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THERAPEUTIC ELECTRICITY AND ULTRAVIOLET RADIATION

THIRD EDITION

Edited by

G. Keith Stillwell

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WILLIAMS & WILKINS
Baltimore/London

Made in the United States of America

First Edition, 1959
Second Edition, 1967

Library of Congress Cataloging in Publication Data

Main entry under title:

Therapeutic electricity and ultraviolet radiation.

(Rehabilitation medicine library)
Rev. ed. of: Therapeutic electricity and ultraviolet radiation / edited by Sidney Licht. 2nd. ed. 1967.
Includes index.
1. Electrotherapeutics. 2. Ultra-violet rays—Therapeutic use. I. Stillwell, G. Keith. II. Series.
RM871.T48 1983 615'.8315 82-17655
ISBN 0-683-07979-4

Composed and printed at the
Waverly Press, Inc.
Mt. Royal and Guilford Aves.
Baltimore, MD 21202, U.S.A.

THERAPEUTIC ELECTRICITY AND ULTRAVIOLET RADIATION

THIRD EDITION

This volume is one of the series,
Rehabilitation Medicine Library,
edited by John V. Basmajian.
Originally published as part
of the Physical Medicine Library,
edited by Sidney Licht.

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STILLWELL: Therapeutic Electricity and Ultraviolet Radiation, third edition*

* *Originally published as part of the Physical Medicine Library, edited by Sidney Licht.*

Series Editor's Foreword

The incomparable Sidney Licht is gone. His death leaves a gap in the lives of all of us who knew him and the many lives he touched through his publications. The previous editions of this book were Volume IV in the old Physical Medicine Library. In seeking an editor for this modernized third edition in the Rehabilitation Medicine Library (which in part derives from the old Physical Medicine Library), I did not need to seek very far for an authoritative writer and editor. Keith Stillwell not only was already an author in the book but also had acquired immense experience in recent years as an editor of rehabilitation literature.

In reviewing the chapters as they were submitted, I have been deeply impressed by the scientific erudition and the humane considerations of the authors. These are no dry expositions of a dry subject. Each chapter summarizes—and where necessary provides details—to improve the treatment of real people with real problems. This is done by logical and clear descriptions that make this book unique in medical literature. Anyone who ignores the lessons summarized in this book and who *at any time* employs therapeutic electricity or ultraviolet rays does so with unnecessary risk to the patient. Put bluntly, I cannot condone such behavior. Dr. Stillwell and his authors have performed a great service to physicians and physical therapists and so to the many people whom they treat.

JOHN V. BASMAJIAN, M.D.

Preface to the Third Edition

The first edition of this book appeared in 1959 with 343 pages of text. There was a second printing some five years later. The second edition, which had additions to some chapters, a new chapter, and a "Postscript," was published in 1967. It had 414 pages of text. During the past two decades there has been considerable change in the clinical applications of both therapeutic electricity and ultraviolet radiation. In order to accommodate these changes and to produce a book of value to clinicians at a reasonable cost, several deletions have been made. Other chapters have been extensively revised or, in some instances, entirely rewritten by new authors. There is a new chapter on Electrical Stimulation for Analgesia.

The chapters on Iontophoresis and Electrosleep Therapy have been deleted. Neither technique has recently had enough clinical usage by physiatrists to justify inclusion in this volume. In a consolidation of the information on ultraviolet radiation, the chapters by Scott and Daniels have been expanded and the chapter by Fischer and Solomon eliminated. The Postscript to the second edition written by the late Philippe Bauwens has not been reproduced.

Mr. Stuart Reiner recommended that his chapter on Instrumentation for Electrotherapy be completely revised by someone else, since his own interests and activities are focused now on other aspects of electronics. In view of the development of transistors and "solid state" electronic equipment, much of the old chapter was obsolete. The revision has been ably accomplished by Dr. Robert Patterson. His chapter can be easily followed and understood by those who have been almost totally uninformed about transistorized circuits. Yet it contains information important to those already knowledgeable in this field.

One of the greatest changes in the therapeutic use of electricity in the last decade has been the widespread use of transcutaneous electrical nerve stimulation for analgesia. The mechanisms underlying the phenomenon are still being elucidated. It is the topic of a chapter by Dr. Gudni Thorsteinsson. It seems likely that this use of electricity will continue to be widely applicable in the foreseeable future, although probably somewhat less than at present. As mentioned in the Preface to the first edition, this use of

electricity has been known to previous generations. It has waxed and waned over the years.

Much of the research being done in recent years by physiatrists on electrical stimulation of skeletal muscle has been done in the laboratories of the Department of Rehabilitation Medicine at the Thomas Jefferson University Hospital by Dr. Gerald J. Herbison and his associates. The chapter on this topic has been extensively revised and expanded by them. There is still a small residue of the old chapter, for which reason Doctor Herbison thought that I should remain as a co-author.

In Part II, the chapter on Instrumentation for Ultraviolet Therapy by the late William T. Anderson, Jr., was carefully reviewed by Mr. Helge Austad, Director of Lamp Engineering at the Canrad-Hanovia company. He commented that "Dr. Anderson . . . did an outstanding job in covering all aspects of ultraviolet radiating lamps. . . . Though there are lamps with longer life and higher output radiation in the UV today, the lamps and the fill are basically the same. We have, in the years since this chapter was written, developed better ways to build and process the lamps to give us better performance at higher power levels but nothing has really changed." Accordingly, the chapter is reproduced unchanged. Mr. Austad's editorial assistance in reaching this decision is much appreciated.

The literature on therapeutic ultraviolet radiation in recent years has not appeared in physiatric journals nor been written by physiatrists. Rather, it has appeared in journals and books devoted to dermatology or photobiology. Dr. Farrington Daniels, Jr., points out that several departments of dermatology have changed their titles to "Dermatology and Photobiology." The perceived indications for ultraviolet radiation are changing. There is greater awareness of the potential adverse effects, particularly with regard to malignant cutaneous diseases. Those who prescribe or administer ultraviolet radiation should keep their knowledge up to date on those aspects, as well as the maintenance and techniques of use of the equipment. In many clinical settings this will probably most reliably be accomplished by close collaboration between dermatology and physical medicine.

Daniels points out that there are segments of the population in modern societies who are deprived of ultraviolet radiation. The effects of this deprivation are not yet clear. As medicine becomes more concerned with the maintenance of "wellness" as well as the cure of disease and the adaptation to its residual effects, we may see an expanding role for therapeutic or prophylactic ultraviolet radiation of the "shut-in" populations. Bauwens observed in his Postscript to the second edition, ". . . it is fair to observe that humans, like green plants and most animals, have adapted themselves to sunlight. They thrive on it and suffer when starved of it."

The scholarly chapters by the late Sidney Licht on the history of the use of these therapeutic modalities are reproduced intact. His talent for organizing such a mass of detail and presenting it in a readable and interesting

way was a rare one. His contributions to the field of physical medicine and rehabilitation were enormous. The Licht Physical Medicine Library has been a great boon to student and practitioner alike. I feel honored to have had the opportunity to serve as editor of this volume.

G. KEITH STILLWELL, M.D., PH.D.

Preface to the First Edition

At least a thousand books have been written on electrotherapy. We have not discovered quite that many titles, but, if we count the different editions (sometimes equivalent to new books) and those we have missed, the list undoubtedly exceeds this number considerably. Since the publication of the first book on the subject in 1744, the average output has been about five books a year. Until the rate drops to less than one new book a year, the subject cannot be ignored or dismissed as "of historic interest only." During the last decade at least one book has appeared each year on electrotherapy. This indicates an interest even if it does not mean that the field is important. Is electrotherapy important? Is it sufficiently important to warrant another book?—a new book? For this is the first *new* book, covering all aspects of electrotherapy, in English in over a decade. The editor does not know the answer to this sequence of questions, but he does know that the number of electrotherapeutic devices manufactured and sold remains high. This does mean that some—quite a few—people want and sometimes demand electrotherapy.

There is discouragingly little evidence that electrotherapy is better than other forms of therapy for the treatment of any disease. However, medicine has not yet advanced to the point where treatment is always based on science. Aspirin, a most widely used drug, has not been proven to relieve headache, but its enormous sales prove that people and their physicians think it does. Electrotherapy is something that some physicians and their patients consider worth trying after, and sometimes even before, other methods fail. Why?

Electricity is closer to the supernatural than almost any force man can manipulate. It can give pain or a sort of "therapeutic sensation" almost at will. It is a positive force which can be felt at once; it is so different from *negative* advice or an imperceptibly slow-acting medication. It is available in many and sometimes dramatic forms, and it is applied from apparatus which may have as many controls as an airplane dashboard. Electricity can make a paretic muscle move as no other force can. It can contract a muscle against the will of the patient to resist it. It is closely associated in the minds of many with such high-sounding but meaningless expressions as *dynamic*

or *atomic*—magic words when applied to therapy. Electricity can be given with precision impressive to all. Its effects can be immediate or readily apparent through movement, sensation, color change, and, sometimes, following the application of the faradic current, the relief of pain. From the time of its first use over two centuries ago it has had a tremendous psychologic advantage: immediacy. It has always had appeal and even glamour. Electrotherapy is not only better than no treatment; its use may renew or elicit hope. It is often used as a *reaction therapy*. Until we have a specific for every symptom and ailment, electrotherapy will have a place in patient management.

During World War II, and soon after, the emphasis in the field of physical therapy shifted to *active* participation by the patient. Electrotherapy rapidly diminished in importance, especially in the United States, where it was regarded by some as old-fashioned. It became difficult to find "progressive" physiatrists willing to associate their names with chapters on electrotherapy. Since "progressive" usually means "young," our problem was to find highly qualified men young enough to be progressive, old enough to be experienced, and broad-minded enough to write about a sparkling subject dispassionately. As any reasonable reader may discover for himself, we have achieved this goal.

In summary: there are times when the honest physiatrist is left with nothing to try but electrotherapy—often to the satisfaction of his patient and himself. At such a time and at other times he will find the chapters of this book as sound as any ever written on the subject.

Most people will agree that light is something which can be perceived by the human eye. Thus, in the strictest sense, the electromagnetic energy called ultraviolet should not be called light. In this book we shall speak of ultraviolet rays, radiation, energy, and therapy. We cannot hope to change a long established custom among many of calling ultraviolet *light*, but we hope that with the advance of time physical medicine specialists will recognize the inaccuracy of such an expression.

The history of ultraviolet therapy is markedly different from that of electrotherapy. From the beginning, ultraviolet was "specific" and even more dramatic—so dramatic that Finsen, one of its earliest protagonists, was granted one of the first Nobel prizes in medicine for his use of it. However, time after time the triumphs of ultraviolet were replaced, or displaced, by drugs—in nonpulmonary tuberculosis, rickets, erysipelas, and furunculosis, in fact, thus far, in almost every disease except psoriasis. Whereas electricity has been with us for more than two centuries and has virtually exhausted its therapeutic possibilities, ultraviolet, the newcomer, remains the subject of continuing scientific examination. Relatively few articles appear each year about its use, but clinicians, especially dermatologists, use and rely on it far more than their literary output would indicate.

There have been many good books on ultraviolet therapy in the past. The multivolume work of Brody and the thorough book by Mayer are but two

examples. We are of the opinion that the chapters on ultraviolet radiation in this book are the best ever assembled under one cover.

In previous volumes of this series, the method of treatment expressed in the title has been applied to diseases or disabilities, for example, heat in arthritis or exercise in heart disease. This approach was avoided in the present volume because the length of chapters so arranged would be too short, in the light of current usage. Nevertheless, the use of all physical agents, particularly their integration with each other and with nonphysical agents, is of such importance that we hope one day to bring out a volume on the physical treatment of disorders. Comments on this plan would be most welcome and helpful.

This is the fourth volume of Physical Medicine Library. The published reviews of previous volumes and the adoption of them as required texts by several of the leading schools of physical therapy in the United States are reward enough for the editor. The reward for contributors, however, poses a problem. The amount of money each receives in royalties for his efforts in behalf of the field of physical medicine is pitifully inadequate (a result of the very nature of multiauthored book in a field where a book sells poorly if low in sensationalism and lay interest and high in technical words). We can only hope that the contributors will receive the same joy as does the editor from the unmistaken approval of the small but elite audience that appreciates attempts to improve the acceptance of physical medicine through better books.

Many physicians were given the opportunity to correct errors in this book. Again, as in the past, a handful of dedicated specialists in the field have responded to our call. We express our heartfelt gratitude to the following physicians for their valued help: André Denier, Jean Meyer, and Jean Torlais of France, Jozef Jankowiak of Poland, Egill Snorrason of Denmark, and, in the United States, Alfred Ebel, Frank H. Krusen, Joseph B. Rogoff, and Arthur L. Watkins.

Dr. Herman L. Kamenetz of New Haven gave his accustomed great assistance in checking references and spelling. Dr. Raimunds Pavasars of Connecticut translated the chapter on Electrosleep Therapy.

In previous volumes of Physical Medicine Library the editor did not ask any one physician to review the entire book for serious errors of omission or commission since to his knowledge there was no one physician who could rightfully be called the best informed on the subject anywhere. On the subjects of this book, however, there is one physician whose contributions are unchallenged as the finest. We asked Dr. Philippe Bauwens of St. Thomas' Hospital in London to read the entire manuscript for critical appraisal. We have not been able to incorporate all of his excellent suggestions into the final text, but we have used so many of them that discerning readers will appreciate in this book a quality not achieved by the editor in previous volumes.

Treatment with electricity and ultraviolet energy is diminishing as newer

remedies are discovered, but patients will continue to benefit from them for a long time to come. This book was assembled for those physicians who will keep an open mind toward these methods until they are proven or disproven to the satisfaction of all.

SIDNEY LICHT, M.D.

New Haven, Connecticut
January, 1959

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PART I

Therapeutic Electricity

1

History of Electrotherapy

SIDNEY LICHT

DISCOVERY OF ELECTRICITY

The first written reference to magnetism, in 1186, by the British monk Alexander Neckham, does not refer to it as something new.[1] The most important early reference to magnetism occurred almost a century later. In 1269, Charles of Anjou lay siege to Lucera in Apulia. In the trenches outside the town, on August 8, sat the "perfect mathematician," Pierre de Maricourt of Picardy, called *Peregrinus* (*Pilgrim*, because he had taken part in the Crusades). The soldier monk was writing a "letter" to his friend Sigerus on how to build a perpetual motion machine with a natural magnet. In the letter he set down the principles of experimental research and described for the first time a compass with pivoted needle (the prototype of many electrical measuring instruments). He named (incorrectly but permanently) the needle ends or the poles of a magnet and suggested the conversion of magnetic energy into mechanical energy (an electric motor).[2] As remarkable

[1] Whittaker, E. *A History of Theories of Aether and Electricity*. London, 1951.
[2] Benjamin, P. *The Intellectual Rise in Electricity*. London, 1895.