the patient, painful and exhausting. To the judicious surgeon they are exasperating by their rebelliousness, and in some rash hands they have opened the way to practice more lamentable than the disease. It will be one of the crowning merits of electro-therapeutics if proved to be equal to bring relief to these patients. Recent reports give good reason to hope that this end may be realised by a careful use of the positive galvanopuncture.

We have not, I am inclined to think, taken heed enough of the work of Tripièr and Apostoli in reference to various disordered states of the uterine appendages. The soothing effect of the vaginal or uterine bipolar application of the induced current in some distressing forms of ovarian neuralgia and vaginismus is said to be marvellous and enduring.

As a last word, I may say that we are face to face with an important revival; and though some American surgeons have gone before us in its acceptance, nowhere more than in our own country has there been shown an open-minded readiness to weigh fairly all the evidence which Dr. Apostoli has to set forth in support of his system.

In London we have heard, through the medical journals, of some failures, of one death, and of more than one accident, probably due to the inexperience of the practitioners. But we have far more encouraging reports from Edinburgh: and if some member of this Society who combines sufficient knowledge of electrical science with practical experience of the diagnosis of uterine diseases, and of the treatment by other methods, will carefully put to practical test the conclusions already arrived at by Dr. Apostoli, I am very hopeful that the result will not be disappointing.

THE ELECTROLYSIS OF FIBROIDS.

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WHAT takes place when an electric current is passed through a fibroid tumour? Does any change take place in the substance of the tumour or only at the points of application of the electrodes? An interesting paper on this subject was read by Dr. J. Inglis Parsons before the British Gynæcological Society on March 14th and 28th of this year. The human body contains about fifteen elements combined in different proportions to form the several tissues. These elements, arranged in an electro-chemical series, are as follows:

Electro-negative.	Electro-positive.
Oxygen	Hydrogen
Sulphur	Iron
Nitrogen	Manganese
Fluorine	Magnesium
Chlorine	Calcium
Phosphorus	Sodium
Carbon	Potassium
Silicon	

But each element in the series is electro-negative to the one which follows it, and electro-positive to the one which precedes it.

In the electrolysis of animal tissues the electro-negative elements are freed or appear at the positive electrode forming at once new chemical compounds, and the electro-positive elements are liberated or undergo similar recombinations at the negative electrode.

It would require a most accomplished analytical chemist to decide what actual changes take place at the relative poles, but what we know is that oxygen and chlorine are liberated at the positive pole and give an acid reaction; and that potash and soda are formed, and hydrogen liberated, at the negative pole. Some of the most likely bodies to be found in the substance composing a fibroid tumour are: Albumen, which contains C H N S O; mucin (C 52.2, H 7.0, N 12.6, O 28.2 per cent.); gelatine (C 50.4, H 6.8, N 18.3, S 4.0 24.5 per cent.); keratin (C 50.3-52.5, H 6.4-7.0, N 16.2-17.7, S 0.7-5.0, O 20.7-25.0 per cent.) (Hermann's *Physiology*), and the saline solutions of the body containing potassium and sodium phosphates. In these compounds "the molecules of the simpler bodies, as OH, CH₃, NH₂, C₆H₅, occur in the most varied and intricate combinations." "Of these complex substances"

which occur in the human body, "only a few can be obtained in a pure condition; the remainder cannot, either because they are too unstable, or because they are not crystallisable; with regard to the majority, we do not therefore know even their composition by weight, much less their constitution. The greater the number of atoms which combine to form a compound, the greater becomes the complexity of its composition, so that elementary analyses are insufficient clearly to indicate its formula. The formulae of the substances are for this reason unknown to us" (Hermann's *Physiology*).

All we can say with regard to the electrolysis of these bodies is that the oxygen and sulphur have a tendency to be liberated at the positive pole, and the hydrogen and potassium would traverse the space between the two electrodes, and appear upon the surface of the negative electrode.

The fact that elements are only liberated at the surface of the electrodes is explained by the theory of Grothüß, which is, that the molecules of any electrolyte, under the influence of an electric current, turn themselves so that their electro-negative constituent is directed towards the positive pole of the battery, and their electro-positive constituent towards the negative pole. The molecule nearest to the positive electrode yields up its electro-negative constituent, and it escapes free, but the electro-positive constituent acts upon the next molecule in the direct line between the two electrodes, attracting its electro-negative constituent, and again repelling the electro-positive atom or atoms. This action, continued in each contiguous molecule, forms a direct chain of decompositions and recombinations across the substance being electrolysed, until the negative pole or electrode is reached, and then the last molecule of the chain having yielded up its electro-negative constituent in the direction towards the positive pole, and there remaining no further molecules for the electro-positive element to split up, it is therefore discharged free at the negative pole. Such is the theory of Grothüß, propounded in 1805, and, as applied to water, it is explained by the accompanying diagram:

A is the positive electrode, and B the negative one. In the upper line the molecules are seen arranging themselves so that the electro-negative element, the oxygen, is turned towards the positive electrode (A). In the lower line the molecules are arranged in a chain across the liquid. The atom of oxygen nearest the positive electrode is then liberated as free gas, and the two atoms of hydrogen combine with the atom of oxygen directed to it in the next molecule, and form a new molecule. This action extends throughout the chain, and ultimately the two atoms of hydrogen of the last molecule, having no further molecules to split up, are liberated as free hydrogen gas at the negative pole (B). Therefore the volume of gas liberated at the negative pole is double that liberated at the positive pole. No appreciable action or change can be seen or detected at any point across the fluid; the gases are liberated only at the points of contact with the electrodes. A similar diagram would explain the electrolysis of hydrochloric acid; only for the oxygen (the electro-negative atom) would have to be substituted one atom of chlorine, and for the two atoms of hydrogen only one would be liberated by the decomposition of each molecule, because chlorine and hydrogen combine in equal volumes to form hydrochloric acid gas. This is the case with a simple compound composed of two elements, and constitutes primary electrolysis. When the compound is more complex, what is called secondary electrolysis takes place. This would be the case in a solution of sodium sulphate Na₂ SO₄. We should obtain at the anode, from the splitting up of the water, an equivalent of oxygen O, and also an equivalent of free sulphuric acid H₂ SO₄, while at the cathode we do not obtain sodium Na, but we have instead of it hydrogen H, and in the solution we have also caustic soda Na HO. This results also from the secondary splitting up of

the water (Sprague, *Electricity*. 1884). When we are dealing with mixed electrolytes, such as the substances composing animal tissue, the decompositions which take place are still more complicated.

It is difficult, in the present state of our knowledge, to say how many secondary electrolyses take place in the passage of the current through the body. That it meets several elements presenting different states of polarity towards each other is certain, but whether chemical change takes place at the points of junction of each of these heterogeneous bodies it is at present impossible to determine. As a rule, electrolysis does take place between any two substances of different electro-chemical polarity at the point where they touch one another, if they are capable of conducting electricity. If in the treatment of a uterine fibroid we use an external potter's-clay electrode, a water rheostat to regulate the current, and an intra-uterine electrode, we know that electrolysis takes place at four points: (1) in the cells of the battery; (2) in the water in the rheostat; (3) between the clay and the skin of the patient; and (4) at the point where the internal electrode touches the mucous membrane of the uterus.

That electrolysis does take place in the tissues is probable from the fact that storage of electricity takes place in a patient subjected to the electrolytic treatment. The patient becomes a secondary battery, and is capable of giving off a current in an opposite direction to the one used from the battery. We have demonstrated this to be the fact on several occasions at St. Bartholomew's with patients under treatment for uterine fibroids. Immediately after the application of electricity has been discontinued we have disconnected the rheophores from the battery and united them to each other, still keeping them connected to the electrodes in contact with the patient; a reverse current has immediately been shown on the galvanometer, at first about 12 milliampères, but rapidly decreasing to 8 and 4. No storage of electricity could take place unless some decomposition of the fluids contained in the tissues electrolysed had taken place. The liquids bathing the cell elements of the tissues must have become split up, and their constituents accumulated on the opposite surfaces of contiguous tissue cells. It is this only which could produce a polarisation current. Becquerel and Faraday have shown that polarisation results from the depositions caused by the passage of the currents.

This possibility of converting the human body into a secondary battery was demonstrated by Dr. Stone in his Lumleian Lectures before the Royal College of Physicians in 1886. He charged the porter of St. Thomas's Hospital by placing his feet in a foot-bath containing a leaden electrode, and passing through him a constant current; he then disconnected him from the battery, and showed that he (the porter) gave off a constant current in a reverse direction to that given by the battery from which he was charged, and Dr. Stone asserted that he would continue to give off such a current, gradually diminishing in intensity, for about four hours (see *JOURNAL*, vol. i, 1886, pp. 812, 813).

In the recent discussions on the electrolysis of fibroid tumours it has been asked: If the passage of an electric current has an effect upon the tumour, how is it that the normal structures, such as the bladder, muscles, skin, adipose tissue, etc., which are included between the two electrodes, are not also affected? It is quite possible that they are affected; that in them the normal tissue-changes always in progress are accelerated, and that assimilation or "progressive metamorphosis" is encouraged. This from analogy would appear to be the case; for when a galvanic current is applied frequently to an atrophied and palsied muscle very often its nutrition is improved and its bulk increased; and Dr. Apostoli has drawn attention to the extraordinary increase of subcutaneous adipose tissue which takes place in the abdominal walls of patients subjected to the electrolytic treatment.

Dr. Poore has said,¹ "it is probably impossible to pass a galvanic current through animal tissues without setting up some electrolytic action, and we are unable to say what part such action may play in the ordinary phenomena caused by the galvanic current." I have elsewhere said,² "it is probable that changes are induced in the ultimate tissue cells of a part exposed to a constant current of electricity, analogous to the chemical action produced in the electrolysis of water. If the current is weak, the process does not go so far as splitting up the watery parts of the cells into oxygen and hydrogen, but produces some sort of activity in the

cell not present there before. It increases or alters the character of the secretion of the cells composing secreting glands, as evidenced by the increase of saliva and metallic taste in the mouth, produced by the application of a continuous current of electricity anywhere in the neighbourhood of the salivary glands. This probable increased cellular activity, the quickening of the building up and destruction of cells neverceasingly going on in the living body, is sufficient to account for the increased demand for blood required for these changes, and the resulting increased supply afforded by the dilatation of the capillaries. The capillaries do not dilate by any power possessed by the constant current to cause muscular relaxation, but secondarily through nervous influence excited by the demand produced in the cells for more blood. The action of the constant current upon muscular tissue, if anything beyond, besides inducing these probable changes in the ultimate muscular elements leading to increased activity in the ultimate cells, increased nutrition, and therefore increased tone (as it is called), is probably to induce contraction rather than relaxation. In considering these changes in the cellular elements of the body and in the blood-supply, the osmotic power of electricity must not be forgotten. It has been found that if two fluids of different densities be divided by a porous diaphragm and an electric current be made to pass through them, osmosis takes place in the direction of the current." That is from the positive to the negative pole. "If the current passes from the lighter to the denser fluid the natural osmotic action is increased; but if the current passes in the reverse direction, the osmotic action is reversed; the denser fluid passing through the diaphragm into the less dense. The osmotic power of electricity probably explains the influence of galvanism in causing the absorption of fluid effused into joints, or serous cavities, when applied in such cases."

The theory suggested by Dr. Inglis Parsons, that the electric current has a modifying influence on the cells of tumours which from their lower vitality could not recuperate themselves so well as the normal cells of the body, is also not altogether improbable. In fact, it may be that in the tumours subjected to a current of electricity a "retrograde metamorphosis" is set up.

The tumours do not disappear so rapidly or so completely as we have been led to expect, or perhaps as British gynaecologists supposed would be the case. I do not think that the electrolytic treatment will supplant the necessity for abdominal section or removal of the uterine appendages in such cases as those in which these operations would be appropriate, but I do think that in the use of electricity we have a means of treating fibroid tumours which is superior to any we have formerly employed, short of their entire removal. I have treated a large number of cases, and in nearly all the symptoms have been relieved, in many the tumours have decreased in size, and in some the decrease has been considerable. The hæmorrhage has usually been arrested; the dysmenorrhœa has been relieved; the pain and discomfort have decreased; the rectal and bladder troubles have also been lessened, and the patients able to get about and walk with much less difficulty. All these favourable symptoms are probably due to the relief from pressure caused by a slight diminution in the size of the tumour. Nearly all the patients I have operated upon have expressed themselves as feeling better—better in health and better in spirits. In those whose tumours were accompanied by menorrhagia no doubt the improvement in health was greatly due to the arrest of the hæmorrhage. That adventitious tissue does decrease and get reabsorbed under the electrolytic treatment I feel sure, and have been able to observe it in several cases of stricture of the urethra.

NOTES OF A CASE OF HYDROSALPINX; A NEW MODE OF ELECTRICAL TREATMENT.

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THE case of which I am about to give the particulars seems to me to be of great interest. It opens up a new question in therapeutics, and will serve as a prelude to a complete memoir which I shall shortly publish on the electrical treatment of salpingitis. In this paper I confine myself to a full and exact report of the case and a statement of the conclusions that may be drawn from it.

¹ *Electricity in Medicine and Surgery*, by G. V. Poore, M.D., p. 233. 1876.

² *Electricity and its Manner of Working in the Treatment of Disease*, by W. E. Stevenson, M.D., pp. 24, 25. 1884.