AIDS TO ELECTRO-THERAPEUTICS

CHAPTER I

INTRODUCTORY

FEW advances in medicine have suffered so much and been threatened with such ill repute as the application of electricity as a therapeutic agent in the treatment of disease. This was due, to a great extent, to the ease with which unqualified and often profoundly ignorant persons were able to impose upon the credulity of the public, the imposition, as is usual in such cases, depending largely on promises of attaining a cure in conditions which had resisted the endeavours of orthodox medicine and surgery, and which were, pathologically, though not necessarily symptomatically, incurable. The natural result of the manifold disappointments and financial losses, which form inseparable companions to such a state of affairs, was a tendency to regard the electrotherapist as little better than a charlatan; and there is no doubt that this conclusion, as applied to a considerable section of the untrained lay public engaged in "electrical treatment," was fully justified. During the last few years, however, the devoted work of a certain number of scientific medical men has succeeded in freeing the

bona fide electrotherapist from the cloud of suspicion which threatened to completely overshadow him, and the subject is now rightly regarded as one which is deserving of the closest attention.

In order that the present satisfactory status of electro-therapy should be maintained, it is essential that all engaged in its application should keep certain salient facts prominently before their minds.

1. Always attempt to arrive at an accurate diagnosis. Do not be satisfied with labelling a case "neuritis" or "rheumatism" until every possible causative factor has been excluded, and if any such factor is discovered insist upon its adequate treatment.

2. Empiricism is bound to result in disappointment, failure, and ultimate retrogression of what should be one of the most scientifically progressive branches of medicine. The theories of the action on the tissues of electrical agents should be thoroughly mastered, and the line of treatment to be adopted in every case should be governed by their application.

3. A fairly large proportion of the cases which are sent to the electro-therapist have already shown themselves resistant to other lines of treatment; some of these will respond to electrical treatment in a most gratifying manner; others, which may appear to be identical in their clinical features with the former group, will resolutely resist all efforts to procure amelioration. Therefore be exceedingly guarded in giving a prognosis, and never hold out rash promises of a speedy cure.

4. Never prescribe electrical treatment in a case where no improvement can result; and in cases which are incurable, but capable of relief, always give the patient a frank estimate of the benefit which he may reasonably expect to derive from such treatment.

The changes which can be induced by electrical

agents in the tissues of the human body are far more perfectly understood than was the case a few years ago, although in many instances considerable further investigation is necessary for their more complete elucidation. They may be classified as follows, bearing in mind that many forms of treatment will produce changes belonging to more than one class:

1. Physiological.
2. Chemical.
3. Physical.
4. Psychic.

1. **Physiological.**—The best examples of purely physiological changes are provided by the reaction of living tissues to X-radiation and radium radiations. The association between these forms of radiation is discussed in Chapters XIII. and XIV., and a more full account given of the tissue changes induced. For the present purpose an example of purely physiological action may be quoted: If a malignant growth, such as a carcinoma, be subjected to suitable exposures of X-radiation, certain of the tumour cells will undergo various changes. These changes may be of a retrogressive or destructive character, resulting in the ultimate death of the cell, or may be of a stimulating nature, resulting in increased physiological activity of the cell and rapid cell-multiplication, and, where this stimulation is in excess of or unaccompanied by destructive action, in the rapid increase in size of the tumour as a whole.

These changes must, in the present state of our knowledge, be considered as dependent upon some direct alteration induced in the vital activity of the living cell protoplasm. Possibly with increased research this group of changes may be included in the class next to be considered.

2. **Chemical.**—To understand the nature of the chemical changes which take place on the passage of a current of electricity through the body, it is necessary to consider in some detail the nature and behaviour of ions.

Certain substances known as electrolytes, if dissolved in water, have the property of becoming dissociated to a greater or lesser extent into ions, the ion being an atom of the substance combined rather loosely with a negative or positive charge of electricity. *E.g.*, sodium chloride will become dissociated into ions of sodium and chlorine, the sodium having a positive charge, the chlorine a negative. In such a solution only a certain percentage of the molecules present will be dissociated into their component ions at any one time, and the more dilute the solution the larger will be the percentage of dissociation. In the case of complex substances the dissociation may not be into its elements, but into less complex substances.

The same ions do not remain in their dissociated state all the time, but are constantly in a state of movement, undergoing recombination to form a molecule of the salt once more. This state of movement is aimless, and does not result in excess of ions of either polarity in any part of the solution. If, now, two electrodes connected to the poles of a battery of cells or other source of constant electrical current be introduced into the solution, a current will pass through the solution, and the following changes will take place: The sodium ions with their positive charge will be attracted to the negative electrode (since like charges dispel, and unlike attract, each other). Any one sodium ion will only travel a very short distance, and will then displace another sodium atom from its association with the chlorine atom, combining temporarily with the

chlorine atom to form an associated molecule. In this way a number of sodium ions will arrive at the negative electrode. Here the positive charge of the ion will be neutralized by the negative electrode, and a free atom of sodium will result. This is the primary change, but immediate secondary chemical changes take place. The sodium atom splits up the water into the hydroxyl radical OH, with which it combines to form caustic soda, and free hydrogen, the latter escaping in the form of bubbles of gas from the surface of the solution around the electrode; while certain of the hydroxyl radicals, which possess a negative charge, will be started on their journey towards the positive electrode.

In the same way the chlorine ions will arrive at the positive electrode, part with their electrical charge, and become free atoms of chlorine. This immediately splits up the water, the hydrogen combining to form hydrochloric acid, with liberation of oxygen. Thus around the negative electrode alkali is produced, around the positive acid.

Solutions of salts, bases, and acids form electrolytes; but carbohydrates, proteins, and some other chemical substances do not, and no current will flow through a solution of such a substance, indicating that the changes above described are essential to the passage of electricity through a liquid. Some gases and solids, or melted solids, are electrolytes.

The human body, having a large number of different salts in solution, will obviously act as an electrolyte, and a constant current in its journey through the body will produce many ionic changes; a consideration of the changes possible will go far to point out a rational line of treatment.

The movement of ions will also act upon muscles and nerves (motor and sensory) under certain circumstances, causing contraction in the muscles

involved—an example of combined chemical and physiological action.

3. **Physical.**—The physical effects of electrical treatment are chiefly dependent upon the production of heat in the body. This may be confined almost entirely to the surface, as in exposure to radiant heat (electric light bulbs arranged under a suitable reflector), or be produced fairly uniformly throughout the tissues under treatment. The latter conditions are attained by the use of high-frequency and diathermy currents; these currents are of an oscillating character, the oscillations being of such enormous rapidity that no ionic movement can take place. The warming of the tissues is due to the resistance which they impose to the passage of the current, and is not accompanied by any muscular contraction or sensation other than that of heat, owing to the absence of ionic movement mentioned above.

These physical effects of electricity are always accompanied by physiological changes—*e.g.*, vasodilatation, increased metabolism, acceleration in removal of waste products.

4. **Psychic Effect.**—It is of the greatest importance to form a correct estimate of the value of this factor in electrical treatment, and to discriminate carefully those cases where it should be introduced. It is quite unnecessary to seek to affect the mental attitude of a patient suffering from an ulcer of the leg by means of imposing apparatus and the production of adventitious noises. Such ruses do not influence the healing of the ulcer, nor do they add to the dignity of the medical profession. On the other hand, many cases present either a pure neurosis or else a definite pathological lesion combined with a neurosis; in these it is desirable to make as profound a mental impression on the patient as is compatible with the adoption of a rational line of electrical treatment.