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PRACTICAL NOTES
ON
MEDICAL
ELECTRICITY.

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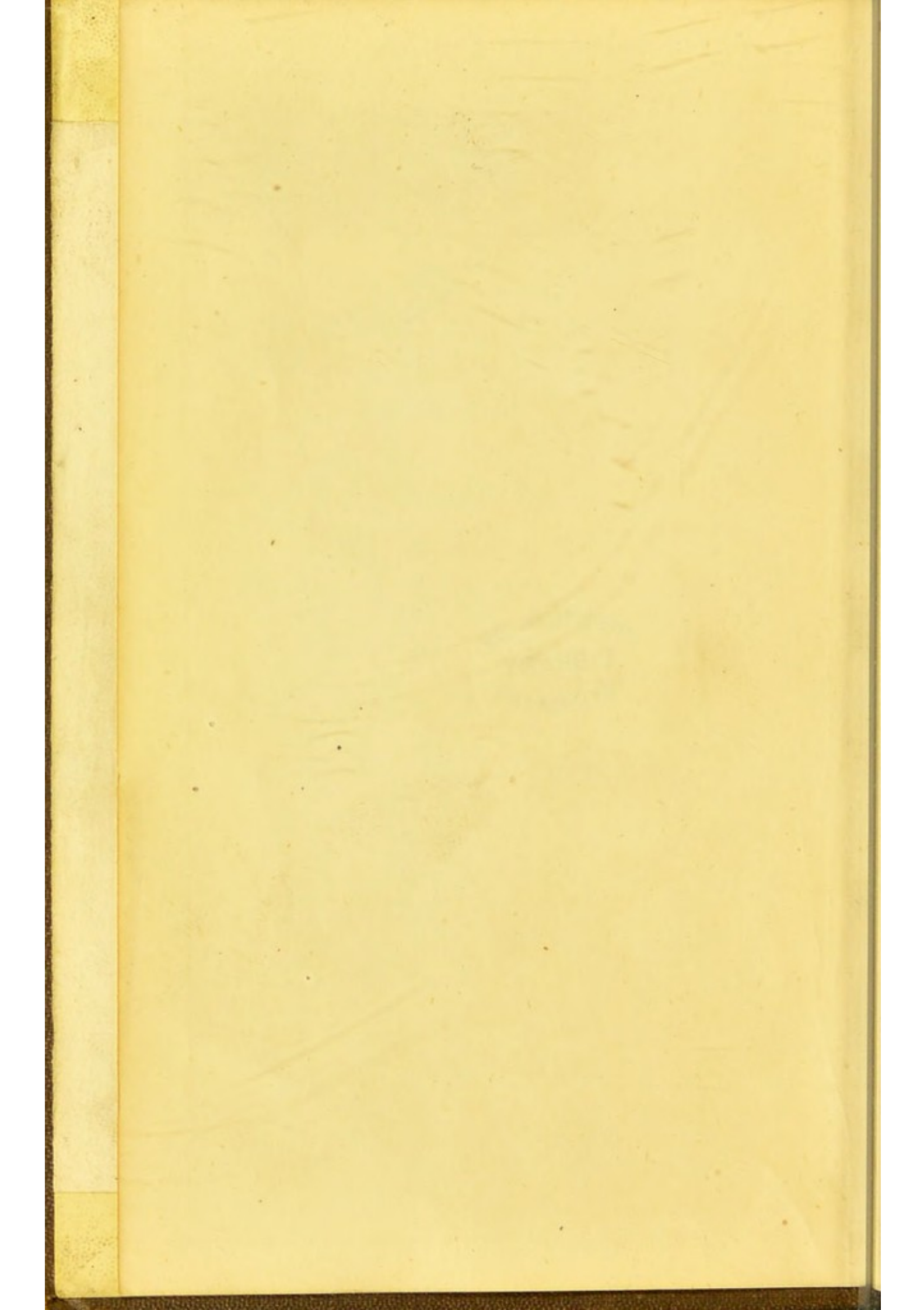
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PRACTICAL NOTES

ON THE USE OF

GALVANISM AND FARADISM

IN

THE DIAGNOSIS AND TREATMENT
OF DISEASE.

BY

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SECOND EDITION.

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PREFACE.

A CONCISE account of the most important uses of Galvanism and Faradism in the Diagnosis and Treatment of Disease having been repeatedly called for, I have endeavoured to condense within a small compass such information as appeared to me most essential for appreciating the present state of this department of science.

18, BRYANSTON STREET,
PORTMAN SQUARE.

October, 1876.



ON
GALVANISM AND FARADISM
IN THE
DIAGNOSIS AND TREATMENT OF DISEASE.

I
INTRODUCTORY.

THERE are few branches of medicine in which so much progress has been made during the last ten years as in the pathology, diagnosis, and treatment of nervous affections; and this progress has been most intimately connected with an improved medical use of the different forms of electricity. That wonderful force which circulates through all the organs of animals and plants; which, although invisible and imponderable, is diffused everywhere; and which, although not identical with nervous force, yet has the closest possible resemblance to it, has of late become one of the most valuable helps of the physician, both for the recognition and treatment of disease.

Amongst the different forms of electricity

there are two which are of particular use in medicine, viz., the continuous galvanic or battery current, and the interrupted, induced, faradic or electro-magnetic current. The *continuous galvanic current* was discovered by Professor Galvani, of Bologna, in 1786. Galvani noticed that if the hind legs of a frog, which were lying on an iron grating, were touched by a copper wire, they became convulsed. In this experiment the electricity was developed by the chemical action of the moisture of the frog's limbs on the iron and copper, and the effect of the current thus developed was to produce muscular motion in the limbs of the animal. The continuous galvanic current is, indeed, invariably produced by the chemical action of a liquid upon two different metals, as, for instance, of water or an acid upon plates of copper and zinc. The principal batteries of this kind which are now in use are—*Daniell's*, which consists of zinc immersed into dilute sulphuric acid, and copper placed in a solution of sulphate of copper; *Grove's*, in which zinc is immersed into dilute sulphuric, and platinum into strong nitric acid; *Bunsen's*, in which carbon takes the place of platinum; *Smee's*, in which platinised silver is combined with zinc, and immersed into dilute sulphuric

acid; and *Leclanché's*, in which the zinc is immersed into a solution of chloride of ammonium, and combined with carbon and peroxide of manganese. The galvanic current which is furnished by all these batteries, is called continuous, because it is produced without any interruption, as long as the batteries continue to act. It exerts attractive and repulsive powers; it will charge a Leyden jar, if the two poles of the battery be connected with the two coatings of the jar; it may send a shock through the arms, if the two poles are touched with the fingers; it will decompose water, oxygen being attracted to the positive, and hydrogen to the negative pole; it will deflect a magnetised needle from its previous position; it will magnetise soft iron, and melt a thin metallic wire.

The *induced, interrupted, intermittent, electro-magnetic* or *faradic* current differs considerably from the constant galvanic current, both in its mode of production and its properties. It is called interrupted, or intermittent, because it is not continuous, but only of instantaneous duration, being produced by the action of a battery current on two copper wires, at the moment when it begins to circulate in them, and again when it ceases to pass. It is also

called faradism, or the faradic current, because it was Faraday who discovered, in 1831, that when the current of a single galvanic pair is sent through a copper wire, it will induce an instantaneous electric action in another wire which is placed parallel with and near to the first wire. In order to be practically useful, all instruments which produce the faradic current are furnished with a contrivance by means of which the current of the galvanic pair may be more or less rapidly interrupted, so as to yield a quick succession of the instantaneous currents. This contrivance is called the rheotome or contact-breaker, and produces, when in action, a musical sound, which is due to the quick succession of instantaneous currents. The action of the continuous battery, on the other hand, is perfectly silent, as the duration of its current is not instantaneous, but continued all the time during which the battery remains in activity.

The power of the faradic current may be very much increased by employing long copper wires, which are coiled round a hollow reel, and insulated by silk or gutta serena; and even more so by introducing into the cavity of the coil pieces of soft iron, which become magnetic under the influence of the battery current, and

thereby generate new electric currents in the coil of copper wire. This is the reason why this form of electricity is likewise called *electro-magnetism*. It is further noticed that, when the instrument is arranged in this manner, two principal currents come into play, viz., one in the first wire which is connected with the battery, and is called the *primary* or extra current; and another in the second wire communicating with the first, and this latter is called the induced or *secondary* current.

Faraday likewise discovered a form of electricity which is produced by the influence of a permanent magnet of steel upon a coil of copper wires, without the intervention of a battery; and which, in order to distinguish it from electro-magnetism, is called *magneto-electricity*. This magneto-electric or magneto-faradic current was formerly much used in medicine, but has recently been discarded, as being in all respects inferior to its twin-brother, electro-magnetism.

All the different forms of electricity are propagated with far greater velocity than any other agent with which we are acquainted, light itself not excepted. According to the calculations of Sir Charles Wheatstone, electricity travels at the rate of 288,000 miles per

second, and any artificial motion which can be produced, appears rest itself when compared with it. Electricity, however, attains this high speed only when unimpeded by disturbing causes, and this rate is, under ordinary circumstances, considerably diminished by the influence of bodies in the neighbourhood, and by the greater or lesser conducting power of the wires used for sending the current on. There are no absolutely perfect conductors of electricity, for even silver wire, which is the best of all, retards its transmission, while all resinous bodies and glass arrest it altogether.

The human body does not conduct nearly as well as metals, and more especially the skin, hair, and nails are found to offer great resistance to the passage of the current. Mucous membranes conduct better than the skin, and the resistance of the latter may be diminished by moistening it. This is the reason why, for medical applications of the current, sponges moistened with warm water are generally used.

The circumstances affecting the conductivity of the human body are very complicated, because the body is not a homogeneous mass, such as a copper wire or steel bar, but consists of a great variety of differently-conducting

substances moulded into one, and all of which have a definite influence upon the resistance of the whole. Not only have we to consider skin, nerves, muscles, bones, blood, mucous membranes, and other substances of widely different chemical composition, but all these parts again differ in conduction according to shape and bulk. The thickness of the skin is not the same in different parts of the body, and therefore a current which will be plainly felt in the face, where the epidermis is thin, will not be perceptible in the palms of the hands or the soles of the feet, where the thickness of the cuticle is considerable. Again, the degree of moisture of the skin varies according to the temperature and condition of the atmosphere, individual peculiarity, rest or exertion, state of health, etc. The resistance of the human body, can, therefore, not be determined with the same scientific exactness as that of the metals, which we can render chemically pure, reduce to any shape we like, and examine at any degree of temperature. Nevertheless, we know a number of facts which are of great practical importance, and by the aid of which the influence of electricity upon the body may be regulated with great precision. It has been proved by physiological researches, that,

when the current has once overcome the resistance of the skin and the bones, it will spread almost equally through all the organs which are interposed between the two poles of the battery, and that the greatest effect is always produced in the immediate neighbourhood of the two poles.

It has likewise been shown by experiments on dead bodies, that the brain and spinal cord are accessible to electricity, inasmuch as the resistance of the skull and bones of the spine is not nearly as great as was previously imagined; and where the conditions of life were imitated, so as to produce a kind of artificial circulation, the results were even more decisive, showing that the current traverses the organs more easily during life than after death. The eyes conduct better than almost any other organ, and positive results were also obtained with the tongue, ears, lungs, heart, liver, spleen, intestines, etc.

The physiological influence of galvanism and faradism upon all the organs of the body has, within the last decennia, been thoroughly studied, more especially by the German school of physiology; and the discoveries which have been made in this branch of science, form now the ground-work of all medical applications of

the different currents in cases of disease. These physiological effects depend partly upon the kind of electricity which is used, and partly upon the property and function of the organ that is submitted to its action. A gentle continuous current applied to the face causes a pleasant sensation of tingling in the skin, and in those who are sensitive to its influence, a perception of taste, and a flash of light; while the faradic current, applied to the same part, produces no taste or flash, but a pricking sensation and contractions of the muscles. The mode in which electricity is applied has also a considerable influence; an induced current applied by metallic conductors acts more on the nerves of the skin, while, if it is applied by moistened sponges, it acts more on the contractile power of the muscles. Again, the length of time during which the electricity is allowed to act is of importance. If a gentle continuous current be directed to the skin for a short time, it dilates the blood-vessels and promotes circulation; but if it be applied for several hours successively—as is often done with Pulvermacher's chains and galvanic belts—the blood-vessels become paralysed, and sloughs are produced. A faradic current conveyed for a short time to the motor nerves and

muscles rouses their vital energy ; but if its action be prolonged for an hour or more, the power of these organs becomes exhausted, and temporary paralysis may be the result.

The special property of the organ to which the electricity is applied, has likewise to be taken into consideration. The same current which produces a flash of light, when applied to the eye, causes a peculiar sensation of taste when directed to the tongue ; sounds when acting on the ear ; muscular contractions when conveyed to a motor nerve, and a sensation of heat when applied to the skin. Finally, the different states of vitality of the organ, at the time when the electricity is directed to it, are of great importance. Thus a morbid increase of sensibility in a nerve, as occurs in sciatica, tic-douloureux, and other forms of neuralgia, may be subdued ; while on the other hand, a nerve, the vital energy of which is materially diminished or gone, may, by electricity, be restored to its normal condition. These various results can be produced with a great amount of certainty, chiefly by the continuous current, which, when applied to the nerves, produces a zone of *increased energy* (catelectro-tonus) at and in the neighbourhood of the negative pole, and one of *diminished energy* (anelectro-tonus) at

and near the positive pole ; *we have, therefore, in the continuous current, a most valuable means of increasing or diminishing, ad libitum, the vital energy of diseased portions of the nervous system.* In paralysis and anæsthesia the former, and in spasm and hyperæsthesia the latter mode of application has to be resorted to.

The *stimulating effects* which the continuous current may produce upon all the different portions of the nervous system become particularly developed by using an intermittent application and voltaic alternatives, *i.e.*, a sudden change of the direction of the current in the metallic circuit.

The *refreshing or restorative effects* of the same current may likewise be utilised in a variety of pathological conditions, particularly in cases of exhaustion of the nervous and muscular system.

The continuous current should always be used when we intend to act upon the centres of the nervous system ; but in many pathological states of the peripheral nerves and muscles, the faradic current, the medical use of which is called *faradisation*, proves beneficial. Faradisation produces the state in which those organs are physiologically active, and may, if judiciously applied, ameliorate

or restore their loss or impaired functions. It augments the supply of arterial blood to the muscles, and thereby increases their nutrition.

The instruments which are now used by physicians for a scientific application of galvanism and faradism, have reached a previously unequalled degree of perfection. The best batteries for utilising the continuous current are those of Becker-Muirhead, Foveaux, Stöhrer, and Leclanché; and the best faradic machines are those of Stöhrer, and Krüger and Hirschmann.

The methods of applying galvanism and faradism have likewise been perfected in accordance with the teachings of anatomy, physiology, and pathology. Shocks are no longer used, and a gentle current applied for a short time has been shown to be more effective than a powerful one used for a prolonged period. Principally of all, it has been acknowledged that in order to do most good, galvanism and faradism must be applied to the seat of the disease.

II.

As a means of diagnosis electricity proves largely useful, and mostly so in paralytic affections. It is true that in some forms of paralysis we may accurately determine the seat of the disease, and the lesion which has given rise to the paralysis, without employing the electric test in the examination of the patient; but in many cases this is not so, and no correct opinion on the cause, seat, curability, and probable duration of the complaint can be given, without minutely examining by faradisation and galvanisation into the condition of the suffering parts. Such an examination frequently gives the most valuable hints on the origin of the disease, and it may be readily understood that, without a knowledge of this, no satisfactory results can be expected from treatment.

The following is a case in which I discovered, exclusively by employing the electric test, that a patient who came to consult me about loss of power in the arm, had suffered from lead-poisoning. The patient himself had had no idea that such could be the case, and was much surprised when the fact was brought home to him:—

Case 1.—A chemist living in Lichfield, aged 41, married, and in tolerably good health, consulted me on November 5th, 1873, for a paralytic affection of the left hand, from which he had been suffering for a month past. He gave me the following history:—He was walking in the country in April of that year, when, on getting over a freshly-planted hedge, he ran a black thorn into the middle of his left thigh. This accident was followed by erysipelas and sloughing of the inner portion of the thigh, and he had to take to his bed a fortnight afterwards. He was laid up for about four months, after which he commenced to go about again, although the sore was then not nearly healed. In the commencement of October last he suddenly noticed that he was unable to use his left hand. Stimulating liniments were used for restoring the lost power, but without effect, and the patient then came to London to consult me.

On examining the left upper extremity, it appeared that there was full control over the muscles of the shoulder and the arm, and that the paralysis was confined to the muscles on the back of the forearm, which extend the wrist and first finger-joints, and move the hand from one side to another. The paralysed

muscles felt flabbier than their fellows on the right side, but were not wasted, and there was no loss of sensation in the skin. On applying the faradic current to the radial nerve which animates these muscles, and also to the muscles themselves, no response was obtained, and a current of considerable power was scarcely felt by the patient. The other muscles of the arm and hand contracted well under the influence of a gentle current, and the patient felt this current plainly. I then applied a continuous galvanic current of forty pairs of plates to the paralysed nerve and muscles, with the result that a sensation of heat and tingling was perceived, but no contraction took place; and only when I increased the galvanic power to sixty pairs of plates, a feeble and sluggish response was obtained.

These peculiar signs shown by galvanisation and faradisation are only met with in paralysis due to lead-poisoning. It is true that we occasionally meet with palsy of the same muscles from exposure of the arm to wet and cold (rheumatic paralysis), and likewise from injury to the radial nerve (peripheral or traumatic paralysis). But in the rheumatic form of this palsy the muscles contract well when a gentle faradic current is applied to them; and where

the paralysis is owing to injury, not only motion, but also sensation in the skin is lost. As therefore, in the present case, the muscles did not respond to faradisation, I could exclude rheumatic paralysis; and as there was no loss of sensation in the skin the palsy could not be owing to injury. I therefore formed the opinion that the influence of lead had caused the paralysis in this instance.

It is true that it appeared at first sight unaccountable how the patient could have got the lead into his system; and when I questioned him on this subject, he denied that he had ever in his business or elsewhere handled lead, or come in contact with it. I nevertheless persisted in my opinion, and suggested to him various ways in which lead might have entered his system, such as sleeping in a newly-painted bedroom, drinking beer early in the day from the tap of a public-house, taking snuff packed in lead-foil, etc. All these queries received a negative reply; but suddenly the patient said that he had used an immense quantity of lead-ointment for dressing the sore on the thigh.

The lead-ointment of the British Pharmacopœia, of which the patient had used an ounce three times daily, contains one part of the

solution of subacetate of lead in $5\frac{3}{4}$ parts of wax and almond-oil; which, at the rate of 3 ounces per diem, would amount to about half an ounce of the solution of subacetate of lead applied daily to a wound having then a surface of ten inches by six.

The dressing with this ointment had been continued for a month, and sufficient lead could therefore have been conveyed to the absorbents for exercising a decided influence on the system. It is a well-known fact that lead is absorbed even by a surface not denuded of the epidermis; and in the present case absorption must have been considerably facilitated by the highly vascular condition of the sore, and by the length of time during which the lead ointment, which was spread on lint, remained on the surface of the wound.

The diagnosis of the case having once been settled, no difficulty was experienced in determining upon a plan of treatment. I prescribed iodide of potassium, which, when taken internally, decomposes the insoluble chloride of lead wherever this may have been deposited, and forms a soluble iodide of lead, which is eliminated through the kidneys; and I held out the prospect of an eventual application of the continuous current to the para-

lysed muscles, in case the removal of the lead from the system should not be sufficient to restore their power.

The patient presented himself again three weeks afterwards, when he reported himself as feeling generally much better and stronger, but the condition of the hand remained unchanged. There was still no power of extension, and the faradic excitability of the nerve and muscles was entirely gone. I now applied the continuous current to the radial nerve, inducing catelectro-tonus in the same, and followed this up by intermittent galvanisation of the paralysed muscles, combined with voltaic alternatives. There was an immediate improvement, and two more applications were sufficient to restore the use of the limb. The faradic excitability of the muscles which had been paralysed returned at the same time with their voluntary motion.

This case possesses several features of interest. It shows, in the first instance, that an external medicinal application of lead, provided this affects a surface of some extent, and is continued for some time, may cause palsy of a limb. It is remarkable that the paralysis should have been confined to the wrist of the same side where the poisoning took place. In

by far the largest majority of cases of lead-palsy the right hand suffers, and if the left be also affected, it is generally much less so than the right. This is owing to the right hand being much more brought into contact with the lead, in those trades in which lead-palsy is chiefly observed, viz., amongst painters and compositors; while in the present case the left wrist suffered from lead having been exclusively used on the left side. The inference seems, therefore, justifiable that lead-palsy is more owing to local absorption than to a general infection of the system with the metal.

The diagnostic value of faradisation was very conspicuously displayed in this case, as there was a total absence of other symptoms of lead poisoning, such as a blue streak on the gums, indigestion, colics, obstinate constipation, etc., which rendered the diagnosis difficult; yet the faradic test showed at once that the case was one of lead-palsy.

The therapeutical use of the continuous current in such conditions was likewise very evident, inasmuch as three applications of it were sufficient to restore to the influence of volition muscles which had been completely paralysed, and which had not shown the slightest sign of amelioration under the in-

fluence of iodide of potassium. The galvanic treatment was rapidly successful in this case, because it was resorted to early. If, as is almost invariably done, electricity is not employed until a high degree of atrophy of the paralysed muscles has set in, and if then the induced current only is used under the impression that it will do as well as the continuous, the treatment is more tedious and less successful in the end. It is true that patients improve even under these circumstances, but they rarely regain complete power over their limbs. The therapeutical lesson therefore to be drawn from the present case is that we should use the continuous current early in all cases of lead-palsy so as to prevent wasting of the muscles and to restore their voluntary motion.

Paralysis of the muscles animated by the radial nerve is a very troublesome affection, as it renders the hand, in a great measure, useless. It is true that the median and ulnar nerves supply motive power to the flexors and other muscles of the extremity; but the radial nerve animates some muscles which are constantly required in the occupations of daily life, and the inaction of which renders the entire limb practically of little use. Foremost amongst these are the muscles which extend and abduct

the thumb, the paralysis of which does not allow the patient to grasp anything with the hand, and to write or draw, when the nerve of the right side is affected. The second in importance is the extensor carpi radialis, which approaches the hand to the front of the body, and is constantly used in dressing and eating. Paralysis of the other muscles animated by the radial nerve is not of such immediate practical importance; yet it may, if the case is not properly attended to, become a serious drawback in the later stages of the complaint. If these muscles remain paralysed they gradually waste away, and this leads in its turn to contraction of the flexor muscles, with consequent deformity of the hand. Thus the whole limb may ultimately become crippled. It is therefore fortunate that we possess, in the continuous current, a remedy by means of which we are able to relieve such cases very readily.

Another form of paralysis in which there is absence of muscular response to the faradic current is that which is called *peripheral*, and which is owing either to injury or to inflammation in the sheath of the nerve. In such cases likewise no complete insight into the nature of the disease can be gained, except by

using faradisation and galvanisation as a means of diagnosis.

Case 2.—D. D——, a girl, aged 16, was admitted into the Infirmary for Epilepsy and Paralysis, under my care, on July 18th, 1870, with paralysis of the right shoulder and arm. She had been in good health before the present affection came on. In April last, she suddenly began to complain of pain and numbness in the right hand and arm; the next few days she experienced a loss of power in those parts; the fingers appeared white, and the skin peeled off. The weakness of the muscles gradually became more marked, and in about ten days from the commencement of the affection, she had completely lost the use of the whole arm and shoulder. She now attended as an out-patient at the West London Hospital, where she was treated with bromide and iodide of potassium, nux vomica, belladonna, and later on, with the syrup of iodide of iron and cod liver oil. For the relief of the pain, liniments of aconite and chloroform, subcutaneous injections of morphine, chloral, and a blister to the neck, were used, and faradisation was resorted to daily for a month, in order to restore the lost power; yet (to use the words of Dr. Wiltshire, under whose care she was,

and who has kindly given me these particulars), "she only got worse, from first to last;" and she was then sent to the Infirmary, where she was admitted under my care.

On examining the patient, I found that there was complete paralysis of motion and sensation of the whole upper extremity, no voluntary movements of the hand, arm, and shoulder being possible, and no touch, pricking, or pinching being in the least degree perceived by the patient. Faradisation of the skin, and of the nerves and muscles of the shoulder and arm, likewise remained ineffectual; but when I applied a continuous current of Becker-Muirhead's battery to the arm, the patient exclaimed that she felt a sensation of tingling in the arms and fingers; and the muscles responded to the current by sluggish, yet plainly perceptible, contractions. Any lesser galvanic power than sixty pairs of plates of the battery did not produce any effect, while under ordinary circumstances, a current of twenty cells causes not only decided sensations of heat and tingling, but also muscular motion.

Now the question arose, what was the actual nature and seat of the disease which had given rise to the paralysis? Was the loss of power owing to disease of the brain, or spine, hysteria,

lead-poisoning, or other causes? The electric test showed at once and conclusively that the paralysis did not arise from *brain-disease*; for in that affection, whatever may be the extent of the loss of power, the nerves and muscles always retain their excitability to faradisation. There is no exception to this rule, and the loss of faradic excitability in this case was therefore quite sufficient to make us reject the idea that in this patient the brain was the seat of the disease.

Was it then a case of *spinal paralysis*? To this question I could also return a negative answer, for in the earlier stages of such an affection the muscles do not lose their excitability to faradisation. Nor could the paralysis in this instance have been due to *lead-poisoning*, for not only was there no evidence to show that the girl had been exposed to the influence of lead, but we also know that in lead-palsy almost exclusively the extensor muscles of the hand and forearm suffer, while the flexors either escape completely or are only slightly weakened; and in this case there was not one particular set of muscles which suffered more than another, but all the muscles of the whole limb were indiscriminately affected.

Nor was the case one of *hysterical* paralysis,

partly because the girl had never shown symptoms of hysteria, but more especially because in hysterical paralysis the nerves and muscles retain their excitability to faradisation for years after the commencement of the affection, while in this case it was lost within a few weeks of the beginning of it.

Another question was whether the girl was shamming? It is well known that girls, especially at the age of this patient, are given to deceitful practices, in order to excite wonder and interest, and that they will continue the deceit for months and even years, as, for instance, the Welsh fasting girl, and the stigmatist, Louise Lateau. But this question was likewise disposed of by the result of the electrical examination. Malingerers may have sufficient control over themselves to bear without flinching severe pain, pricking, pinching, or burning; but it would be absolutely impossible for them to resist the influence of a faradic current of high tension in making their muscles contract. This influence is irresistible, where the nerves and muscles are in a healthy condition, and the question of shamming may, therefore, be dismissed.

After thus excluding the various affections which may give rise to such a paralysis, I was

led to the conclusion that the patient suffered from a rheumatic affection of the brachial plexus of nerves. This is a disease which is not influenced by any purely medicinal treatment. The patient had indeed, before she came under my care, been treated for more than two months by a very able physician with those remedies which are generally looked upon with most confidence in the management of such affections; yet there was no improvement whatever. On the other hand, her general health was so good that no medicines were required on account of that. The only thing which could do good in this case, was to use the continuous current systematically to the paralysed nerves and muscles; and this was done daily, with most satisfactory results. After four applications, sensation returned in the paralysed limb, so that the patient was again able to perceive touch, pricking, pinching, etc., just as well as before the commencement of her illness. The paralysis of motion proved more stubborn; but after seven applications the girl was able to move her fingers. The treatment was continued for another fortnight, at the end of which the patient could not only move all her fingers, but also flex and extend the wrist. I then discharged

her, as I wished to see whether she would continue to improve on the treatment being suspended, or whether she would remain in the same condition; for it might have been said that a process of natural cure had set in, and that the progress the patient had made was only simultaneous with, but not owing to, the galvanic treatment which had been adopted; and the patient returned home after a three weeks' stay in the hospital.

Six weeks after her discharge she presented herself again, and it was then found that she was absolutely in the same condition as when she had left. She had not become worse in the interval, but made no further progress, the arm and shoulder being just as useless as before. The supposition of a natural process of cure could, therefore, not be entertained; and as the patient and her parents were most anxious that the treatment should be resumed, she was readmitted on September 27th. The use of the continuous current was now re-commenced, with the result that in a few days a further decided improvement took place; the patient soon became able to move the arm and shoulder in all directions, and to grasp things with some force. She was, however, not discharged

until the power of the right arm was in all respects quite equal to what it had been previous to the commencement of the affection. The recovery of power went on steadily, from the periphery to the centre, the fingers being the first, and the shoulder-blade the last to regain it. The patient was sent home on November 28th, perfectly recovered.

This was an interesting case, inasmuch as the diagnosis of it was made with the aid of one form of electricity, and a cure was accomplished with the help of another; and by no other means could the disease have been accurately recognised, nor a successful treatment have been carried out. But for the electricity, therefore, the patient would have irretrievably lost the use of the right arm and hand, which, as her parents were poor, would most probably have blighted her prospects in life.

In certain forms of complete or partial paralysis from brain-disease, the faradic current is likewise of great use, as it will show the presence or absence of inflammatory irritation in the brain. In some cases the electric excitability of the nerves and muscles is diminished, the muscles flabby, and the nervous tone depressed; in another class of cases the faradic

response is exactly the same in the healthy and the paralysed limbs; while in a third class of cases, where there is inflammatory irritation at the seat of the disease, early rigidity of the muscles, and *increased* electric excitability is discovered. This test will be found useful *in cases of railway injury*, where an accurate diagnosis is often beset with considerable difficulties.

Case 3. Railway injury of the right cerebral hemisphere.—On Whit-Monday, May 21st, 1866, W. A. R., a grocer, aged 32, was a passenger by an excursion train from Bicester to Euston, there being a very large number of carriages drawn by two engines. When the train reached Bletchley the pointsman turned it on to a siding, and thereby caused it to run against the abutment of a bridge, in consequence of which the engines were completely smashed, and many carriages very much damaged.

Mr. R. was riding with his back to the engines, about the middle of the train. He had no recollection of the shock of the collision; but it came out in evidence that the passenger sitting opposite to him was thrown forward and against him with great force, and knocked him against the back of the carriage, the two heads knocking against one another.

R. was unconscious for about half an hour ; after having had stimulants given him he recovered some degree of consciousness, but appeared soon to relapse again into complete insensibility. Some hours afterwards he was sent on to Euston Station, where he was seen by a surgeon, who pronounced the case to be one of concussion of the brain, with escape of fluid from the spinal column. On recovering himself in the waiting room, the patient asked for stimulants to set him up for the day, as he had business to transact, but was told he had better keep quiet. He was put to bed at the Euston Hotel, felt a little better next morning, and succeeded in dressing himself. On going downstairs he had a fit, in which he lost his consciousness. He was now again put to bed, and although he wished later on to be removed home, Mr. Spelding, the medical officer of the London and North-Western Railway Company, refused his consent, and kept him three weeks at the hotel.

At home he consulted Mr. Croft, of Bicester, who saw him twice in a fit. In December, 1866, he came to London, where he was seen in consultation by the late Mr. Solly and myself. After having carefully examined him, I drew up the following report on his condition:

A. *Condition of the Nervous System.*—Since the accident which occurred in May last, the intellect of the patient appears to have become impaired. He finds it difficult to fix his attention on any subject, and cannot apply himself to work of any kind. His temper has become irritable, and his memory bad, especially for recent occurrences. His manner is peculiar, and different from what it has been. His vision does not seem to be injured, although he states that he has several times lost his sight for some hours, and has seen stars and sparks. The ophthalmoscopic appearances are negative. There is a peculiar twinkling of the eyelids, which is not under the control of the patient. The special senses of hearing, smell, and taste, are normal. The expression of the face is care-worn, and the tongue tremulous when protruded, but there is no lateral deviation of its apex.

There is some hesitation in the speech; he is apt to confound words, and to repeat a sentence twice over. He complains of a sensation of pressure on the top of the head, and of giddiness, more especially on stooping. He has had several convulsive fits, with loss of consciousness, since the accident. The sleep is bad, and restlessness at night is particularly

complained of. The temperature of the right side of the face is 93° , and that of the left 91° . (Mr. Croft had previously, on several occasions, discovered increase of temperature on the right temple.) The æsthesiometer shows loss of sensation, particularly in the left side of the head. The patient says that when he attempts the slightest exertion his head becomes very hot, and this was ascertained to be the fact.

He likewise complains of pain at the lower portion of the spine, and there is tenderness on pressure on the first lumbar vertebra.

The power of motion in the extremities appears much impaired, particularly on the left side. The patient seems unable to walk without support, and has great difficulty in getting up from a chair. Even if supported, he cannot walk for any distance, but only just across a room.

The loss of power is rather less in the upper than in the lower extremities, for the patient is able to write, to dress, and to feed himself, although it takes him much longer to do these things than before the accident. There is great tendency to spasmodic jerkings of the whole frame, and more especially of the left thigh. These jerkings increase on

attempting exertion, or when he is excited. Apart from this, a continuous tremor is perceptible in the limbs, more especially those of the left side, which sometimes increases so much that the patient stamps the foot on the ground.

On applying the faradic current to the radial nerve and to the extensor muscles on the back of the forearm, it appeared that there was considerably increased response to the current in the left side. The same thing was noticed when the peronæal nerve and the muscles under its control were faradised in the right and left leg, *when there appeared a spasmodic jerking of these muscles on the left, and a quiet contraction on the right side.*

This symptom led me to diagnose an irritative lesion in the right cerebral hemisphere, involving the corpus striatum and the optic thalamus, giving rise to a semi-paralytic and choreic condition of the left side of the body.

The sense of touch in the limb appears to be diminished, and there is occasionally a feeling of numbness alternating with pricking both hands and feet are habitually cold.

B. *Condition of the organs of circulation, respiration, digestion, etc.*—For some time after; the accident the patient had suffered from

palpitation of the heart, chiefly on exertion. The pulse is very small and feeble, with 80 beats in the minute. There is no disease of the heart or lungs. The appetite is bad; the bowels are regular; the urine sometimes thick, and sometimes very pale. There is irritability of the bladder.

Mr. Solly coincided in my opinion on the patient's condition; and our report was sent to the Company in due course. We prescribed iodide of potassium, and believed that under the prolonged use of this medicine, together with rest and judicious general management, the patient might ultimately recover.

The Company having refused to compromise the case, the patient brought an action against them, which came on at the Court of Exchequer, at the Guildhall, before Sir Fitzroy Kelly, on February 18th, 1867. Mr. Serjeant Ballantine and Mr. Wills were for the plaintiff, and Mr. Hawkins and Mr. Home for the defendants. On the medical side there were for the plaintiff—Mr. Samuel Solly, Dr. Althaus, Dr. Giles, of Oxford, and Mr. Croft, of Bicester; for the Company — Dr. Sibson, Dr. Radcliffe, and Mr. Spelding. Serjeant Ballantine made an opening statement, after

which witnesses were called to prove the accident, and the plaintiff and his wife were likewise examined. After that the Court rose, and adjourned until next morning, when it appeared that the counsel for the defendants considered the medical evidence on the plaintiff's side too strong, and therefore suggested a compromise. An offer of £1,500 damages was made, and accepted for the plaintiff.

In this case of course the question arose, and was thoroughly discussed between Mr. Solly and myself, whether the patient was shamming. We were, however, both of opinion, that although there might possibly be some exaggeration in the patient's complaints, yet he was unquestionably disabled from following his occupation. Perhaps not overmuch value might be attached to some of his statements, but there were two objective symptoms of importance, viz., the differences of temperature and of faradic response on both sides of the body. We also thought that, if the patient had been inclined to shamming, he would have preferred to simulate hemiplegia, which is a far more common condition, and one much better known to persons in the patient's class of life, than the somewhat complicated and much rarer state of nervous

derangement exhibited by him. This view was also confirmed by the fact that such able advisers as Dr. Sibson and Dr. Radcliffe considered it impossible to contest the medical evidence which was coming forward on the side of the plaintiff.

Faradisation and galvanisation are likewise very *useful for the detection of malingerers*. Shamming certain diseases for the purpose of extortion, or for exciting compassion or interest, and avoiding the necessity of working, is much more frequent than is generally supposed. Where certain forms of paralysis are assumed by malingerers, faradisation has, in my practice, contributed to the detection of the fraud.

Case 4. Malingering detected by faradisation and the use of nitrous oxide gas.—In November, 1871, I was consulted by the secretary of the Amalgamated Society of Carpenters and Joiners, with regard to the case of one of their members, who professed to have lost the use of the left arm, in consequence of an accident which he had had three years previously. This society pays £100 to members who are permanently incapacitated for work either by disease or accident. The patient had had a fall from a considerable height, and

asserted that he had ever since been unable to use his left arm. He had been admitted into a provincial hospital, where he remained for three months, and where (to use his own words) the surgeon tried as hard as he could to cure him, but failed. In course of time, the man, who was known not to have done any work since the occurrence of the accident, applied to the society for the £100 to which he was entitled, and I was then requested to give an opinion whether he was only temporarily or permanently disabled.

The claimant was a tall, powerful man, of determined countenance, and evidently considerable force of will. He professed to be unable to dress himself, and had to be assisted when the helpless limb was bared for examination. I found the temperature and bulk of the left arm, in all its parts, quite equal to those of the right. The limb was held in full extension, and drawn to the body, while the fingers were somewhat tightly flexed. On attempting to flex the forearm and to supinate the hand, considerable resistance was encountered; and when additional force was used for effecting this purpose, the patient called out with pain, and said he could not bear the manipulation.

Seeing this condition of the limb, only three pathological conditions could be suspected, viz., paralysis with contraction, ankylosis, or dislocation, provided always that the patient was sincere. In peripheral paralysis, owing to injury of the motor nerves of the part, which is the only form of that disease which could be thought of in this case, there is rarely any great amount of contraction, but the paralysed limbs are mostly found flabby; and if the case be one of long standing, the muscles are wasted, and the temperature is considerably diminished. These clinical signs, although of value, are, however, not invariably present, and I therefore employed faradisation as a test which gives absolutely decisive results in such cases, and enables us at a glance to decide the presence or absence of peripheral paralysis. In this form of palsy the muscles lose their faradic excitability, while their galvanic response may be preserved, or, under certain circumstances, even be increased. If, therefore, in the present case, the muscles of the useless limb could be made to respond by contraction to the faradic current, it would be rendered evident that there was no paralysis from injury to the nerves in this case.

On using faradisation, I found that all the muscles of the arm and hand responded readily to the current by contraction of their fibres, and I could therefore eliminate one of the three morbid conditions which could give rise to the patient's complaint.

I then informed the Secretary that, although I had satisfied myself that there was no paralysis, yet I could not give a certificate concerning the exact nature of the affection from which the patient suffered, unless he were previously placed under the influence of an anæsthetic. All parties having consented that this should be done, I procured the assistance of Mr. Clover, who, on the following day, administered nitrous oxide gas to the patient. The latter was rapidly rendered insensible; and I could now freely move the arm in all directions, there being evidently neither dislocation nor ankylosis. As soon as this was ascertained the influence of the anæsthetic was withdrawn, and the patient, who recovered himself in a few moments, was informed that his case was not nearly so bad as he had imagined, and that he would certainly recover the use of the arm under proper treatment. I gave a certificate to the effect that the patient appeared to suffer from a painful affection of the shoulder-

joint, which would rapidly yield to subcutaneous injections of morphia or a judicious use of galvanism; and that there was neither paralysis, nor dislocation, nor ankylosis seriously to interfere with the use of the extremity. The claim of the impostor was, therefore, not allowed.

THE ELECTRIC PROBE.

Electricity is also useful for the discovery of bullets lodged in the body. In many cases, especially after great battles, considerable difficulty is experienced by surgeons in deciding whether a solid body which is felt in the depth of a gun-shot wound is a bullet or a piece of bone. Now we know that lead conducts infinitely better than flesh or bone, and the galvanic current will, therefore, indicate with ease the presence of a piece of lead which may be imbedded in the soft part or bones, by a deflection of the magnetic needle on closing the circuit, while the needle will remain motionless if flesh or bone is touched by the probe. The electric bell has also been used for this purpose, and makes the discovery of a bullet even more *striking*; for when the circuit is closed, and a bullet be present, the galvanic current causes a hammer to strike against an

alarum bell, and this is repeated when the circuit is opened. German surgeons used the electric probe successfully in the Franco-Prussian war.

ELECTRIC BIOSCOPY.

A further use of electricity is, that by its means we are enabled to *recognise death with absolute certainty* within a very few hours after its occurrence. The signs of death which are generally relied upon, are cessation of the heart's action and of respiration, a fall of temperature, rigidity of the body, a glassy eye, dilated pupil, non-transparency of the fingers to candle-light, and finally decomposition. With the exception of the last, however, all these signs are occasionally of doubtful value. Thus a slight degree of deafness in the practitioner who is in attendance, may prevent feeble heart's sounds from being perceived by him; and cases are on record in which experienced medical men have failed to hear the respiratory murmur in persons who were in a trance and afterwards recovered. Decrease of temperature is likewise not quite reliable, for in some cases the temperature rises after death, and in hot weather the fall is very slow; while

life has still been extant where the body-heat had fallen to 81° . Decomposition is an unquestionable sign of death; but this is often exceedingly slow, more especially in cases of poisoning, in habitual drunkards, and in persons who have died of wasting diseases.

None of these signs are as ready and decisive as faradisation, which indicates death with the greatest certainty, within two or three hours after its occurrence; for the muscular movements which are produced by the faradic current, may be observed in health as well as in disease, and also in lethargy, apoplexy, syncope, and all kinds of asphyxia, or poisoning, as long as there is a breath of life; and when this contractility has disappeared in all parts of the body, we may say with certainty that death has taken place. This property gradually diminishes from the moment of death, and is entirely gone within two or three hours afterwards. Faradisation may therefore not only prevent the terrible misfortune of burying a person who is still alive, but it will also encourage the medical man to persevere with his efforts for restoring life in people who are apparently dead from apoplexy, lethargy, syncope, drowning, freezing, the inhalation of chloroform, poisoning by charcoal fumes, etc.

In such cases it proves likewise one of the most effective means of restoration to life.

In all doubtful cases, and wherever the relations of the deceased should desire it, faradisation should therefore be employed, it being a radical means for preventing premature burial. Especially after great battles, or where there are several victims from shipwreck, railway accidents, etc., it would have the additional advantage of enabling the attendants at once to distinguish the dead from the living, so that the doctors need not lose precious time with the dead, but might concentrate their attention on those who could still be benefited by it. Finally, it might enable the authorities to accelerate the burial or embalming of the dead, in case it should be undesirable to wait for the ordinary delay. During cholera epidemics, and amongst the poor, an earlier interment than now takes place would often be advisable.

One case is already on record where a woman had been in a trance for thirty-two hours, and where death had been certified by a qualified medical practitioner, when faradisation of the muscles of the face and limbs, almost accidentally used, caused them to move. The burial of the woman was therefore postponed,

attempts at resuscitation were made, and she recovered herself twelve hours afterwards. She then stated that she had heard her friends and the doctor speak of her death, but that she had been utterly unable to give the slightest sign of life, or to call for help. Two years after this occurrence she was still alive, and tolerably well.

I now proceed to consider the therapeutical effects of the different forms of electricity in those diseases for the relief or cure of which they should be medically employed.*

I.—DISORDERS OF THE MIND.

Faradisation is an invaluable remedy in certain forms of insanity, where a stimulating effect upon the diseased nervous centres appears necessary, that is, in atony of the brain, depression, and paralysis of function. Such

* For further information concerning this subject the reader is referred to my *Treatise on Medical Electricity, theoretical and practical*. Third Edition, 1873. London, Longmans and Co.; and for my most recent experience on the electrolytic treatment of tumours to a paper on that subject which I read before the Annual Meeting of the British Medical Association in Edinburgh, in August, 1875 (Longmans and Co.).

patients become more lively, seem to take renewed interest in what is going on, and resume their working habits. On the contrary, it does no good where there is increased excitability, and if used in such cases would probably do harm. One of the best modes of applying it in cases of depression, is to direct the faradic current to the phrenic nerves at the neck. The brisk respiratory movements caused by this proceeding are useful in decarbonising the blood, improving circulation, and removing that passive congestion which is so frequently found in the cerebral blood-vessels.

Although every form of insanity is a symptom of diseased action of the brain, yet it would be a mistake to assume that coarse structural alterations of the brain are always present. On the contrary, such changes are mostly absent, especially in recent cases. Other nervous affections often precede, for years, the outbreak of the mental disorder, and may be generally traced to a morbid condition of the spinal cord or the peripheral nerves. Where these organs are in an irritable condition, and where there is altogether increased impressionability, irritable weakness, nervousness, neurotic diathesis, etc., the continuous current applied as a sedative—an electro-

tonus—produces excellent results. Where mental disease has followed attacks of neuralgia, the painful nerve should be acted upon; and where there have been palpitations of the heart, spasm in the throat, and difficulty of breathing, the pneumogastric nerve should receive the galvanic influence. If there are no symptoms of peripheral irritation, an application to the spine answers best. Cases of long standing, in which structural disease has already commenced, resist the influence of galvanisation.

II. CEREBRAL AND SPINAL EXHAUSTION.

The chief symptoms of this condition are nervousness, irritability of temper, depression, want of mental energy, impaired memory, a sensation of weight and pressure on the top or back of the head, drowsiness, giddiness, hesitation or embarrassed speech, flushings of the face, sensations of tingling and numbness in the extremities, rapid exhaustion of muscular power after exertion, palpitation of the heart, and shortness of breath, various forms of dyspepsia, irritability of the bladder, a jaded appearance, and frequently an immoderate craving for alcoholic stimulants. All these symptoms are

not present in every case of cerebral or spinal exhaustion, and some of them occur in structural disease of the brain and its blood-vessels; nevertheless the group of symptoms just mentioned is well marked in a considerable number of cases which come habitually under our notice; and that they are owing to functional debility rather than to structural disease, is shown by the circumstance that most of them recover. The condition of anæmia seems to be more prevalent than that of congestion in these cases; and the most frequent causes are worry, anxiety, affliction, or acute exhaustive diseases, such as small-pox and typhoid fever.

The medicinal treatment of this condition often yields but unsatisfactory results. The patient's sufferings are at first looked upon as arising from congestion of the liver, and the aid of blue pill is called in. After a time, however, it is found that a more strengthening plan of treatment is required, and the sulphate of iron or tincture of steel are ordered, which are apt to disorder the stomach and liver. Bromide of potassium is then substituted; but the patient, as a rule, derives only little benefit from such prescriptions. Change of air and scene, and phosphorus for internal use,

are more successful; yet many cases occur in which even such a plan of treatment does not answer; and the constant galvanic current, applied either as anelectro-tonus or catelectro-tonus, is then the best remedy. Where sleeplessness is a prominent symptom, the former, and where there is much drowsiness in the daytime, the latter is preferable. Its use should always be combined with such general and dietetic directions as may appear suitable for a given case.

III.—PARALYSIS.

In the various forms of paralysis, both faradisation and galvanisation find a legitimate and useful sphere of action. The mode of application, and the amount of benefit to be expected from them, depend upon the nature of the cases which come under treatment.

1. The most frequent form of paralysis is *hemiplegia* or sudden loss of power in one side of the body, which is generally owing to rupture of a morbidly altered blood-vessel in the brain, softening, or plugging of an important cerebral artery. Where these lesions are severe, death or permanent paralysis may be the result; but where their extent is moderate, a

natural process of reparation sets in after a time, which is accompanied by a gradual amelioration of the paralytic symptoms ; and spontaneous recovery may take place. This, however, is hardly ever complete. In other instances the cicatrix acts as an irritant on the brain, the paralysed muscles become rigid and contracted, both in the arm and leg, and more especially the flexor muscles. Finally, the paralysis may continue without rigidity, the paralysed muscles being flabby.

Where the cerebral matter has been severely and extensively injured, either by the rupture of a morbidly-altered blood-vessel or by softening, and where there is a high degree of rigidity in the paralysed muscles, the prognosis is unfavourable, more especially as far as the recovery of power over the arm is concerned. But where the effusion of blood or softening have been of limited extent, the prospects of the patient are much better, and nothing is then more beneficial than faradisation and galvanisation. It remains, however, to determine at what period of the complaint electricity should be used, which of the two currents should be employed, and whether the application should be more central or peripheral.

I follow the rule to postpone the galvanic treatment until the danger of cerebral fever, which so often follows an attack of hæmorrhage, has entirely passed off, and as this, if it occurs at all, comes on within ten days after the stroke, the application of the continuous current may be considered safe two or three weeks after the attack. If we were to wait much longer, the prospects of ultimate recovery would certainly be diminished. We know that if the paralysis continues for six months or longer after the rupture of a blood-vessel or softening, wasting of the nervous matter in a certain portion of the spinal cord is apt to come on; and when this wasting has become fully established, any further therapeutical efforts must inevitably fail. Pathological anatomy, therefore, plainly warns us not to defer the galvanic treatment of paralysis from brain disease longer than a short time after the occurrence of the attack.

In cases where the continuous current is applied early—that is, about three weeks after the occurrence of the attack—it is sufficient to apply it to the injured hemisphere of the brain and the region of the cervical sympathetic nerve. After a few applications there is generally greater ease in the head as well as in the

limbs. If there has been pain this is relieved, and the use of the limbs may gradually become re-established. The arm is generally more slow to recover than the leg, and the recovery proceeds in a direction from the centre to the periphery.

In cases where several months or years have elapsed after the occurrence of the attack, galvanisation of the brain alone is not sufficient ; and peripheral galvanisation and faradisation should then be combined with it. In such cases the paralysis is no longer exclusively due to the injury of the affected hemisphere, but also to the anæmia and loss of vital energy of the nerves and muscles of the affected limbs, the molecules of which have lost that mobility which previously enabled them to respond to the orders of volition. Whether in such cases galvanisation or faradisation should be resorted to, will depend upon the individual aspect of each case ; and it may be laid down as a general rule that, where the faradic response of the muscles is normal, galvanisation, and where it is diminished, faradisation should be employed. In some cases it is useful to combine both methods.

The old-fashioned way of using electricity, which consists of letting the patient take hold

of one metallic conductor by the right, and of another by the left hand, and then sending a severe shock through, is to be strongly deprecated. It can do no good, as it acts indiscriminately upon healthy and diseased parts, and has often done harm, by causing irritation of the brain, and even a fresh attack. The patient should be carefully examined before the electricity is used, and this should only be applied to those nerves and muscles which are actually in want of it. Any severe shocks are particularly objectionable in this form of palsy, in which only a gentle current, applied according to anatomical and physiological principles, can do good.

The following is a case of cerebral paralysis owing to rupture of a blood-vessel, where, in spite of a large effusion of blood having taken place into the left corpus striatum, the patient nevertheless ultimately recovered.

Case 5.—A clergyman, aged 46, married, who had for many years done hard work in a populous parish near London, and undergone much anxiety, had an attack of paralysis of the right side in September, 1868. In this attack he completely lost his consciousness, speech, and the power of the right arm and leg, this being accompanied by incontinence of the

bladder and rectum ; and for six days his life was despaired of. These symptoms showed conclusively that the effusion of blood into the left side of the brain was very large. After a time, however, the patient rallied, and when he first consulted me, in December, 1869, had very nearly recovered the use of the leg. The principal trouble to him was then his right arm, which was cold and stiff, and showed paralysis and contraction of a number of muscles. He could not write or cut his meat, and was unable to bring his hand to his forehead, or to the opposite shoulder, or to the back. His memory was bad ; his temper irritable ; there was a singing noise in the head ; the tongue was tremulous when protruded, and its apex pointed to the opposite side. He felt dizzy in walking, and more especially on going downstairs. He had lost his habitual fluency in talking, and was sometimes obliged to stop in the middle of a sentence in search of a word. His face was slightly distorted ; and he complained of palpitations of the heart, but there was no heart-disease. The appetite was pretty good, but constipation troublesome. I applied the constant current individually to the paralysed nerves and muscles of the right arm, and likewise to the left hemisphere and

region of the cervical sympathetic nerve. In a short time the patient recovered the use of his arm, and was nearly well after a month's treatment. He came to me from time to time after that, principally with the view to remove his inability of continued mental application, and to improve the fluency of speech. I last saw him in 1873, when he appeared perfectly well.

2. *Spinal paralysis* is owing to disease of the antero-lateral columns of the spinal cord, or of its meninges, and the vertebræ. There is, according to its seat, either loss of power in the lower extremities, bladder and rectum, or, where the disease is higher up, also paralysis of the arms and hands, and mastication, deglutition and respiration may be interfered with, while the intellect, speech, and the nerves of special sense remain in their normal condition. There is great loss of sensation, and the nutrition of the paralysed limb is seriously impaired.

Whether galvanisation is likely to do good in spinal paralysis or not, depends upon the cause, duration, and extent of the disease, and upon the age and constitution of the patient. Where the loss of power is owing to a tumour pressing on the cord, or to caries of the ver-

tebræ, or where it has come on from fracture or dislocation of the bones of the spine, or where the nervous matter is actually destroyed by hæmorrhage, inflammation, or softening, no form of electricity can do any decided or permanent good.

There are, however, many cases of spinal paralysis which come on after acute diseases, such as typhoid fever and small-pox, or hæmorrhage, or after convulsive seizures, over-exertion, and railway and other injuries, and in which we have only to do either with congestion or anæmia of the cord. In such cases the continuous current is most useful, young patients and recent cases being more likely to recover than the reverse.

3. *Hysterical paralysis* occurs generally in consequence of a sudden mental shock, or long-continued painful emotions, in girls and women whose sensibility is unusually acute, and may attack a few muscles only, or a limb, or the whole body. It is either caused suddenly, or creeps on gradually and unawares. This is a decidedly functional disorder, and in no way connected with structural lesions in the nervous centres, peripheral nerves, or muscles. It affects with preference the legs and vocal cords, causing inability to walk and loss of

voice, and is subject to considerable and sudden variations under the influence of pleasant or painful emotions, and of treatment. A woman affected with hysterical paralysis of one side of the body, may, under the stimulus of great excitement, get out of bed, walk several miles, and exert herself otherwise; and may, after the excitement has subsided, relapse into complete immobility. I have seen a case, in consultation with Dr. Todd, where the affection wandered about the body in a singular manner. At first there was loss of power in the left side; after a few months the left side recovered, and the right became affected; the arm then recovered, and both legs became affected, and this again changed into paralysis of the left hand. At one time, the only paralysed part was the first finger of the left hand. There was no attempt at shamming in this case, the lady being very anxious to get well, as she was engaged to be married. Some of these cases get well in a very short time, and sometimes make the fortune of charlatans, while others resist for years a variety of well-directed therapeutical efforts. A thorough change in all the circumstances of life often does more good than medicine or galvanism. I know the case of a lady who

had for years been confined to her couch by hysterical paralysis, for which the greatest medical talent had been consulted without any beneficial result. She however recovered her strength suddenly on hearing that in one of the late commercial crises she had lost her fortune, and she has ever since been most active and zealous in the discharge of the various duties which have fallen to her lot. When it is impossible to change the circumstances of life, or to act favourably on the emotions in other ways, galvanisation of the spinal cord, producing anelectro-tonus where there is a high degree of excitability, and catelectro-tonus where there is depression, is the best treatment.

Case 6.—A girl, aged 19, living at Kilburn, became an out-patient at the Samaritan Free Hospital, in September, 1864, and was sent to me by Dr. Savage. She had always been in indifferent health, and during the last three years had gradually lost the power over her arms and legs to such an extent that she was scarcely able to walk even when supported, and incapacitated from doing any work. The cause of the affection was said to be due to some trouble she had had. She first menstruated when 15 years of age, but was always irregular, the discharge being pale

and scanty, Sixteen months ago the catamenia ceased altogether, and from that time she became nearly idiotic. She was listless when I first saw her, had a vacant look, and considerable dilatation of both pupils, more especially of the left one. The left iris was hardly influenced even by strong light. She could only speak in a faint whisper. She was frequently troubled by pain in the head and the back. Her hands and feet were always cold. She complained of sickness in the morning, loss of appetite, and constipated bowels. She was always worse after emotions, and had frequently had hysterical fits. The muscles were badly nourished, but contracted tolerably well under the influence of the faradic current. There was nearly complete anæsthesia of the whole left side, including the conjunctiva. On the right side the loss of sensation was not so marked as on the left; but the prick of a pin was only felt as if it were a touch by some blunt instrument. I applied a continuous current of from 40 to 50 pairs of plates to the spine twice a week. After six weeks of this treatment the patient was so much improved that she could walk three miles at a time without support; she could dress and feed herself; was able to do heavy work about the house, and had al-

ways warm hands and feet. The voice had returned, the bowels acted regularly, and she was cheerful, and took an interest in life. The pupils also gradually recovered their normal size; and the catamenia re-appeared on the 27th of December, and continued from that time at regular intervals. The patient has several times called upon me and informed me that she has continued in good health ever since.

4. *Lead-palsy* affects chiefly painters and compositors, but may also be caused by drinking water, beer, or wine which has passed through leaden pipes, or been adulterated with the metal, or by taking snuff which has been packed in lead foil, or by using cosmetics and hair-dyes containing lead, and in various other manners. The internal administration of iodide of potassium is the best remedy for removing the lead from the system, for this salt changes the insoluble chloride of lead into soluble iodide of lead, which is eliminated by the kidneys; but this alone is seldom sufficient for curing the palsy, which requires a special treatment. The best results are obtained by the production of catelectro-tonus of the suffering nerves, and stimulation of the muscles by intermittent applications of the

continuous current, with voltaic alternatives. Faradisation is also useful, but more tedious than galvanisation.

5. *Rheumatic paralysis* of certain muscles or sets of muscles is by no means unfrequent. The angler, the huntsman, the gardener, and others who for pleasure or from necessity expose themselves much to damp and cold, are chiefly liable to this kind of palsy, which affects with preference the muscles of the lower extremities, thus giving rise to incomplete paraplegia, which is sometimes mistaken for spinal disease; and the muscles of the shoulder and arm are likewise liable to it. Faradisation and galvanisation are the best and quickest means of restoring the lost power.

Case 7.—Mrs. G., aged 51, was sent to me by Dr. Hyde Salter, in January, 1862. Three months before she had suffered from a severe attack of rheumatic fever, nearly all the joints having been affected. As soon as she was able to move about again she went into the country, where her general health improved. Her right arm and hand, however, remained painful and useless, and she was therefore advised to try faradisation. On examining the forearm and the hand with the æsthesiometer, I found that the sense of touch

was considerably impaired. The muscles were wasted, more especially the flexors and the interossei and lumbricals; and on applying the faradic current to these muscles individually, it appeared that their sensibility, as well as their contractile power were nearly gone. The hand had lost its natural shape, and resembled a bird's claw; a configuration of the hand which is always associated with loss of power in the interossei and lumbrical muscles, and renders it useless. The pain was greatest at night, and chiefly felt in the fingers. The general health of the patient was tolerably good, but she was very thin, and suffered from despondency. I used faradisation of the skin for the relief of the pain, and of the suffering muscles for restoring them to their normal nutrition and function. After two operations the power of the fingers was increased; the muscles responded more readily to the faradic stimulus, and the æsthesiometer showed an improvement in the sense of touch. The pain was much diminished. After a fortnight's treatment, the patient attending every other day, she was able to cut her own meat, and to do some housework, and in a month she could do needlework for three hours consecutively without pain or fatigue. There was then no longer any differ-

ence in the sense of touch in the right and left arm, the bulk of the muscles was increased, and the hand had resumed its normal shape. This result was all the more satisfactory, as the age and general weakness of the patient were not in favour of a rapid cure.

Case 8.—An unmarried lady, aged 28, consulted me in March, 1873, for loss of power in the left arm, which had come on suddenly four months ago, after she had slept in a damp bed. There was at first great pain in the arm, but lately this had given place to a feeling of stiffness, which was combined with a knotted condition of the skin and cellular tissue, and wasting of the muscles. The flexor muscles did not suffer, for the patient could use her hand for grasping, but she could not stretch the arm, nor move it backwards or upwards, nor could she place the hand on the opposite shoulder. The galvanic and faradic excitability of the muscles was diminished. I produced catelectro-tonus in the suffering nerves and muscles, and combined this with intermittent stimulation and voltaic alternatives. Almost immediately after the current had commenced to act, she could move her arm better in all directions. She gradually recovered the power over it, and went to the country after having

had fourteen applications. The arm then felt still rather stiff, and it required an effort to make certain movements; yet she could do everything with it that she wanted. A few more application might have entirely restored the flexibility of the limb.

6. The existence of *reflex paralysis* has recently been questioned by some able observers, and there can be no doubt that many cases which were formerly claimed as such are really owing to structural disease of the spinal cord, which may escape examination by the naked eye, but is revealed by microscopical and chemical investigation. Nevertheless I believe, after duly weighing everything that has been said against reflex paralysis, that there will still be found cases which may be fairly claimed as belonging to this class, and where the sudden recovery of function after the removal of some peripheral irritation, leaves no doubt about the nature of the disease. Where we have reason to suspect a case to be one of reflex paralysis, and where, after removing any irritation which may cause the paralysis, yet motion does not return, faradisation or galvanisation are the most effective remedial measures at our disposal.

Case 9.—Mrs. D., aged 42, pricked the fore-

finger of her left hand with a needle. This caused great pain, of which she did not at first take much notice; but as the finger soon afterwards became inflamed, she applied for medical advice. Notwithstanding the treatment she underwent, the inflammation increased, gangrene ensued, and at last amputation of the finger became necessary. This operation was performed by Mr. Spencer Wells, on December 23, 1858. Three months elapsed before the stump was healed, as at first the pus was of a very bad character; and the secretion only improved after repeated cauterisations with nitrate of silver. When the cicatrix had at last been formed, it appeared that the patient had lost the use of her hand, and Mr. Wells then sent her to me. When I first saw her, the fingers were extended and stiff, flexion and lateral movements being impossible. The forearm could only with difficulty be bent, and every movement of it was painful. Numbness was felt in all the fingers, and pain in the elbow was complained of. The stump, which had a livid colour, was very tender, and at the slightest touch of it the patient almost fainted. Besides this, she had that peculiar symptom which is by no means rare in persons who have undergone

an amputation ; that is, she felt pain in the removed part, which increased towards evening. Otherwise she was in fair health, with the exception, however, that she had three years before, after a difficult labour, lost the catamenia, and in consequence of this, she suffered from headache for a few days every month. I directed the primary faradic current to the left arm, the positive pole being alternately applied to the trunks of the median and ulnar nerves. Intra-muscular faradisation of the interossei and lumbricals was also performed. Immediately after the first application, the patient was able to bend the second and third phalanges of the fingers ; and after three more applications she was no longer troubled with pain in the removed finger. After the ninth operation the catamenia re-appeared. The restoration of the mobility of the first phalanges of the fingers required a somewhat longer treatment, as in them the affection was very obstinate ; but after some weeks this was also attained. At the same time the stump had assumed a much healthier colour ; it was firmer, and not so sensitive to touch as before. The catamenia continued afterwards at regular intervals.

Case 10.—M. W., a married woman, aged

46, suffered a fracture of the lower end of the radius of the right arm, in consequence of a fall. She became an out-patient at the Middlesex Hospital, where a bandage was applied; but by the carelessness of the patient, this got out of order, and the bone healed badly in consequence. It was then again fractured, and put straight; but the cure was now protracted over ten months; and when the bone was at last healed the arm remained painful and useless. She became, sometime afterwards, an out-patient at the Samaritan Free Hospital, and was sent to me by Dr. Henry G. Wright. I faradised the median and ulnar nerves twice, after which the pain was gone, and the arm could be used quite as well as before.

Case 11.—A gentleman, aged 46, when on a shooting excursion, in October, 1867, accidentally shot the thumb of his right hand off at the metacarpal joint. The wound took nearly six weeks to heal, and it was then found that the hand was paralysed. Strychnia and stimulating embrocations were used, but without effect; and the hand was totally useless when the patient consulted me in April, 1868. One application of the continuous current restored its mobility; but as it was still

weaker than the left, the current was applied three times more, after which the hand was as useful as it could be minus a thumb.

Case 12.—A young lady, aged 15, of scrofulous habits, suffered from an abscess on the right side of the neck, which had to be opened, and was rather slow to heal. When the wound was closed, it was found that there was complete loss of power in the left trapezius and other muscles which execute the lateral movement of the head, so that the patient was unable to turn the head to the left side, while she could turn it to the right. I was consulted sometime afterwards (July, 1869), and applied the continuous current intermittently to the suffering muscles. After the current had acted a short time, I desired the patient to endeavour to move her head to the left, and she could do it, although with some difficulty. A few more applications restored full power to the muscles of the neck.

7. *Peripheral paralysis* from injury to the nerves, occurs chiefly in consequence of accidents, such as gun-shot wounds and railway collisions, blows and falls, and also from pressure by tumours and effusions. Where a nerve has been actually destroyed, the properties of the muscles animated by it are

entirely lost, and can never be recovered; but where the continuity of the nervous fibres has only been more or less damaged, the paralysis is incomplete, and electricity is then the best remedy for it. The following case is one which was caused by a railway collision:—

Case 13.—An unmarried lady aged 30, of delicate constitution and sedentary habits, was sent to me by Dr. Thorowgood, in June, 1868. She had had a railway accident, near Basle, in Switzerland, in September, 1867, when the carriage in which she was seated fell down a steep bank and was upset. She was stunned for a time, but soon recovered herself. Her right collar-bone, however, was found to be broken, and the skin and subjacent parts on the lower half of the right forearm were severely lacerated. For a fortnight after the accident, she felt pins and needles in her arms and legs, but had not done so lately. The fracture of the collar-bone healed within two months, and the injury to the soft parts of the forearm likewise. Three deep scars were to be seen on the front of the latter. There were all the symptoms of certain branches of the nerves of the arm having considerably suffered. The sensibility of the skin of the lower part of the forearm, hand, and

fingers was diminished ; the third finger being the worst in this respect. Concerning the sense of touch, it was found that the two points of the æsthesiometer were felt at the proper distance in the first, second, and little finger, but not in the third, where only one point was felt. Electro-cutaneous sensibility, both from faradisation and galvanisation, was likewise impaired, more especially in the third finger. The interossei and lumbrical muscles of the right hand were weak and wasted ; the intra-metacarpal spaces being hollow, and the bones protruding. Farado-muscular contractility was much diminished, but nowhere completely lost ; galvano-muscular contractility was somewhat increased. The patient experienced much difficulty in carving, dressing, writing, and buttoning her sleeves and gloves, but she could do all these things with an effort ; she was able to bend the first phalanges, but not the second and third. There was no difference of temperature in the two hands. The lower portion of the forearm was wasted, there being a difference of seven-eighths of an inch between the two arms ; for, while the left arm measured fully seven inches, the right measured only six and one-eighth. The general health of the patient was satisfactory.

I applied the positive pole of twenty cells to the cicatrices, in order to promote the regeneration of nervous fibres, and also acted intermittently on the suffering muscles. After four such applications the patient felt a good deal stronger in the arm and wrist; she could hold things better, wrote with more ease, and her hand and arm did not ache after writing, as formerly. She also found carving and dressing easier, and had succeeded in turning a key in a lock, which she could not do before. After a few more applications, the third finger, which had formerly appeared as a "dead log," recovered its sensibility, and she distinctly felt the two points of the compasses. The metacarpal spaces became more filled up, and when she left town for change of air, a month after the commencement of the treatment, the arm and hand were altogether much more useful than before.

Case 14.—Count Z., aged 63, was sent to me by Sir James Clark in June, 1857. He had, about twenty years ago, suffered from a rupture of the capsular ligament of the hip joint, in consequence of an accident, and had never quite recovered from the effects of it. He complained of great numbness and stiffness in the right leg, the muscles of which were

not nearly so well nourished as those of the left, so that he had much difficulty in walking. Sir James Clark believed that faradisation would be the best means to restore him, and advised him to consult me. The patient was much improved by a short treatment, but had to leave town soon afterwards, to return to Russia, before a complete recovery could have been effected.

The following case of paralysis was owing to pressure on a nerve:—

Case 15.—A married lady, aged 23, was sent to me by Sir James Paget, in January, 1865. She had had her first confinement in November, 1864, during which she was for some time under the influence of chloroform. While in this condition her head rested heavily on the left arm, and pressed so much on the brachial plexus that a number of muscles animated by it became paralysed, there being also loss of sensation in the left arm. The affection was most severe in the muscles of the forearm, the patient being unable to lift the wrist, which was much swollen, and had to be bound up with a splint. As she also complained of great weakness in the other limbs and the back, I combined the application of the continuous current to the spine with fara-

disation of the left shoulder and arm. After six weeks of this treatment, the patient had entirely recovered the use of the left hand, and felt very much stronger generally.

Paralysis also occurs sometimes after acute diseases, such as typhoid fever, small pox, scarlet fever, erysipelas, diphtheria, etc., and this form of it is also best treated by galvanisation and faradisation.

8. *Paltes of the muscles of the eye* are generally treated with iodide of potassium and counter-irritation of the skin in the neighbourhood of the eye; but where these means do not succeed, faradisation and galvanisation should be employed.

Case 16.—A clerk, aged 34, was sent to me by Mr. Soelberg Wells, in July, 1871. He had suffered from various forms of enthetic disease. for which he had been treated with mercury and iodide of potassium. At present his chief difficulty was double vision, from paralysis of the right rectus internus muscle, and inability to raise his right eyelid. I applied the constant current to the suffering muscles, with the result that after the first application the patient could raise the eyelid a little. The improvement was progressive, and after thirteen applications the eyelid was perfectly well.

9. *Facial paralysis* comes on most frequently after exposure to damp and cold, owing to which a rheumatic effusion takes place into the sheath of the portio dura, or its peripheral branches. This yields readily to galvanisation or faradisation; but where the paralysis is owing to injury of the nerve, or where it occurs as a symptom of cerebral hemiplegia, or tumour or locomotor ataxy, the prognosis is less favourable. Some forms of this affection appear to be remediable even where it has existed for a very long time. I have had a patient under my care in whom facial palsy had come on during birth, who had had it all her life until 23 years of age, and whose expression was then greatly improved by a short galvanic treatment.

10. *Loss of voice* is often due to paralysis of certain muscles of the larynx, and is curable by an external or internal application of the faradic current.

Case 17.—In May, 1862, I treated an interesting case of this kind, together with Prof. Czermak, of Prague, who had just then introduced the use of the laryngoscope into this country. The patient was a woman, aged 30, who had lost her voice two months before, in consequence of a great shock. An ex-

amination of her throat showed that both vocal cords were perfectly motionless and paralysed. After two applications of faradism, the patient could speak again, although in a hoarse tone only. It was then discovered, by another examination with the laryngoscope, that the right vocal cord had, to a great extent, recovered its motion, but there was as yet no improvement in the left. By further treatment, the left cord was also brought back to its normal condition, and the voice entirely restored.

IV.—SPASMODIC DISEASES.

Most cases of *St. Vitus's Dance* may be advantageously treated by galvanisation of the spine and faradisation of the affected muscles. *Scrivener's palsy*, which resists all other means, also frequently yields to a persevering application of the continuous current. The difficulty or impossibility to write is not confined to professional writers or "scriveners," but also attacks others whose temperament is of a nervous kind. In *spasmodic wry-neck* and *asthma* the same treatment deserves a trial, and in some forms of *stammering* it does a great deal of good.

V.—ANAESTHESIA.

Loss of sensation in the nerves of special sense, with consequent weakness or loss of sight, deafness, loss of smell and taste, and numbness or loss of the sense of touch and common sensation, are best treated by galvanism and faradism, unless there should be structural lesions, which render recovery impossible. In *asphyxia* and *syncope*, faradisation is most useful; more especially in the asphyxia of newly-born infants, and from chloroform and opium. In most cases the best plan is to direct the current to the phrenic nerve at the neck, which will induce immediate contraction of the diaphragm, and artificial respiration.

VI.—NEURALGIA.

1. *Tic-douloureux*.—The severest form of neuralgia is that known as *tic-douloureux*, Fothergill's disease, or *epileptiform neuralgia of the face*. This resists all purely medicinal treatment, and has only been known to yield to excision of a part of the suffering nerve, and to the use of the continuous current. Electricity, however, appears preferable to surgery in these cases; in the first instance,

because it does not destroy the nerves which are necessary for the proper nutrition of the face; and secondly, because it has the power of completely altering the condition of the affected nerves, in consequence of which it produces more permanent results than any surgical operation. Finally, it goes much straighter to the seat of the disease than operative procedures. A very remarkable case of this affection, in which both surgery and electricity had a fair trial, occurred some years ago, in the practice of the late Prof. Niemeyer, of Tübingen:—

The patient was a gamekeeper, aged 64, who had been in fair health until 1862, when he first felt a kind of painless shock darting through the left side of the head and face, and such shocks soon became frequent. A twelvemonth afterwards severe pain came on, chiefly at the jaw and cheekbone, occurring about once in three weeks; the shocks lasted one or two seconds, and were repeated twenty or thirty times in the course of the day. In 1864, when the attacks became more frequent, the patient consulted Prof. Billroth, then of Zurich, with the view of undergoing a surgical operation. A few decayed teeth were extracted, but this gave no relief. Quinine,

iron, arsenic, iodine, and veratrine were then given, equally without benefit, and only subcutaneous injections of morphia did some temporary good. Leeches were also used, but failed. Prof. Billroth then excised a piece of the infraorbital nerve, $1\frac{1}{4}$ inch long; and this piece, when microscopically examined, was found to be perfectly healthy. After this operation the patient was, for a few days, free from pain; but the latter soon returned, and the painful parts of the alveolar process of the jaw were then scraped off by raspatories. After this he was easier for some months, but then there was another relapse, and the patient requested a "radical operation." Prof. Billroth, in February, in 1866, performed a most formidable operation, in which he broke off the posterior wall of the antrum and the posterior part of the orbit, dissected away the second branch of the fifth nerve up to the foramen ovale, divided the nerve close to the foramen rotundum, removed the zygomatic and superior alveolar branches, and took the infraorbital nerve right away. The patient made a good recovery, but was better for some weeks only. Another operation was therefore, in April, 1866, made on the buccinatorius nerve, after which erysipelas set

in, and a salivary fistula was formed, owing to the duct of the parotid gland having been injured. In May, the tic was again as bad as ever, and the posterior dental nerves and the mental nerve were then excised, and the whole of the parotid gland sloughed away. In July, 1866, the patient left the hospital, free from pain.

He did not, however, continue very long in this condition, for, in December of the same year, he was as bad as ever. There was no pain in those parts the nerves of which had been removed, but the neuralgia now occupied part of the upper jaw, the nose, eyelid, and ear, and seemed to go from the temple right into the head. Prof. Billroth then, as a last resource, tied the common carotid artery, with temporary benefit; and when this operation also appeared to have done no real good, the patient consulted the late Prof. Niemeyer, with the view of having galvanism applied.

In December, 1867, he was admitted into the hospital at Tübingen. At that time he used daily eight grains of morphia for subcutaneous injection. Fits of pain came on twenty or thirty times in a day, and drove the patient nearly mad. The continuous current was now used, and with such beneficial

effect, that it was soon possible to discontinue the subcutaneous injections of morphia. After three months' treatment the patient left the hospital quite well. He had a relapse some months afterwards, but this again yielded to galvanisation.

No case than the one I have just related could show more forcibly the superiority of a judicious galvanic treatment over those severe surgical operations which had been practised by a great master in the art. It is quite evident from the description of the case which I have just given, that the seat of the disease was not in the peripheral branches of the fifth nerve, to which alone surgery could direct its efforts, but in the trunk of the nerve at the base of the brain, where it is altogether inaccessible to the knife. The continuous current on the other hand, had no difficulty in reaching the seat of the disease, and in subduing the morbid excess of sensibility, without injuring or destroying any structures. In fact, *tic douloureux* might cease to be looked upon as incurable, if it were treated by *anelectro-tonus* of the fifth nerve in the commencement of the affection. I have by that means treated a number of such cases, mostly with great benefit; but where the neuralgia has lasted for

years, and occurs in the aged, the treatment must be persevered with for a considerable time, as otherwise relapses are sure to occur.

2. *Headaches.* There are few headaches which resist faradisation by the electric hand, or a gentle continuous current; but we must at the same time rectify any derangements of the stomach and other organs which may be present, and which are so frequently instrumental in producing headaches. I have seen a large number of such cases, in which either of the above-mentioned methods of application proved successful.

A frequent and peculiar form of this affection is the *sick headache*, or *migraine* (hemicrania). This resists faradisation, but generally yields to a persevering use of the continuous current applied to the mastoid processes and the temples.

3. *Neuralgia of the arm and shoulder* is not so severe an affection as true tic, but may nevertheless cause intense suffering. It generally resists a purely medicinal treatment, but is curable by the continuous current.

Case 18.—A married lady, aged 32, was sent to me by Mr. Wolff, of Gloucester Gardens, in July, 1871. She had for the last three or four years suffered from severe

neuralgia in the right arm and shoulder, with this peculiarity that she never was actually free from pain, but suffered constantly, at times, however much more than at others. There was slight thickening in the supra-clavicular region, but otherwise no structural change could be made out anywhere. The limb was almost useless, for the pain became so much worse when she attempted to do anything with the hand, that she dreaded using it at all. Her general health was otherwise tolerably good, and no particular cause could be assigned for the occurrence of the neuralgia. She had used a great variety of remedial measures, but all to no purpose, and the pain was getting worse instead of better. I now applied the continuous current to the region of the cervical sympathetic nerve, and to the thickening in the supra-clavicular region. Three applications produced apparently no effect, but after the fourth she was better, and after the fifth a good deal better. After a fortnight's treatment the pain was entirely gone. Two years later, I had the satisfaction of ascertaining that the patient had continued perfectly well ever since.

4. *Sciatica* is generally curable both by galvanisation and faradisation.

Case 19.—A Scotch farmer, aged 35, was sent to me by Sir James Clark, in July, 1857. He had never been in strong health, and suffered a long time from acidity in the stomach. Eight years ago he had his left thigh amputated for tumor albus; and he wears now an artificial leg, which, being very heavy, exerts a great strain upon the left side of the pelvis. Three years ago, he first began to feel pain on the back of the right thigh, and on the inside of the leg down to the ankle. The pain having been dull and heavy for some time, soon became keen and acute, so that the patient was laid up with it. He thought it was brought on by his having taken too much exercise. He did not suffer from violent paroxysms of pain, followed by free intervals, but had no rest at all. He placed himself under the care of two eminent practitioners in Edinburgh, and after some time was much relieved, the acuteness of the pain slowly but gradually subsiding. He then left Edinburgh, but being still very bad, acupuncture was resorted to, from which he received immediate relief. The pain, however, never left him entirely, and was much about the same shortly after the operation. About two years afterwards he came to town and consulted Sir

James Clark, who asked me to faradise him. The pain was "a dull ache" at that time; it increased much on walking, even for a short distance, and in the early part of the night. Pressure had no marked influence upon it. The muscles of the leg twitched a good deal in the morning, but not much in the course of the day; these twitches were quite painless, and no doubt caused by mal-nutrition of the limb. I first used faradisation of the skin. but as two such applications produced no effect, I applied the next day moistened electrodes, placing the positive one to the tuberosity of the ischium, and the negative to the ankle, for six minutes. Immediately after this application, the pain was gone; it returned three hours after the operation, but was not nearly so severe as it had been before, and the patient had a good night's rest. I repeated the application three times more; after the second, the pain went away till the following morning; and, after the fourth, it was only slightly felt in walking, but not while at rest. The patient was then obliged to leave town, and six weeks afterwards wrote to say that since faradisation had been used, the limb had been a good deal better. He was, however,

not totally free from pain when he walked to any distance ; yet the pain went off sooner, was less severe, and not so liable to return as formerly. I therefore advised him to undergo another course of the same treatment, which he did, some time afterwards. Faradisation was used six times more, as above, and with such beneficial effect that he was no longer in pain, even when walking three or four miles at a time.

The following is a case of diffuse neuralgia, which was cured by faradisation :—

Case 20.—A merchant, aged 30, of vigorous constitution and active habits, was a passenger by the Canadian steamer which foundered at sea on the 4th of June, 1861, about 200 miles off the coast of Canada. Many of the passengers were drowned ; but this gentleman, by means of a life-buoy, was enabled to float until, three quarters of an hour afterwards, he was picked up by a boat which was passing. Life was then almost extinct. The water was at the time excessively cold, as large masses of ice were floating in it. The patient soon rallied ; but he had to remain in his wet clothes for a considerable time, and even after landing could not at once obtain a change of dress. He did not at first experience any ill

effects from this accident; but, after a time, began to feel severe burning pain in the arms and legs; and when the pain subsided, he perceived numbness in the limbs, and loss of muscular power. He soon afterwards returned to England, and was during his passage treated by the ship-surgeon, who prescribed anodyne applications, as opium, aconite, etc., to the arms, and general tonics; but he derived no benefit from the remedies used. On his arrival in this country he consulted Mr. Snape, of Bolton-le-Moors, who thought that faradisation would be the best means of restoring him, and sent him to me. The patient complained to me of a burning neuralgic pain, especially in the fore-arms and thighs, which increased very much towards evening and in the night, so that he was prevented from sleeping, and felt exhausted in the morning. There was also loss of sensation, especially in the right hand and fore-arm, where the prick of a pin could not be felt, while on the other parts it caused a dull sensation, not of a prick but of a mere touch. The sense of a touch, especially in the right hand, was much diminished. Finally, there was a semi-paralytic condition of the arms; the patient could move them, but he had no power over the muscles;

he could not grasp anything with force, and experienced great difficulty in writing. The contractility of the muscles was not diminished, for they answered readily to a faradic current of moderate power, only the influence of volition over them had considerably decreased. The flexor muscles of the forearm were most affected. The general health of the patient was good, notwithstanding the loss of rest, and the wear and tear consequent upon great suffering. I used faradisation of the skin and the suffering muscles, with the result that the pain, which was very severe at the time the patient came to me, disappeared during the first application; and he slept soundly the following night. The pain returned in the morning, although in a less degree; but after a few more applications, it was entirely subdued. The loss of sensation also yielded to the means employed. After three operations, the patient was again able to feel distinctly not only the prick of a pin wherever I applied it, but also the mere touch of blunt instruments. He left town after having been under my care for six days, and was then quite free from pain; the sense of touch was normal, and the muscular power had returned. I have not seen him since; but Mr. Snape has written

to me to say that the effects of the treatment have been permanent, and that the patient returned some time afterwards to Canada, in perfect health.

VII.—RHEUMATISM.

In acute and chronic rheumatism of the muscles, faradisation and galvanisation are invaluable remedies, which act more quickly and immediately than any other means at our disposal. Rheumatic effusions in the joints are likewise amenable to them; but the treatment in such cases is not so rapidly effective as where only the muscles suffer.

Case 21.—A musician, aged 31, had, during a tour in Scotland, in the summer of 1859, contracted rheumatism in the right shoulder and arm, which prevented him from following his occupation. He had been treated by an able practitioner, and taken nitre, bicarbonate of soda, iodide of potassium, and guajac. The pain was relieved for a time, but it never entirely left him, and a considerable contraction of the flexor muscles of the arm and forearm remained, for which all remedies proved useless. He consulted me in September, 1861, when I found loss of sensation in

the arm, for the patient did not feel the prick of a pin, nor could he distinguish the two points of the æsthesiometer when held at the usual distance. He complained of a dull aching pain, which at times became acute, and was very severe when he got warm in bed. The fingers felt numb. The biceps and brachialis internus muscles were so contracted that the arm could not be extended; the flexor digitorum communis was also somewhat rigid, and the interossei and lumbricals were wasted, so that the hand was nearly useless. The size of the arm and forearm was considerably diminished, being only $10\frac{1}{2}$ inches at a point eight inches from the acromion, and only 9 inches at a point three inches from the olecranon; the corresponding numbers for the left arm being 13 and $10\frac{1}{4}$. The general health was tolerably good, but the appetite indifferent, and digestion impaired. I prescribed Vichy water and faradisation and galvanisation of the right arm. The result of this treatment was satisfactory. In the course of a week the pain was gone. Soon afterwards, the rigidity of the muscles began to subside, sensation was re-established, and the right arm regained its proper size. Digestion was likewise improved, and the appetite better.

The interossei and lumbrical muscles were most stubborn, and only began to mend at the end of the third week. They ultimately regained their power, and, after five weeks' treatment, the patient was sufficiently well to be able to resume his avocation.

Case 22.—Dr. T., aged 47, had been a sufferer from rheumatism in the left shoulder for more than seven years, when he came under my care (1857). He had tried almost every means for the relief of the pain, which, especially in autumn and winter, became very troublesome; he had also used galvanism, applied in the old-fashioned way of sending shocks through both arms, but without any beneficial effect. Faradisation of the skin relieved the pain almost immediately, and it was only necessary to use it twice.

Case 23.—A spinster lady, aged 76, was sent to me by Dr. Peter Allen, in November, 1871. She had for many years suffered from rheumatic swellings and pain in the joints of the thumb and other fingers, principally of the right hand, and also of loss of power in the hands and fingers. She experienced considerable difficulty in picking up little things, and on using the hands the pain became so much worse that she was prevented from doing any

work, which was a great privation to her, as she was of a very active disposition. She also complained of disturbed sleep, loss of energy, and impaired memory. After a short treatment, which consisted principally of the application of the constant current to the region of the cervical sympathetic nerve, and to the nerves and muscles of the hands and fingers, the patient felt better in every respect. Her nights were comfortable, her memory improved, the hands and fingers felt much stronger, and she was a great deal more brisk and energetic. Considering the age and general condition of the patient, this might at first sight have appeared an unpromising case; but a marked improvement took place after the first application of the current, and the final result was most satisfactory.

Lumbago yields readily to the continuous current, and likewise, but less rapidly, to faradisation. If the latter be used, it should be repeated two or three times daily, for not less than twenty minutes each time; while one application of the continuous current daily for five or ten minutes is sufficient for a cure.

Case 24.—In September, 1875, a physician, aged 42, who had on several previous occasions suffered from lumbago, had a sharp

attack of it, which came on when he got out of his cold bath in the morning. The symptoms were those usually observed in lumbago, viz., severe pain in getting up from a chair or couch, in bending forward, and in turning round in bed; while there was less pain in walking, and none at all in the sitting posture. He used at first chloroform and belladonna liniment to the loins; but as this produced no relief, he wished to try the effect of the constant current. It was applied so that the positive pole was held to the lumbar spine, and passes with the negative were made over the painful portions of the loins. From 40 to 50 cells were used, for about five minutes at a time. Immediately after the application the patient felt relieved, and could rise from the sofa on which he had been, without any discomfort. The pain returned some hours afterwards, but yielded completely to the further use of the current, which was applied altogether ten times.

THE END.

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