present. The refractive index of this heavy water is considerably lower than that of ordinary water, but exact figures cannot be given until the concentration has been accurately determined.

The separation of any isotope in sufficient quantity to permit investigation not only of its spectroscopic but also of its other chemical and physical properties suggests a wide range of interesting experiments but the isotope of hydrogen is, beyond all others, interesting to chemists. I believe that it will be so different from common hydrogen that it will be regarded almost as a new element. If this is true the organic chemistry of compounds containing the heavy isotope of hydrogen will be a fascinating study.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CALIFORNIA
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GILBERT N. LEWIS

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NEW BOOKS

Life and Experiences of a Bengali Chemist. By PRAFULLA CHANDRA RÂY. Chuckervertty, Chatterjee and Co., Ltd., 15 College Square, Calcutta, India, 1932. x + 557 pp. 14 × 22.5 cm.

This is an interesting and inspiring account of what a chemist's life can be. The first half of the book (Part I) is explicitly autobiographical. It describes in nearly chronological order: the author's early years on his father's estate in Bengal and at school in Calcutta; his student days under Crum Brown at Edinburgh; his return to become a professor of chemistry at Presidency College at Calcutta; his life as a teacher; his establishment during his spare time of the Bengal Chemical and Pharmaceutical Works, Ltd., now one of the great industrial concerns of India; his studies in the history of Hindu chemistry; his extensive experimental researches; finally, his manifold and multifarious activities in the public service.

The second half of the book (Part II) is only autobiographical; it contains numerous essays on educational, industrial, economic and social subjects. They not only serve to define the author's personality and point of view but they are also of the greatest interest, particularly to a far-away American, for the light they throw on the problems of present-day India. The author attacks scathingly the caste system that hangs as a millstone about India's neck and the ignorance and superstition of many of the Hindus. But his fiercest invective is launched against the spiritlessness and supineness of his fellow Bengali. As regards the British-Indian government he reaches, although by a different route and disagreeing with him in many vital points, the same position of non-coöperation championed by his compatriot Gandhi.

To the readers of this autobiography it is clear that, while Sir P. C. Râу has been a great scholar, chemist, teacher and administrator, these activities have been to him of secondary importance; he has been first, last and all the time a patriot—a Hindu and a Bengali. And he dedicates this account of his life, his opinions and his hopes for his country "To the Youth of India."

ARTHUR B. LAMB

Kettenreaktionen. (**Chain Reactions.**) By KLAUS CLUSIUS. Verlag von Gebrüder Borntraeger, W 35, Schöneberger Ufer 12a, Berlin, Germany, 1932. iv + 73 pp. 24 figs. 16.5 × 25 cm. Price, to subscribers, RM. 9.60; separately, RM. 12.80.

This is a brief review covering the field of gaseous chain reactions. The author starts by a description of the general characteristics of chain reactions and outlines the principles of their kinetic analysis. This is followed by a more detailed consideration of a few typical stationary chain reactions of the photochemical and thermal kind, to which some 20 pages is allotted. The remaining 30 pages are devoted to the non-stationary chain reactions, chiefly to the phenomena of the lower and the upper critical explosion pressure limits. Some rather disconnected bits of information on experimental technique are scattered through the text.

The presentation is far from exhaustive, but in the limited space used by the author one could hardly expect more material to be covered. The booklet will give a fair concept of the present status of the knowledge in the field of chain reactions to a reader already familiar with the principles of the kinetic treatment of reaction velocities. No serious mistakes have been noticed, but the reviewer feels that the fundamental work of Semenoff on the theory and experiment of the critical explosion limits and of non-stationary chains in general has not been sufficiently stressed by the author.

G. B. KISTIAKOWSKY

Elektrolyte. (**Electrolytes.**) By Dr. HANS FALKENHAGEN, Professor at the University of Cologne. Verlag von S. Hirzel, Königstrasse 2, Leipzig, Germany, 1932. xvi + 346 pp. 104 figs. 17.5 × 25.5 cm. Price, Mk. 23: bound, Mk. 24.80.

One of the most important and significant of recent advances in chemical theory has been the deeper insight into the nature of solutions of electrolytes which we owe to Debye and others who have been inspired by his leadership. Although others had conceived the idea that the fundamental weakness of the classical dissociation theory of Arrhenius was the neglect of the electric forces of attraction and repulsion between ions, Debye was the first to devise a mathematical technique adequate to predict quantitatively the effect of these forces on the measurable properties of solutions. This book is so permeated with the ideas of Debye that it is to be regretted that the publisher did not provide a portrait of Debye as a frontispiece.

Debye in a foreword says, "It is manifest that the time has now arrived to present the theory of electrolytes as developed up to the present time as a coherent whole and from a consistent point of view. That has been done in this monograph and I am grateful that such an expert as Falkenhagen, who himself has made such valuable contributions to the development of the theory, has undertaken this troublesome task."

The work opens with nearly one hundred pages devoted to fundamental definitions and a discussion of the strength and weaknesses of the older classical theory and the activity concept. Then follows a systematic mathematical development of the new theory in a manner which is clearer and easier to follow than it is in the scattered original literature. The seventh chapter derives the basic equations of the theory which describe the so-called ionic atmosphere and the time of relaxation of this atmosphere.

The next chapter is devoted to the thermodynamic properties of solutions. The concept of the activity coefficient which was originally developed empirically as a measure of the deviation of real solutions from the hypothetical ideal solutions is given a firm theoretical basis and applied to the colligative properties of solutions and to the influence of added electrolytes on the dissociation of weak acids (neutral salt effect) and on the solubility of other salts or non-electrolytes (solubility product law and salting out effects). The heats of dilution of solutions are also discussed in this chapter.

The ninth chapter is devoted to the electric conductance of solutions—a field in which the new theory has led to important advances because the Debye point of view differs so fundamentally from that of Arrhenius. The square root law for the variation of the conductance of extremely dilute solutions with the concentration which was long ago discovered empirically by Kohlrausch has been derived theoretically by Debye and later in an improved manner by Onsager. Debye and Falkenhagen have predicted that at very high frequencies the conductivity would depend on the frequency and this prediction has been verified experimentally after it was made. Finally Wien's experimental demonstration that Ohm's law fails at very high voltages has been shown to be a consequence of the new theory.

The tenth chapter is devoted to the viscosity of solutions—a field in which the theoretical development is due chiefly to Falkenhagen.

The greatest weakness of the Debye theory in the early stages of its development was that the mathematical difficulties of a rigid development compelled the introduction of inexact assumptions for the sake of simplification and as a consequence the resulting equations were only valid for extremely dilute solutions. The eleventh chapter shows substantial and encouraging progress in conquering these difficulties. The attempts to distinguish between the dissociated and undissociated fraction of the electrolyte by optical means (absorption spectra, refractive index, Raman effect) are discussed. The work ends with an account of the application of statistical methods to the problem by Fowler and by Kramers.

The title "Elektrolyte" may be misleading as it tends to give the impression that the work is a comprehensive discussion of all properties of solutions, whereas some properties of solutions, such as the compressibility, the coefficient of expansion, and diffusion coefficients, which have not yet been interpreted by the new theory are not discussed. It is, however, surprising that a discussion of transference numbers is omitted. One of the outstanding weaknesses of the Arrhenius theory is that it predicts that transference numbers should be independent of the concentration whereas it has long been known that in general transference numbers do vary with the concentration and this is an obvious corollary of the new theory of conductance and therefore would seem to merit comment in this book.

Citations to the original literature are of course given abundantly in the footnotes but the author relegates too much important and interesting discussion to the footnotes, which are printed in such small type that many users of the book will be unable to read the footnotes without eyestrain. Thus for example Brönsted's interesting views as to the nature of acids and bases and as to the mechanism of acid and base catalysis are discussed in a footnote which extends over three pages.

However, these criticisms concern minor matters. The book as a whole gives an admirable, systematic and substantially complete presentation of the new interionic attraction theory as developed up to the early part of 1932. It will be extremely helpful to anyone who wishes to acquire a really up-to-date knowledge of electrochemistry. It will be indispensable to research workers in this field and will unquestionably catalyze further development of our knowledge of solutions.

GRINNELL JONES

Applied x-Rays. By GEORGE L. CLARK, Ph.D., Professor of Chemistry, University of Illinois. Second edition. McGraw-Hill Book Company, Inc., 330 West 42d Street, New York, 1932. xiv + 470 pp. Illustrated. 15 × 23.5 cm. Price, $5.00.

The second edition of Applied x-Rays has been largely rewritten and expanded to nearly twice the size of the first edition. The general scope of the book has remained the same, although much new material has been included. As the author states in the first edition, "the book aims to tell what this new tool is, how it may be used, what results it produces, why it can be applied to practical problems of everyday life, and how industry is beginning to use it."

Part I comprises properties of x-rays, x-ray equipment, spectra, chemical analysis from x-ray spectra, absorption and scattering, radiography, and the physical, chemical and biological effects of x-rays. Part II is devoted to the x-ray analysis of the ultimate structure of materials. It includes crystals and x-ray diffraction, experimental methods, interpretation of diffraction patterns, results of crystal analysis for elements and inorganic compounds, crystal chemistry, structure of alloys, crystal structure of carbon compounds and several specialized subjects such as grain size and orientation, applications to metallurgical problems, colloidal and amorphous materials, liquids and polymerized organic substances

Part II contains a wealth of diverse material much of which is not to be found except scattered through the various journals. Throughout the book the treatment is descriptive and suggestive rather than detailed or theoretical. For example, the lay reader is given a rather clear idea as to how the structure of crystalline materials is worked out but in a general way not in detail. However, for the large group of readers who are more interested in knowing how x-rays can be used in various problems and what results have been obtained by their use, this book will be of the greatest value. To this large group of readers the book is to be highly recommended.

BERTRAM E. WARREN

Methoden der Kristallstrukturbestimmung mit Röntgenstrahlen. I Bd. Die Lauemethode. (Methods for the Determination of the Structure of Crystals by Means of Röntgen Rays. Vol. I. The Laue Method.) By Dr. E. SCHIEBOLD, Professor at the University of Leipzig. Akademische Verlagsgesellschaft m. b. H., Markgrafenstrasse 6, Leipzig C 1, Germany, 1932. xii + 173 pp. 63 figs. 16.5 × 24.5 cm. Price, M. 12; cardboard cover, M. 13.

The Laue method is the first of a series of three monographs on the methods of crystal structure determination by x-rays. Vol. II, "The Rotating Crystal Method" is now in press, and Vol. III, "Debye-Scherrer and Powder Method," is in preparation.

The Laue method was chosen as the subject of the first volume of this series as being the original diffraction method. The author's long years of experience with this method and its practical application to crystal structure determination make him well qualified to write this monograph. The subject matter includes the experimental technique of the Laue method, the indexing of Laue patterns by analytical and graphical methods, crystal symmetry, determination of the lattice constants, the Bravais lattice, space groups, intensity of the diffraction spots, arrangement within the unit cell and parameter determination. Chapter V on the intensity of the diffraction spots contains 56 pages and comprises a rather complete summary of the more important factors which enter this phase of the problem.

It is strange that although the graphical method of the gnomonic projection is in practice the simplest method of indexing Laue patterns, and almost exclusively the method used in this country, the author should have passed over this subject in a few pages and devoted 24 pages to the indexing by analytical methods. Actually this is probably a good point, in that one has here what is not generally found in discussions of the Laue method, and furthermore one glance at the 24 pages of wearisome trigonometric equations and laborious analytical calculations is the most convincing way of deciding that the graphical method justly deserves the popularity which it has always enjoyed in this country. Vector notation is used very little and the non-mathematically minded reader will have no trouble.

The paper and binding are good and the printing and reproductions clear, but in the copy reviewed the printing rubbed rather badly under finger touch.

BERTRAM E. WARREN

The Catalytic Oxidation of Organic Compounds in the Vapor Phase. By L. F. MAREK, Massachusetts Institute of Technology, and DOROTHY A. HAHN, Ph.D., Mount Holyoke College. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 419 Fourth Ave., New York, 1932. 486 pp. 60 figs. 16 × 23.5 cm. Price, $9.00.

The great industrial importance of organic gas-phase oxidation processes has resulted in the recent accumulation of a vast amount of more or less empirical data, much of which is hidden in the patent literature and in obscure technological publications. At the same time, there has been a marked development in the theoretical viewpoint of the nature of contact catalysis, and the concept of chain reactions has been applied to gas-phase oxidations with significant results.

However, there has been no adequate review of this field as a whole since the books, published ten or more years ago, by Rideal and Taylor, Sabatier and Reid and Falk. In supplying this deficiency, "it has been the purpose of the authors to consider the facts regarding both developed and undeveloped processes and to review these critically in so far as possible."

The result, this present volume, contains a complete survey of the general literature, an excellent critical selection of patents, and numerous valuable private communications: a total of nearly 2000 references. All organic gas-phase oxidations, whether known to be catalytic or not, have, quite sensibly, been considered; moreover, much relevant information on liquid-phase oxidations is included. In addition, many closely associated parallel reactions such as dissociation, polymerization, hydration, etc., are reviewed in order to complete the picture.

Thus, a chapter on the thermal decomposition of ethyl and the higher alcohols precedes one on their oxidation, and a complete review of the reactions of the water gas system introduces a study of the oxidation of methanol to formaldehyde. The paraffins from methane to pentane are of particular interest owing to "the tremendous possibilities offered for conversion to valuable chemicals," and their oxidation is considered in detail. Other chapters deal specifically with the production of hydrogen from methane, and with surface combustion. The oxidation and hydration of the lower olefins and acetylene are reviewed together. A chapter on the oxidation of petroleum oils deals with the aliphatic hydrocarbons heavier than pentane. Additional data on the members of the gasoline range, together with reviews of ignition temperatures, oxidation mechanism and inhibition (for which the authors continue, at times, the use of the unfortunate term "negative catalysis") are found in a special section, "The Cause and Suppression of Knocking in Internal Combustion Engines." Aromatic compounds are reviewed in three chapters, devoted principally to the oxidation of benzene and naphthalene. Finally, there is a discussion of the apparatus used in commercial processes. Throughout these chapters the authors have by no means restricted the citations to work dealing specifically with the subjects in question, but have included numerous references to matters of allied interest.

A general description of the characteristics of gas-phase catalysis and its theoretical background is given in a brief introductory chapter. Further references to theory are found at intervals throughout the book, but on the whole the treatment of this aspect has been subordinated to the presentation of practical or experimental facts. The authors acknowledge that "In many cases, the discussion could not be made as critical as desired, because of trade secrecy..., the multiplicity of conditions used..., and the paucity of data."

The immense amount of diverse material covered necessarily entails a certain degree of confusion in its presentation, which in this case is augmented by the fact that the chapter headings in the Table of Contents have not been subtitled, as is customary in these Monographs and as was done so effectively in the classic treatise of Sabatier and Reid. Moreover, there are no author and patent indexes.

In spite of these deficiencies, this volume undoubtedly constitutes a valuable reference work, complete and up-to-date. As a time-saving source-book alone, it may well be worth many times its high price.

HAROLD A. BEATTY

Applied Colloid Chemistry. General Theory. By WILDER D. BANCROFT, World War Memorial Professor of Physical Chemistry at Cornell University. Third edition. McGraw-Hill Book Company, Inc., 330 West 42d Street, New York, 1932. ix + 544 pp. Illustrated. 14.5 × 21 cm. Price, $4.00.

Bancroft's third edition of Applied Colloid Chemistry is the "Golden Bough" of the subject and Bancroft is its Frazer. He has brought the book up to date in countless details and added over 10% to the pages of the second edition (1926). Everything which is even remotely connected with the colloid state is given at least a brief reference—and some things which are not. The original 60 things which he said one can only know about after understanding colloids, have had one change (pharmacy becomes pharmacology); one addition, medicine, and one apparent addition, for "it now looks as though insanity were primarily a problem in colloid chemistry."

The book is interesting because it makes such an enormous number of natural phenomena seem more or less interrelated and within the colloid family. Everyone who wants to study colloidal chemistry thoroughly ought to possess it. The author probably reads more widely in chemistry than any other person who also writes, and he adds a great deal to his subject through his own experiments and those of his students. He is neither dogmatic nor captious but rather eclectic, and the book contains more references to the literature than any other book I have read. The data on "Thickness of Surface Films" (chapter XVII) have been about doubled.

W. R. WHITNEY

The Free Energies of Some Organic Compounds. By GEORGE SUTTON PARKS, Associate Professor of Chemistry, Stanford University, and HUGH MARTIN HUFFMAN, Assistant Professor of Biochemistry, California Institute of Technology. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 419 Fourth Ave., New York, 1932. 251 pp. Illustrated. 15.5 × 23.5 cm. Price, $4.50.

In this book the authors have given a complete and fairly detailed account of the measurements that have been made on the free energies of organic compounds. This alone would make the book a valuable contribution to chemical literature, but they have enhanced its importance by including a system whereby the free energies in the liquid state of most of the simpler types of organic compounds can be calculated from their structures. Even for so complicated a substance as mannitol the calculated and observed values differ by only 1500 calories. When, as in eicosane, the calculated values differ by more than 10,000 calories the authors boldly claim the greater accuracy for the calculated value. The reviewer believes that future experiments will confirm the authors' conclusion.

The free energy increment per methylene group for gaseous olefins is less than the common value for liquid paraffins and liquid fatty acids. This result appears improbable, as the free energy increment per methylene group should be greater in the gaseous than in the liquid state. The increment for the olefins may easily be in error, for it is calculated from the free energy difference between the first and fifth members of the series. This difference is too small for accuracy. Further, the calculation of the free energy increment per methylene group should not involve the first member of a series, for first members often have anomalously high free energies.

The American Chemical Society is to be congratulated on this valuable and interesting addition to its monographs.

GERALD BRANCH

Jahrbuch der organischen Chemie. (Yearbook of Organic Chemistry.) By Professor Dr. JULIUS SCHMIDT, Stuttgart. Vol. XVIII, 1931. Verlag von Franz Deuticke, Helferstorferstrasse 4, Wien, Austria, 1932. xix + 345 pp. 17.5 × 25.5 cm. Price, M. 36; bound, M. 39.

The Jahrbuch has attained maturity. In celebration of the twenty-fifth anniversary of the first issue, Professor Schmidt has added to the present volume a foreword in which he reviews his struggle to keep the series alive despite war and depression, and expresses his joy and pride in its final success. The pride is justifiable; the author can be congratulated whole-heartedly on his achievement. He has steadily reported in his Jahrbuch all researches in organic chemistry that were manifestly significant, and year by year his reports have followed the trends of the investigators, faithfully reflecting the great interest in natural products and in the application of new physical methods. The latest volume is the best of the series.

E. P. KOHLER

Qualitative Organic Analysis. An Elementary Course in the Identification of Organic Compounds. By OLIVER KAMM, Scientific Director, Parke, Davis and Company. Second edition. John Wiley and Sons, Inc., 440 Fourth Ave., New York, 1932. ix + 311 pp. 15.5 × 23.5 cm. Price, $2.75.

The second edition of this well-known textbook should be most welcome, not only to those already familiar with the earlier issue, but also to all organic chemists who wish up-to-date information in this fundamentally important field.

The general outline, arrangement of the material and method of presentation remain practically the same as in the first edition, the book being divided into a Theoretical Part (A), Laboratory Directions (B) and Classified Tables of Compounds (C). A subject index concludes the book. On the inside of the back cover is pasted a Solubility Table showing just how solubilities are used as the basis for the primary division of organic compounds into main groups.

The systematic procedure in the identification of an unknown remains as before, namely: 1, physical examination; 2, a determination of constants; 3, elementary analysis; 4, solubility tests; 5, determination of homologous series; 6, consultation of literature, tables, etc.; and 7, preparation and identification of derivatives.

Like most of the Wiley publications, type and paper are excellent, the proof-reading has been well done, and the few typographical errors noted are not serious.

The following comments are offered: (1) *Amide Formation* (pages 60, 186, etc.).—The student should be cautioned not to pour a large amount of concentrated ammonium hydroxide solution upon a liquid ester (for example, ethyl oxalate) in a test-tube, for the violence of the reaction may hurl the material into his face. (2) *Coupling of Heterocycles* (page 73).—While it is true that the nitrogen heterocycles themselves do not ordinarily couple with diazonium salts, this is not the case with all of their derivatives, many of which (notably the hydroxyl derivatives) yield dyes which have been patented. (3) *Diarylhydrazines* (page 73).—The difference in basicity and in other properties between the *sym.* and the *asym.* diphenylhydrazines should be pointed out, because the latter are used subsequently in certain reactions. (4) *Proteins* (page 97).—The xanthoprotein reaction is described as "a common test for the *phenolic* group." (5) *1,2-Diketones* (page 108).—The inclusion of the quinoxaline (or phenazine) reaction is recommended as a test for these diketones, since this condensation generally occurs instantaneously and quantitatively in alcoholic solution with *o*-phenylenediamine, the products are crystalline, easily purified and of sharp melting point. It is generally simpler and much more satisfactory than the benzilic acid rearrangement, and is, of course, equally useful in the identification of 1,2-diamines.

MARSTON TAYLOR BOGERT

Aluminiumchlorid in der organischen Chemie. (Aluminum Chloride in Organic Chemistry.) By GEORG KRÄNZLEIN, I. G. Farbenindustrie A.-G., Höchst am Main. Second, revised and enlarged edition. Verlag Chemie, G. m. b. H., Corneliusstrasse 3, Berlin W 10, Germany, 1932. 143 pp. 16 × 23.5 cm. Price, Mk. 12.

In this handy volume the author presents an excellent picture of the role of aluminum chloride in organic chemistry—its service in synthesis; its action in reactions which involve reduction, dehydrogenation, rearrangement, polymerization or cleavage; and its technical applications. The various modes of action are illustrated with carefully selected examples, and supported with very many references to the literature.

Monographs on special topics in organic chemistry are becoming increasingly valuable both to the student and to the investigator. This volume on an important reagent is one of the best of its kind.

E. P. KOHLER

The Terpenes. Vol. II. The Dicyclic Terpenes, Sesquiterpenes and their Derivatives. By J. L. SIMONSEN, D.Sc. (Manc.), F.I.C., F.R.S., Professor of Chemistry, University College of North Wales. The Macmillan Company, 60 Fifth Ave., New York, 1932. xi + 627 pp. 14 × 22.5 cm. Price, $7.00.

With the publication of the second volume of "The Terpenes" the author has given us a work which will be indispensable to the student of terpene chemistry. As stated in the preface, few, if any, natural products have formed the subject of such intensive study as the pinenes and camphor. The section dealing with the sesquiterpenes includes the brilliant researches of Ruzicka and his collaborators.

The present work is more than a mere review of the literature, and could only have been written by one thoroughly acquainted with the subject. The development of the views regarding chemical constitution is taken up in order, and where further research is needed, the author has so indicated.

It is gratifying to have so excellent a work on the terpenes available in the English language.

E. K. NELSON

BOOKS RECEIVED

January 15, 1933–February 15, 1933

KURT ALDER. "Die Methoden der Dien-Synthese." Handbuch der biologischen Arbeitsmethoden, Emil Abderhalden, Editor. Abt. I, Chemische Methoden, Teil 2, 2 Hälfte, Heft 9 (Schluss). Urban and Schwarzenberg, Friedrichstrasse 105 B, Berlin N 24, Germany. 212 pp. RM. 13.50.

HANS BODE AND HANS LUDWIG. "Experimentelle Einführung in das Wesen organisch-chemischen Reaktionen insbesondere für Lehramtskandidaten." Verlag Franz Deuticke, Helferstorferstrasse 4, Wien, Austria. 48 pp. M. 1.50.