

To begin with, the book can be recommended almost without reservation to the serious student who wishes to do experimental work involving the use of radioactive substances. It is not an easy book; the theoretical discussion, which is suited to advanced graduate students in physics, is likely to present difficulties to nonphysicists. The book is more a textbook of experimental physics than a manual of laboratory procedures or techniques. These articles contain descriptions of the techniques now in use in radioactivity measurements, adequate to orient the student, who will then consult original papers in the literature. In fact, one might remark that in the field of β - and γ -rays, it complements most admirably the important Siegbahn compendium "Beta- and Gamma-ray Spectroscopy," published in 1955. The study of these two books constitutes an excellent introduction to research in the field.

There are five parts to the book. The first, by Segré, deals with radioactive decay; the second, by G. C. Hanna, with α -radioactivity. The next two parts, on γ -rays and β -rays, are written jointly by M. Deutsch and O. Kofoid-Hansen. The last section, by E. M. McMillan, is on particle accelerators.

Of the various articles, Segre's, on the general nature of radioactive decay, discusses concisely the problems of counting fluctuations and statistics, and measurements on lifetimes and branching ratios; he includes a section on what every young man ought to know about dosimetry. A 200-page review of α -decay by Hanna is divided almost equally into discussions of the theory of α -decay and a detailed account of experimental methods in alpha-detection and measurement.

The two articles on γ - and β -decay are more theoretical. Both are based mostly on material compiled up to 1955. The first constitutes an excellent exposition of the physical processes involved in γ -ray emission, absorption, internal conversion and angular correlation. The discussion of experimental techniques, though good, is somewhat too sketchy for immediate reduction to practice; Siegbahn here is more useful. The expert will find both articles somewhat outdated now. The long article on β -rays has required much recent modification because of the advent of parity non-conservation, which profoundly alters our view of the subject. However, the article suffers not so much by being late as by being slightly premature; it just misses the conclusive identification of the nature of the β -ray interaction as a mixture of axial-vector and vector. The relatively simple techniques of β -ray measurement are well described. One can only regret that this lucid and well-written pair of expositions is so unfortunately timed.

The last article, McMillan's on accelerators, is an authoritative description of all the machines that have been developed to accelerate particles to high energies, and to which the development of both classical nuclear physics and high energy physics is indebted. This is perhaps the best treatment of the subject this reviewer has seen; it is clear, concise and meticulous in historical detail—a point on which nowadays apparently only novelists can be praised. Not intended primarily for accelerator specialists, this article is just what non-specialists should welcome.

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Contributi Teorici e Sperimentali di Polarografi. Volume IV. Edited by GIOVANNI SEMERANO. Centro di Polarografia, Via Loredan 4, Padova, Italy. 1959. 361 pp. 17 × 24 cm. Price, 2500 Lire.

The aim of this serial publication was described in the review of the third volume in THIS JOURNAL (80, 3170 (1958)).

This fourth volume is a collection of twenty-one papers, dealing mainly with polarography but also including some related topics. The publication is polylingual; the papers are in either Italian, French, German or English, and each of them has summaries in these languages.

This is not a "book" in the accepted sense, but rather it seems rapidly to be acquiring the character of a "journal of polarography and related subjects." After reading several of the papers my impression is that it is a "good" journal. However, any attempt at reviewing it would be tantamount to an attempt to review a current issue of any of the estab-

lished journals, which attempt obviously is unfeasible. If you are involved in electroanalytical chemistry, and polarography in particular, you will need to add this publication to those you already regularly consult.

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The Chemistry of Heterocyclic Compounds. Volume XIII. *s*-Triazines and Derivatives. By EDWIN M. SMOLIN and LORENCE RAPOPORT, Central Research Division, American Cyanamid Co., Stamford, Connecticut. Arnold Weissberger, Consulting Editor. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1959. xxiv + 644 pp. 16.5 × 23.5 cm. Price, \$30.00. Subscription price, \$28.00.

The book begins with an introduction (16 pp.) covering in addition to nomenclature problems the parent compound, *s*-triazine, and some of its reactions. This is followed by chapters on cyanuric acid and derivatives (130 pp., mainly halides and esters), alkyl(aryl)-*s*-triazines (38 pp.), monohydroxy-, hydroxyamino-, dihydroxy-*s*-triazines and related compounds (32 pp.), mono and diamino-*s*-triazines (52 pp.), ammelide, ammeline and related compounds (40 pp.), melamine and substituted melamines (80 pp.), isocyanuric acid and derivatives (33 pp.), condensed ring *s*-triazines (50 pp.), hexahydro-*s*-triazines (71 pp.), and hexamethylenetetramine (51 pp.). Attached is a chapter on *s*-triazin-borane (borazole) and its derivatives (30 pp.). A subject index, but no author index, concludes the volume.

The preface of this book claims the literature to be covered from 1860 through 1953, and occasionally in some areas of special importance to the beginning of 1955. This is a modest understatement as far as the older literature is concerned. With a total of more than 1500 references the authors have done exceedingly well so far. It is, however, regrettable, especially in a field where the knowledge increases so rapidly, that no closer literature target date was possible. Only a very modest use has been made of the possibility of adding recent knowledge in form of footnotes. Some grossly erroneous statements, mainly in the chapter on *s*-triazine itself, could otherwise have been avoided. The authors have wisely restricted themselves to low-molecular triazine compounds of definite composition and therefore have only slightly touched the immense field of amino-triazine-aldehyde resins. The chemically much better defined dyestuffs containing *s*-triazine rings, however, have been treated shortly, but adequately. The referee believes that the inclusion of the *s*-triazaboranes with the *s*-triazines is an unfortunate choice. It stresses formal analogy without doing justice to the entirely different characteristics of hydrogen and nitrogen bonds to boron *versus* carbon. It is perhaps unnecessary to mention that this chapter suffers especially from the early literature-closing date.

The book is well written, the style clear and concise, the presentation amply fortified by structure formulas and reaction schemes. Individual compounds, besides being discussed in the text, are compiled in forty-nine tables scattered over the different chapters with mode of preparation, yield, and some physical data usually given. The description of the numerous and complex reactions of hexamethylenetetramine with nitrating agents, leading to a variety of mono- and bicyclic hexahydropolynitro-*s*-triazines, among them commercially important explosives, deserves special praise.

The referee has found many otherwise excellent and carefully written books edited in this country to be deplorably negligent in correct citation of author's names, especially from foreign countries. The book under review unfortunately exceeds in this respect all those the referee has seen so far in the past. Hechenbleikner, who has been associated with the same company as the authors, is cited sometimes as Heckenbleikner or Hechenbleickner. Leibig instead of Liebig, Wohler (throughout the book!) for Wöhler, Blitz for Biltz, Willstatter for Willstätter are only a few more examples which tend to impress the reader that the book might be as careless too in other more important aspects.

The most serious objection the referee has, however, is to the awkward arrangement of the contents of this book as far as simple *s*-triazine compounds are concerned which was perhaps justified at a time when the knowledge of *s*-tri-

azine 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.

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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 Longworth 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 ap-

paratus 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 Longworth'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