azinc compounds was almost exclusively confined to the derivatives of cyanuric acid. A more systematic arrangement as followed in other volumes of this series would have made the vast and valuable knowledge presented by the authors more readily available. In fact, on search for a certain compound, one is almost obliged to browse through the entire book, especially since cross references are only occasionally given and the subject index is grossly inadequate for this purpose. For instance, 2,4-dichloro-*s*-triazine is found on page 217 under dihalo-*s*-triazines (a sub-heading of the chapter on dihydroxy-triazines!), also on p. 13 (Introduction) and on p. 61 (Cyanuric acid), without cross-references, each place listing another method of preparation.

With the limitations set forth above, the book will prove a very valuable source of information, especially on the older literature, to the steadily growing numbers of chemists in science and industry interested in *s*-triazines.

GENERAL CIGAR CO., INC.
RESEARCH LABORATORY C. J. GRUNDMANN
LANCASTER, PENNSYLVANIA

Electrophoresis: Theory, Methods and Applications. Edited by MILAN BIEL, Fordham University, New York, and Institute of Applied Biology, Inc., New York. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 1959. xx + 563 pp. 16 × 23 cm. Price, $15.00.

It has, of course, become physically impossible for anybody to read more than a small fraction of the articles, even in his own specialty, appearing in the scientific journals. Books like the one under review are thus more and more important. Although electrophoresis has a long history it has attained the rank of an essential tool for research, particularly in biochemistry, only in the past two decades. Tiselius' paper on what is now called "free" electrophoresis, appeared in 1937, and first showed, clearly and unmistakably, the main components of human blood, and indicated the power of the much improved tool for investigation. From this landmark research in electrophoresis has spread out in many directions, as is shown by chapters prepared by the specialists in the various fields. Since these range from mathematical physics to clinical medicine no one person could conceivably appraise these contributions critically. The reviewer was active in research on free electrophoresis shortly after the publication of Tiselius' paper, but has been otherwise engaged since then. He can only judge the various chapters according to their intrinsic interest and their apparent effectiveness in bringing him up to date.

In an interesting and important introduction Tiselius reviews the history of electrophoresis and summarizes its accomplishments. He also shows that much remains to be done, particularly in dealing with substances of low molecular weight and with non-aqueous solvents.

The first two chapters: "Electric Potentials in Colloidal Systems" by Overbeek and Lijklema, and "Acid-Base Equilibria of Proteins" by Linderstrøm-Lang and Nielsen, would require more time, and, also, he must admit, more knowledge, to judge adequately, than the reviewer has at his disposal. Both of the subjects mentioned are treated largely from the viewpoint of the Debye-Hückel interionic attraction theory. Both demonstrate that the subjects are extremely complex and that generalizations are difficult to reach. Future workers undoubtedly will find these chapters, with their abundant references to the literature, invaluable. Science has suffered a serious loss in the early death of Dr. Linderstrøm-Lang.

The two chapters by Longsworth which follow are of much more familiar material to the reviewer. The first of these is entitled "Moving Boundary Electrophoresis-Theory," and deals with the underlying principles of electrolytic conductors with special attention to boundaries between conductors with different compositions. Of particular importance is the discussion, in compact form, of Vincent Dole's mathematical treatment of the formation and movement of multiple boundaries. With this theory it is possible to predict the number and relative motion of the boundaries which form from an initial boundary containing any assortment of strong electrolytes. In addition effects such as the reactions between proteins and protein complexity are discussed in very readable form. In the next chapter "Moving Boundary Electrophoresis-Practice" the actual manipulations and the details of the various types of apparatus used is dealt with. The optical setups include Longworth's own "schlieren scanning" system, the astigmatic schlieren arrangement and the more recent interference methods. Many other details involved in the use of free electrophoresis as a research method are discussed. The two chapters form a compendium essential to the understanding and use of this type of electrophoresis as a tool for investigation.

However, free electrophoresis has its limitations. The apparatus used is elaborate and expensive, the boundary systems set up must be gravitationally stable, and the resolution into separate boundaries is sometimes inadequate. "Paper Electrophoresis" the subject of Chapter 3 by Wunderly involves an attempt to overcome some of these difficulties. However, the use of a support such as paper introduces new variables, such as the interaction of both solvent and solutes with the support, electro-osmosis, increased length of path for the current, etc. A vast amount of ingenious experimental work has been carried out in this field with the result that paper electrophoresis is, at least, a close competitor of the free variety, and in the case of routine tests may have advantages, even for quantitative results. In any case the chapter gives an excellent account of the method, and a full bibliography of the relevant literature.

In a chapter entitled "Zone Electrophoresis in Various Types of Supporting Media" Kunkel and Troutman discuss the results of using various colloidal materials as mechanical stabilizers of the solutions through which the current is passed. Here again the supporting media complicate the phenomena observed. However, much greater resolution of the components of biological materials is attained than with free electrophoresis. Not long ago physiology was open to the taunt that it was "the chemistry of imaginary substances." With the improved techniques now available these substances have been shown to have existence, and there are far more of them than the physiologists imagined. This chapter is an important contribution to the techniques and theory of their separations.

In addition to demonstrating the presence of interesting and important substances it is obviously desirable to get them out of solution in pure form so that they can be studied in detail. The editor, Bier, has contributed a chapter on "Preparative Electrophoresis without Supporting Media," showing how the electric current can be used to do this job. Much ingenuity has been expended on the problem, with considerable success, and in common with other fields discussed in this book many openings for further research are indicated.

Brown and Timasheff in their chapter "Applications of Moving Boundary Electrophoresis to Protein Systems" continue, with some overlapping, the discussions in Longsworth's chapters, with more detail as to specific proteins. Electrophoretic studies on protein heterogeneity, interaction in protein systems and protein denaturation are considered, illustrating once more the vast amount of research activity in these fields.

The reviewer found Moore's chapter on "Clinical and Physiological Applications of Electrophoresis" interesting reading, but it is a hard task to summarize it adequately. The methods have been applied to what appears to be the whole range of diseases of humans and animals. To quote "most diseases produce abnormalities in the serum pattern, but they are non-specific. There is almost always a decrease in albumin and an increase in one or more of the globulins." Nevertheless, electrophoretic methods appear to be of help in following and understanding the diseases the flesh is heir to, and will undoubtedly be more so in the future.

In a well-written treatise Brinton and Lauffer discuss "The Electrophoresis of Viruses, Bacteria and Cells, and the Microscope Method of Electrophoresis." As a matter of fact the microscopic method preceded the moving boundary procedure for quantitative studies, and goes back to the work of Ellis in 1912. It is useful in researches on large colloidal particles, such as bacteria, and requires relatively simple equipment. Many of the procedures possible with the moving boundary and paper methods also can be carried out with the microscope apparatus with the advantage that the individual particles can be seen.

"Applications of Zone Electrophoresis," with the exclusion of proteins, is dealt with by Wieland. Separation of the components of complicated mixtures of amino acids, and related substances, can be carried out using paper and other substances for support. The zones can be further separated

by successive applications of electrophoresis at right angles to each other, or by combining electrophoresis with chromatography. The procedure has been used for many mixtures, mostly of biological interest, and even for inorganic ions.

The authors are to be commended for producing a most useful book which will have influence, not only in its own field, but also in a whole range of research, particularly in biology. It represents a vast amount of hard work on the part of the authors. It is to be hoped that the book will get the recognition it deserves from the scientific public. The reviewer has only one criticism to make, *i.e.*, that the mathematical apparatus in some of the chapters is overelaborate for interpretation of the data at the stage of precision now attained, but that is only his personal opinion.

THE ROCKEFELLER INSTITUTE
NEW YORK 21, N. Y. D. A. MACINNES

Recent Advances in the Chemistry of Cellulose and Starch. Edited by J. HONEYMAN, M.A., Ph.D., Shirley Institute, Manchester. Published by Arrangement with the Manchester College of Science and Technology. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1959. viii + 358 pp. 14.5 × 22 cm. Price, $9.25.

A currently popular method of producing a book is to call a conference and to require the invited speakers to furnish chapters suitable for publication in book form. This book embodies one of the better efforts along these lines and is based upon a course of lectures held in Manchester, England, in 1958. The editing is excellent and the typography, especially in formula depiction, is unusually fine. As befits the present advanced status of the topics covered, the disciplines of physics, physical chemistry, organic chemistry and biochemistry are all brought to bear upon the subject in a well-integrated manner; this is true science. The chapters, short and compact, emphasize modern concepts and delineate the research frontiers in a fascinating manner. The concisely written, introductory chapter by Leslie Hough is outstanding as a summary of modern concepts in monosaccharide structure. Cellulose, being the most thoroughly investigated entity in organic chemistry, is emphasized in the chapters, but nevertheless the coverage on the organic chemistry of the starches is certainly the best modern exposition on this topic currently in print. Great reliance is placed upon the "degree of crystallinity" of cellulose preparations but "measurements" on this vary by 100% or more according to the method employed. It is therefore painfully obvious that the concept has no true experimental basis. The old and puzzling problem of the nature of polysaccharide degradation by alkali has received new illumination in the recent application of the principle of organic β-elimination by Kenner and associates and is well outlined by Corbett. It is odd that while the recent exciting utilization of cellulose triacetate is well described, no mention whatsoever is made of cellulose nitrate. While the biochemical treatment of the synthesis and hydrolysis of cellulose and starch is written in an excellent and challenging manner by Whelan, it is highly probable that the currently accepted schemes of synthesis will shortly require revision. But this is not a fault—it is progress. The reviewer is pleased to recommend this book in the highest degree to *both* the "expert" and the beginner—higher recommendation can be made for no book.

DEPARTMENT OF CHEMISTRY
THE OHIO STATE UNIVERSITY M. L. WOLFROM
COLUMBUS 10, OHIO

The Structure of Electrolytic Solutions. Edited by WALTER J. HAMER, National Bureau of Standards, Washington, D. C. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1959. xii + 441 pp. 15.5 × 23.5 cm. Price, $18.50.

This book edited by Walter J. Hamer is a compilation of old and new ideas, new approaches, novel techniques and recent data related to the structure of electrolytic solutions. Forty-two eminent scientists, representing twenty-four research institutions of seven nations, have collaborated in such a way that each of the twenty-seven chapters encompasses the recent thoughts of one or more brilliant minds and/or the results of recent experiments by at least one qualified expert in the particular field of endeavor. The scope of the book is so broad that it embraces subjects ranging from dilute solutions to concentrated solutions, fused salts and the pure ionic solid state.

The book is not intended for the novice, but is pitched at a quite high level. It should be regarded as an authoritative reference book to be used by persons well acquainted with such treatises as "The Physicial Chemistry of Electrolytic Solutions" by H. S. Harned and B. B. Owen, and "Electrolyte Solutions" by R. A. Robinson and R. H. Stokes. It is unfortunate that no attempt was made in this work to completely standardize the nomenclature or to choose a common set of symbols. Nevertheless, it appears that the author of each chapter has clearly defined his terms so that with a little care the sophisticated reader will encounter little difficulty in following the train of thought.

All of the subject matter is of current interest and each chapter is well-written and adequately illustrated. This book should be a valuable addition to the libraries of advanced students of the behavior of electrolytes.

DEPARTMENT OF CHEMISTRY
IOWA STATE UNIVERSITY JACK E. POWELL
AMES, IOWA

Seventh Symposium (International) on Combustion at London and Oxford, 28 August–3 September, 1958. Published for the Combustion Institute. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 1959. xlvi + 959 pp. 18.5 × 26 cm. Price, $35.00.

To the research worker, the proceedings of the symposia organized by the Combustion Institute have become a necessary complement to the current literature. The hundred and twenty-four papers presented before the Seventh International Symposium on Combustion are grouped under eleven chapters, covering a wide range of topics on which the chemist, the physicist and the engineer each speaks in his own language. A welcome feature of this book is a substantial account (70 pages of fine print) of the discussion which followed each group of papers. Although there are no survey articles, several aspects of the philosophy and history of the field, and of the present state of the art, are explored in introductory addresses by Prof. Sir Cyril Hinshelwood, Dr. Bernard Lewis, Sir Alfred Egerton and Dr. J. W. Linnett.

Of special interest to chemists are the papers grouped under: Mechanism of combustion reactions, Spectroscopy of flames, Ionization in flames, Special fuels, Instrumentation in combustion research. The other headings are: Structure and propagation of flames, Ignition and limits of inflammability, Interaction of flames and surfaces, Turbulence in flames, Combustion in practical systems, Detonation and its initiation.

The rich collection of findings reported in these papers reveals significant advances in familiar directions, rather than novel concepts or radical departures from recent trends. Several papers are devoted to the hydrogen–oxygen reaction; the nature of ignition and the mechanism of antiknock action are still hotly debated. As a result of technical refinements, direct sampling methods, sometimes in conjunction with mass spectrometry, are yielding information on intermediates and clarifying the relations between composition profiles and flame structure. The mass-spectrometric identification and measurement of ions in flames, and speculation about their origin and possible role, open a promising field. Another interesting new trend is the increasing attention paid to unconventional fuels, especially metals.

DEPARTMENT OF CHEMISTRY
LAVAL UNIVERSITY C. OUELLET
QUEBEC, CANADA