

**THE PRINCIPLES OF
ELECTROTHERAPY; AND
THEIR PRACTICAL
APPLICATION**

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649081127

The principles of electrotherapy; and their practical application by W. J. Turrell

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Edited by Trieste Publishing Pty Ltd.
Cover @ 2017

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Siquid novisti rectius istis,
candidus imperti: si non, his utere mecum.
HORACE, *Ep.* i 6. 67-8.

LONDON
HENRY FROWDE AND HODDER & STOUGHTON
THE *LANCET* BUILDING
1 & 2 BEDFORD STREET, STRAND, W.C. 2

WB495
T958p
1922

First Published 1922

PRINTED IN ENGLAND
AT THE OXFORD UNIVERSITY PRESS
BY FREDERICK HALL

22
1922

P R E F A C E

THIS book is the outcome of an attempt to explain the therapeutic action of electricity upon rational grounds and upon physiological principles.

In Part I current electricity is discussed. The therapeutic action of static electricity is here considered, because it is mainly the currents derived from the static machine, and not the static charge itself, which possess therapeutic action. The static machine serves to generate a static charge, which, when sufficient voltage has been attained, discharges as a current of very low intensity, but of very high potential, and so affords methods of therapy unattainable by other means.

The necessity of clearly distinguishing between the polar and inter-polar action of the constant current is pointed out. The action of interrupted currents of low frequency is shown to be due to the relatively high velocity of the hydrogen ion compared to the velocities of the other ions in the tissues.

The steps by which D'Arsonval was led to the discovery of high-frequency currents are described, with extracts from D'Arsonval's original paper. The action both of high-frequency currents of tension and of quantity are fully discussed.

The second part of this book deals with the fascinating and difficult task of explaining the therapeutic action of radiant energy. Tracing this method of treatment from its general principles we are led step by step to formulate a new hypothesis, or, perhaps, to develop an existing theory of the therapeutic action of the radiation from an X-ray tube or radium. We first of all note the fundamental identity of the mode of action of ultra-violet radiation with that of the radiation from X-rays and

Prof. Mrs. D. B. D. Emma

radium. We realize that radiation, like light, only acts when it is absorbed, and we next find that Kohler has shown that the nuclei of the cells in the gill plate of the salamander are 'particularly opaque to light of the wave length of the ultra-violet' (Bayliss). Tracing this subject farther we learn from Dr. Regaud that it is the chromatin of the nuclei, at the time of their division, which is the most radio-sensitive component of the human tissues, and consequently is the first to be destroyed by the radiation of X-rays. We are, then, met with the difficulty that the immediate destruction of the cells does not account for the latent period which precedes the characteristic reactions of both ultra-violet radiation and X-rays. To account for this latent period, we suggest the setting free of some toxin resulting from the splitting up of the chromatin. Passing on later to discuss the very important question of the action of X-rays on the blood, we find that the presence of such a destructive toxin or ferment, a leucolysin, has been clearly demonstrated by Curshmann and Gaupp, as occurring after the exposure of a leukæmic patient to X-rays. We are thus enabled not only to complete the evidence in support of our theory, but also to suggest an explanation of the recognized diminution in the efficiency of repeated radiation by X-rays in the treatment of leukæmia, on the possible and rational ground that, as the outcome of the action of the toxin, antibodies are developed which render the white corpuscles less radio-sensitive.

The recent work of the Erlangen gynæcologists, Drs. Seitz and Wintz, appears likely to revolutionize to a very large extent our views on radiotherapy. At first sight we are apt, impressed by the great increase in the power of their apparatus and the prolonged exposure which they administer, to lose sight of the careful and far-reaching experiments upon which their methods are based.

It is, however, from the latter, and especially from their systematic tabulation of the varying lethal doses required

to destroy different types of cells that the most lasting and valuable results are likely to spring. A single instance will suffice to illustrate this point: if 40 per cent. of the unit skin dose, as Drs. Seitz and Wintz state, has the effect of stimulating rather than destroying cancer cells, then the present practice of employing prophylactic radiation, before operation, and also post-operative radiation, should be immediately discontinued. For the doses generally given in this country for these purposes do not usually exceed this 40 per cent., and consequently their application is far more likely to prove harmful than beneficial: moreover, the necessary lethal dose required to destroy cancer cells is far too drastic and provokes too grave constitutional disturbances to be used for prophylactic purposes.

It is not possible within the limits of this book to give more than a broad outline of the work of the Erlangen technique, and it is far too early to pronounce definitely upon its merits; but as it is certain that this method of treatment will exercise a most powerful influence on the future of radiotherapy, an attempt has been made to deal briefly with its essential points.

The third part is concerned with electro-diagnosis. The chief portion, dealing with the electrical diagnosis of peripheral nerve lesions, has already appeared in the *American Journal of Electrotherapeutics*. A chapter on the electro-diagnosis of certain diseases has been added.

The fourth part explains the action of electrotherapy in some of the diseased conditions for which it is applied, and indications are given of the type of case suitable for electrical treatment. To this part some practical hints on treatment are added.

In the compilation of this book I have drawn very largely upon the writings of French electrotherapists—in no other way would it be possible to deal adequately with this subject. No student of the history of electrotherapy can fail to recognize the fact that this form of treatment

was first placed upon a scientific basis as the result of the work of French scientists. Imbued, perhaps, with the pride of antiquity, we trace the pedigree of this speciality back to the writings of the ancient Greeks: yet, nevertheless, every electrotherapist, whatever his nationality may be, is proud to claim as the Founder and the Father of Modern Electrotherapy that great scientist, Duchenne, of Boulogne, whom a French speaker so well described as 'the man who has played a preponderating part in the researches and discoveries, upon which the edifice of neuro-pathology has been erected'. These researches were based upon, and these discoveries resulted from—as Duchenne himself states—'a method of electrization, which surpassed his expectation in yielding scientific and practical results of the highest importance'.

I am especially indebted to the writings of Professor Bergonié, Drs. Miramond Laroquette, Nogier, Bordier, Bécère, Larat, Regaud, Max Roques, and MM. David and Desplats.

Due acknowledgement must also be made of the assistance in reference to the static machine which I have received from the writings of Dr. Benham Snow, of New York, who has done so much to develop the use of this instrument; and in connexion with the same subject I should like to record my indebtedness to Dr. Howard Humphris, to whose kindness I owed my first introduction to this useful machine, and also many valuable hints in regard to the methods of employing the currents derived from it. In dealing with radiant energy I have been greatly assisted by Professor Merton's kind advice and helpful criticism. Like other radiotherapists in this country I was indebted for my earliest information of the Wintz method to Dr. Reginald Morton, whose paper, published in the *Proceedings of the Royal Society of Medicine*, I have so largely drawn upon when dealing with that intensive method of radiotherapy. I have also, in discussing this important subject, availed myself of some