscles is not lost, and if important changes have not occurred in the joints. In many cases the affected muscles, although not atrophied, do not respond to the faradic current, but will to the interrupted galvanic. The latter should therefore be used until the muscles are put into a condition to respond to the former. Besides galvanization and faradization of the paralyzed muscles, the electrical treatment should include galvanic spinal-nerve and plexus-nerve currents. Thus far but little benefit has accrued from the electrical treatment of *progressive muscular atrophy*. If the initial change in this malady were myopathic (as asserted by Friedreich), good results from localized faradization might be obtained. The author's most recent experience as to the curability of this disease by electricity is not in accord with Onimus and Legros's, who declare that it is without avail in this disorder, for it does appear to have the power, in some instances, of arresting its progress. *Posterior spinal sclerosis* is sometimes retarded in its course and progress by electricity, and galvanization of the spine

lessens somewhat the severity of the neuralgic pains which belong to this malady. Recently it has been shown that persistent use of the faradic brush to the spine, body, and extremities, is in suitable cases remarkably effective. Of all the remedial means now employed, this is the most promising, for Strumpf, of Düsseldorf, who has revived this treatment, reports not only amelioration but apparent cures of this before intractable disease.

Nothing is more certain in therapeutics than the relief to *pain* by galvanization of the affected nerve or nerves. In *tic-douloureux* decided relief to the pain is obtained by electrical applications to the fifth, and a permanent cure not unfrequently results in those cases belonging to the category of the essential neuralgia, so called. The best method of application is that advised by Onimus and Legros, which consists in placing the positive pole on the point of emergence of the affected nerve, and the negative over the superior ganglion of the cervical sympathetic. About ten elements of Siemens and Halske is the proper strength, and five to eight minutes the proper time, for these applications. This method of treatment is, according to Frommhold, the most effective remedy for *migraine* or *hemicrania*.

In *cervico-brachial neuralgia*, and in *sciatica*, excellent results are obtained by galvanization of the affected nerves. The positive pole should be placed over the point of emergence of the nerves from the cord, and the negative over the main divisions of the peripheral expansion. Both labile and stabile currents may be employed. A current from thirty elements will usually be required. The electrodes should be large sponges well moistened. In old cases of neuralgia, a needle such as is used for acupuncture, but insulated to near its point, may be introduced down to the neighborhood of the nerve-trunk and attached to the positive pole, while the negative sponge-electrode may be passed over the course of the nerve. This mode of galvanization is especially to be recommended in old cases of *sciatica*. A daily *séance* of from five to fifteen minutes is required usually in cases of neuralgia. The cure is much more difficult, and the applications must be continued over a much longer period of time, in those cases of neuralgia dependent on neuritis. Decided amelioration and even cure may be hoped for by sufficiently prolonged applications, when the nerves are so far altered that induced currents do not cause any muscular contractions. Some of the most satisfactory results have been obtained from galvanization of the uterus in uterine and ovarian nerve-pain.

In certain kinds of *muscular spasm* the galvanic current has unquestioned utility. Cases of spasmodic *wry-neck* (*torticollis*) of recent origin, due to "rheumatism," are quickly relieved by galvanization by stabile currents of the affected muscles, and faradization of the opposed muscles. Old cases of *wry-neck* and convulsive tic of the face, and writer's cramp, are not benefited by this treatment. Cases of *chorea*

have been cured by static electricity, but little benefit has been derived, according to the author's observation, from galvanism or faradism.

Galvanism is sometimes of great service in *epilepsy*, but no exact indications for its use can be laid down. Obviously it can only be serviceable in idiopathic epilepsy. The applications should include the brain (transverse current from mastoid process), the cervical sympathetic, and those nerve-trunks along which an aura is transmitted.

The author has witnessed some remarkable results from the galvanization of the pneumogastric nerves, and as conspicuous failures from the same practice, in *spasmodic asthma*. Even in those cases not permanently improved, great relief to the difficult breathing is experienced when the current is passing. The positive pole is placed over the pneumogastric, beneath the mastoid process, and the negative pole is applied to the epigastrium. Faradism is not serviceable in this disease.

Ecophthalmic goitre, a disease of the sympathetic system and manifested objectively by proptosis, goitre, and palpitation of the heart, is cured by galvanization of the cervical sympathetic and of the pneumogastric, and by applications to the eyes and thyroid gland, when it is merely functional in character.

There can be no reasonable doubt of the influence of electricity over the nutritive functions. Beard and Rockwell employ the method termed by them "general electrization," which consists in faradic applications to the surface of the body, "one pole, usually the negative, being placed at the feet or the coccyx, while the other is applied all over the surface of the body." They formulate their principles in these applications as follows: "Constitutional diseases are better treated by general, and local diseases by localized electrization." According to Benedikt—and in this view electricians are generally in accord—the true method of using electricity consists in making applications to the affected part or organs, and, to this rule may be added, to those parts or organs also in which symptoms are felt.

General electrization is useful "in those diseases that are dependent on, or associated with, impairment of nutrition and general debility of the vital functions, such as *nervous dyspepsia*, *neurasthenia*, *anæmia*, *chlorosis*, *hysteria*, *hypochondriasis*, *paralysis*, and *neuralgia* of a constitutional origin, *rheumatism* and other toxic diseases, some forms of *chorea*, and oftentimes in functional disorders of the genital, digestive, and other special organs."

In *anæmia* and *chlorosis* the usual remedies for these states may be much assisted by central galvanization, and localized applications to the vegetative organs. *Regurgitation of food*, *gastralgia*, and *feebleness of digestion*, are often signally benefited by galvanization of the pneumogastries, and by localized applications to the abdominal organs. Strong currents are needed when internal organs are to be affected by electrodes applied to the integument of the abdomen. A more effec-

tive application in these cases consists in the use of an insulated rectal electrode, while a sponge electrode of large size, and well moistened, is passed over the various organs of the abdomen. The relief of constipation by this means has already been alluded to.

Various diseases of the pelvic organs, both in the male and female, are successfully treated by electricity. *Amenorrhœa*, when dependent on atony of the ovaries and uterus, is cured by static electricity, by faradism, or by an interrupted galvanic current. A shock from a Leyden-jar may be transmitted through the pelvis, or a strong faradic or galvanic current may be applied by means of one pole on the spine, the other on the hypogastric region. In the case of married women an insulated vaginal electrode may be introduced and placed in contact with the os uteri. This is a more effective way of making the applications than by the electrodes placed externally. In *neuralgic dysmenorrhœa* the galvanic current will afford relief in a large proportion of cases; and, in *congestive dysmenorrhœa*, an inverse current will diminish the blood-supply, and thus lessen suffering. The treatment of these affections should be conducted during the interval. The *chronic congestive enlargement of the uterus* is sometimes remarkably benefited by a galvanic current of moderate intensity slowly interrupted, but it is doubtful if any case of chronic interstitial metritis is ever cured, or even ameliorated, by this means.

Although the changes in the joints, induced by gout and rheumatism, may not be cured by galvanization of the central nervous system, as claimed by Meyer, yet there is no doubt that *myalgia*, *lumbago*, and other so-called rheumatic diseases of the muscular system, may be promptly relieved and cured by the constant current. The *stiffness of the joints* and the *muscular soreness* which remain after an attack of acute rheumatism are best relieved by passing a mild galvanic current through the affected parts.

Herpes, especially *herpes zoster*, and *prurigo*, when they are referable to an alteration of the cutaneous nerves, are curable by electricity. The author has seen excellent results in cases of shingles, from galvanization of the affected intercostal nerves—the positive pole being placed over the point of emergence of the nerves, and the negative brushed over the terminal filaments in the skin. Beard reports the cure of obstinate cases of *chronic eczema* by central galvanization, and his results have been confirmed by others. The author has seen a number of cases of *acne* get well under the influence of galvanization of the cervical sympathetic, and local galvanization of the skin of the face—the positive pole on the neck, the negative passed over the affected parts. It need hardly be stated that strong currents are not to be used when the poles are applied in these situations. Among the other skin-affections treated by galvanism with success are *prurigo*, *psoriasis*, and even *scleroderma*; but, as Dr. Piffard, of New York,

has remarked, this method is "by no means uniformly successful." It is applicable to the treatment of the *neuroses of the skin*.

ELECTROLYSIS.—When the electrical current is made to traverse insulated needles introduced into the tissues of the body, electrolytic effects are produced, decomposition of the tissues ensues, hydrogen and the alkalis appear at the negative pole, and acids and chlorine at the positive. Remak, in his various publications, much insisted on the catalytic action of the constant current. Effusions into and about inflamed parts, and into the substance of tumors, may be made to disappear by the external application of galvanism, through moistened sponge-electrodes. It is doubtful, however, whether neoplastic formations can be thus made to undergo absorption. The disappearance of effusions induces such an appearance of shrinking of tumors and inflammatory products, that actual absorption of the neoplastic material may be supposed to have occurred.

Galvano-puncture is used to remove *malignant* and other *new formations*. The sanguine expectations once entertained that cancer can be thus removed, although justified by the results in a few apparently successful cases, have not been realized. Beard proposed and has executed a new method, entitled "working up the base," which consists in electrolytic decomposition of the subjacent parts of a cancer. A number of needles, insulated to near their points, are introduced into the healthy tissues beneath the morbid growth, and a current from twenty to sixty elements is passed through them. Decomposition ensues, and there takes place a separation of the morbid mass. As the pain of this method is great, etherization should be resorted to.

Aneurisms, so situated as to be beyond the reach of surgical interference, have been treated by galvano-puncture, but the success, although brilliant in a few instances, has not been such as to justify very sanguine expectations of its future utility. *Erectile tumors* are curable by electrolysis. *Goitre* is sometimes made to disappear by the same means. The *cysts* connected with glandular tumors in the neck may be permanently occluded by galvano-puncture. The most useful applications of this method have been in *hydrocele*, which may be often cured in my experience by introducing two needle-electrodes, insulated to near their points, and passing a current from twenty to forty elements. Not less effective is the same method in the treatment of *hydatid* disease of the liver. One needle connected with the negative pole is introduced, and the sponge-electrode is placed at some indifferent point on the abdomen.

Spasmodic and *permanent stricture of the urethra* are treated by electrolysis, an insulated sound with a metallic tip, connected with the negative pole, being passed into the stricture, and the positive pole placed at some indifferent point. The most successful results have

been obtained by Mallez and Tripier, and Dr. Robert Newman, of New York; but it is the author's observation, as also the experience of Dr. Keyes, of New York, that this method has little real utility.

Wounds and *ulcers* of an indolent character, and *bed-sores*, may be made to heal by attaching to them a galvanic couplet (zinc and silver), one of the elements remaining in contact with the sore, and the other on the skin in the neighborhood. They should be connected by a copper wire, and be confined to the parts by strips of adhesive plaster. This method has been especially serviceable in the treatment of bed-sores.

GALVANO-CAUTERY.—This method consists in cauterization by a platinum wire heated by the galvanic current. The battery used for this purpose furnishes a large quantity of electricity of low tension; hence the elements are few in number but have extensive surface. When a quantity of electricity is made to traverse a platinum wire which offers great resistance, the wire is heated and may be melted. The platinum in the form of wire-loop, or dome cautery, or knife, heated by the electrical current, is the cauterizing agent. If the wire be not so highly heated as to cut through the tissues too rapidly, but little bleeding results, and a clean surface is left which promptly granulates and heals.

The instruments now employed for galvano-caustic work are chiefly the batteries of Piffard and Byrne, and the storage system of Trouvé. Byrne's is said to be the most efficient of the original caustic batteries. The elements of this consist of zinc and platinum, and are so arranged as to offer the least resistance. The exciting fluid is bichromate solution, and this is kept active by a bellows, or some other arrangement for agitating the fluid.

The storage system is supplanting all other arrangements for the purposes of galvano-cautery. This consists of an element or combination of elements which may be charged by another battery. The form of "storage-cell" or "accumulator" now chiefly used consists of plates of lead, immersed in dilute sulphuric acid. These are charged by some Daniell or Bunsen cells, communicating with them, and in action for several hours. Bubbles of hydrogen gas form on one lead plate, and of oxygen on the other; whence they are said to be "polarized," and the current produced by the recombination of the gases is called a "current of polarization." By such an arrangement the quantity of electricity furnished by some Bunsen or other cells, acting for many hours or days, can be given out in a short time and in immense quantity. The accumulators of Faure, charged in Paris, have been transported across the ocean to give out their force in New York. Trouvé has utilized this principle in constructing his "polyscope." A storage-cell of Planté is charged by the action of two Bunsen elements,

and subsequently the stored-up electricity can be employed in heating a platinum wire or knife for cauterizing purposes, or for illumination.

When this system is fully developed, storage-cells, or accumulators, will be provided from some station and transported to any point desired, and the force given out as required. Furnished with suitable platinum loops, knives, and cautery, the operator can employ the machines anywhere. Obviously, this method will be utilized on a large scale for various operative procedures—for the removal of the tongue, of polypi, of hæmorrhoids, for opening the trachea, deep-seated abscesses, etc. A beautiful application of the galvano-cautery was made by Thomas, when he opened the sac of a tubal pregnancy by a galvanic knife. The evident advantages of this system are the little pain which attends the operation, and the absence of hæmorrhage. It is necessary to accurately adjust the strength of current, so that the wire or knife will have the requisite temperature to cut the tissues sufficiently and yet not so rapidly as to prevent adequate closure of the vessels. (For full details, see the author's "Treatise on Medical Electricity," second edition, p. 262, *et seq.*)

STATIC ELECTRICITY.—The modified Holtz or Toepler-Holtz electrical machine is now used to procure all of the nerve and muscular effects hitherto obtained by faradic electricity, and also therapeutical results of a very striking kind. It has long been known that chorea and other nervous affections may be readily cured by static electricity, but a remarkable extension has been given to the subject by late discoveries. *Chorea* is now treated by the "electric bath," sparks being drawn from the spine. If the Holtz machine is used, sparks can readily be drawn through the clothing, by presenting the brass knob along the spine. The results, which have been so long obtained at Guy's Hospital by this mode of electrical applications, are now generally conceded. It seems to be the most successful method of treating this disease. *Neuralgia* is now promptly relieved in most instances by insulating the patient and drawing sparks from along the trajectory of the nerve affected. The pains of *progressive locomotor ataxia* are much benefited in the same way, and it is said the disease itself is arrested. *Amenorrhœa*, other conditions favorable, is quickly cured by sparks, or a shock sent through the pelvis. The *general nutrition* is greatly promoted by electrization by sparks.

The Toepler-Holtz machine may, by connecting the interior of one condenser with the exterior of the other, be utilized to procure the muscle and nerve reactions of the faradic current.

Trowé's Polyscope, referred to above, will probably be largely employed in the future, for the purposes of illumination. Suitable throat and other mirrors, platinum knives, and loops, are furnished with the instrument for illumination of the cavities, and for the various caustic operations. It is very powerful, occupies but little space,

and promises, when certain mechanical defects are overcome, to fulfill more perfectly than any other apparatus the requirements of a surgical galvano-caustic and a medical illuminating apparatus.

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Nux-Vomica.—The seeds of *Strychnos nux-vomica* Linné (Nat. Ord. *Loganiaceæ*). (U. S. P.) *Noix vomique*, Fr. ; *Krähenaugen*, Ger.

Abstractum Nucis Vomicae.—Abstract of nux-vomica. Dose, gr. ss—gr. ij.

Extractum Nucis Vomicae.—Extract of nux-vomica. Dose, $\frac{1}{6}$ —gr. $\frac{1}{2}$.

Extractum Nucis Vomicae Fluidum.—Fluid extract of nux-vomica. Dose, \mathfrak{m} j— \mathfrak{m} v.

Tinctura Nucis Vomicae.—Tincture of nux-vomica. Dose, \mathfrak{m} j— \mathfrak{m} xv.

COMPOSITION.—Nux-vomica contains two alkaloids and a peculiar acid. The alkaloids are *strychnine* and *brucine*, and the acid *strychnic* or *igasuric acid*. The proportion of strychnine ranges from one fourth to one half of one per cent, and of brucine from one eighth to one per cent. These wide differences are in great part due to the varying skill of the chemists who have made analyses. Besides these, another crys-