microsomes are intact. The particle-free preparation retains the ability to cyclize squalene but is no longer efficient in catalyzing the demethylation reactions leading to cholesterol. The present findings in conjunction with earlier ones establish the sequence squalene-lanosterol-cholesterol as a major pathway in sterol biogenesis.

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BOOK REVIEWS

Electrolyte Solutions. The Measurement and Interpretation of Conductance, Chemical Potential and Diffusion in Solutions of Simple Electrolytes. By R. A. ROBINSON, D.Sc., Ph.D., F.R.I.C., Professor of Chemistry, University of Malaya, Singapore, and R. H. STOKES, Ph.D., D.Sc., F.R.A.C.I., A.R.I.C., Reader in Physical Chemistry, University of Western Australia. Academic Press Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1955. xiii + 512 pp. 15 × 22.5 cm. Price, $9.50.

To all who are interested in the properties of electrolytic solutions, the appearance of this authoritative volume should be a welcome event. The substantial contributions of both authors to this field qualify them admirably to write on the subject, and they have produced a book that has much to offer to specialist and student alike.

Robinson and Stokes have restricted themselves to three fundamental properties of electrolytes–conductance, chemical potential and diffusion—and their penetrating analysis of the experimental and theoretical studies in these fields has produced interpretations and generalizations that are both new and important. The discussions, based upon the interionic attraction theory of Debye and Hückel and especially upon the later contributions of Falkenhagen and of Onsager and Fuoss, demonstrate a surprising adequacy of modern theory when allowance is made for the dimensions of the ions. The reader will be impressed with the progress that has been made in the past two decades, developments that have fashioned equations valid for solutions of moderate and even high concentrations from limiting laws applicable only to "slightly polluted water."

During the first major period in the development of solution theory, exact thermodynamics was applied extensively to the study of electrolytic solutions, and the Debye–Hückel theory was used to extrapolate to the experimentally inaccessible region of extreme dilution. From reading the present volume one may conclude that the investigation of ionic solutions has entered a new phase in which the kinetic approach will take its place beside the thermodynamic. The submicroscopic view is introduced in chapter 1—"Properties of Ionizing Solvents." In subsequent chapters the reader comes to regard ions not as the time-honored point charges but as kinetic units with several relatively firmly attached water molecules migrating at a rate of perhaps 1 cm./hr. in a field of 1 v./cm. while subject to instantaneous Brownian velocities of 200 miles/hr. In the reviewer's opinion, the thermodynamic approach is never outmoded and rarely overemphasized, yet the complexity of the problem justifies a twofold attack. For this reason, the present book is complementary to such valuable existing treatises as that of Harned and Owen. The fruitfulness of the coordinated assault is particularly evident in the section on ion-solvent interactions and the chapter on ion-pair formation.

The key to a quantitative theory of electrolyte solutions is an ionic distribution function that gives the probability of finding one ion in a certain position relative to another and permits a distribution of electric potential to be calculated. In pure water, thermal motion overcomes the short-range order near the central molecule, and random distribution obtains at distances greater than a few ångströms. However, the distribution is more complicated in an electrolytic solution, where competition between long-range coulomb forces and thermal motion maintains non-random distribution even at considerable distances. Unfortunately, an inconsistency between the Boltzmann distribution and the principle of linear superposition of fields adds materially to the difficulty; the most expedient escape from this dilemma leaves the theory really adequate only for symmetrical electrolytes. In one of the best sections of their book, Robinson and Stokes gave a critical evaluation of the Bagchi treatment, the Eigen–Wicke modifications, and other distribution functions and justify in a convincing way their selection of the modified Debye–Hückel treatment of the interionic forces.

Although the chemical potential is known to be strongly influenced in concentrated solutions by interactions of the ion-solvent and non-electrolyte types, many complicating factors not fully understood still bar the way to a satisfactory theory. On the other hand, "we are now in the unexpected position that, at least for uni-univalent electrolytes, the theory of conductivity is more exact and successful than the theory of chemical potential." Thus by introducing the factor $1 + ka$ (where a is the ion-size parameter) into both the electrophoretic and relaxation terms, an equation representing the conductance of hydrochloric acid up to 0.09 M and at temperatures from 5 to 65° is obtained. The value of a (4.3 Å.) is the same as is found from measurements of electromotive force and does not vary with temperature. Furthermore, the introduction of a relative fluidity into these formulas yields calculated conductivities for lithium chloride solutions that agree approximately with the measured values up to 9 M. The equations for transport numbers involve only electrophoretic terms, the relaxation factors having cancelled out, and the computation is again very successful up to a concentration of 3 M for hydrochloric acid and to 1 M for lithium and potassium chlorides. Although the migration of ions in electric fields has been studied very extensively, it is only recently that diffusion, one of the simplest of irreversible processes, has been given the attention it deserves. The chapters devoted to this topic summarize the remarkable progress that has already been made.

The first three of the 15 chapters concern themselves with basic concepts and a discussion of the state of the solute and solvent in electrolye solutions. Chapter 4 deals with ionic distribution functions, and chapters 5, 6 and 7 present both the theoretical and experimental aspects of electrolytic conductance. Chapters 8 and 9 treat the measurement and interpretation of chemical potentials, whereas chapters 10 and 11 are devoted to a similar discussion of diffusion. The last four chapters are entitled, respectively, "Weak Electrolytes," "The 'Strong' Acids," "Ion Association," and "The Thermodynamics of Mixed Electrolytes." The list of symbols and the table of important constants will be of much help to the reader, and the 62-page appendix is an admirable and most welcome feature of the book. The extensive tables of activity and osmotic coefficients and water activities included therein will be particularly useful. Likewise, the data on ionization constants of weak electrolytes in water and in mixed solvents and the variation of these constants with temperature can be found in such a complete and convenient form in no other source known to the reviewer.

In view of the authors' distinguished studies of the hydration of ions and of the isopiestic vapor pressure method, it is not surprising to find these topics treated most capably. However, it is difficult to find any section of the book that does not reveal the same high standard of clarity, competence and attention to detail. The descriptions of experimental techniques are perhaps occasionally somewhat less adequate than the theoretical parts. The discussion of the hydrogen–silver chloride cell (p. 198), for example, applies only to very dilute solutions and to a phenomenon that cannot occur when the electrodes are properly separated. The processes given for concentration cells involving a transfer of water as well as electrolyte (pp. 194–195) would seem to apply only if the water participates in the reaction at Electrode A; when this electrode is in position B the processes are reversed. Among the many excellent features of the book are the discussions of standard states, medium effects and activity coefficients in mixed solvents, non-electrolyte effects in the theory of chemical potentials, incomplete dissociation of salts and properties of electrolyte mixtures. The style is remarkably uniform throughout the book; variations in the spelling of the word "stoichiometric," however, betray the dual authorship. There is a rather brief but adequate subject index. It is to be hoped that an author index will be added in a later edition.

Robinson and Stokes have produced one of those rare volumes that not only summarizes and systematizes but shows clearly the path to further progress. Their book will be useful to scientists in many fields and indispensable to investigators concerned with the behavior of ionic solutions.

NATIONAL BUREAU OF STANDARDS
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Nuclear Science Series. Report Number 17. Biochemical Aspects of Basic Mechanisms in Radiobiology. By HARVEY M. PATT, Editor. National Academy of Science–National Research Council, Washington, D. C. 1954. ix + 158 pp. 17.5 × 24.5 cm. Price, $1.50.

This book was prepared from the transcript of a conference sponsored by the National Academy of Sciences and the National Research Council. It was held in Highland Park, Illinois, on May 13–15, 1954. Questions and comments by the 25 participants in the conference are so frequent and extensive that the five principal speakers serve largely as leaders of discussion and targets for comments rather than to present formally organized papers. The published book preserves most of this informal aspect of the conference.

Ernest C. Pollard presented data on the effects of ionizing radiation, on enzymes, viruses and other large molecules in the dry state, so that indirect effects by way of activated solvent molecules were largely eliminated. E. S. G. Barron discussed radiation effects on these biologically important molecules in dilute solution so that this indirect effect was large. Frederick G. Sherman, Kenneth P. DuBois and Charles E. Carter discussed from different points of view inferences concerning the biochemical nature of primary cellular damage that can be drawn from data on the effects of radiation on more complicated biochemical systems including living organisms. Radiation damage is most evident by interference with cell division and suggests primary damage to the hereditary apparatus of the cell. Therefore the present knowledge of the structure of nucleoproteins and the possible sites of radiation damage to them is reviewed in considerable detail.

This book is in no sense a text on any phase of radiation chemistry or biology. It does, however, give a useful review of the varied points of view of some of the leading research groups studying radiation effects on biological systems, and can be read with interest and profit by individuals wishing to orient themselves in this field. Radiation chemistry, radiation genetics, and the systemic effects of radiation on higher organisms are considered only to the extent that they can throw light upon what may be called the primary biochemical lesion.

In the preface the editor asks that, because of the preliminary nature of much of the material, the data presented should not be referred to without the author's permission. This reviewer hopes this request does not set a precedent for future publications. A book as widely advertised for sale as this one represents in all senses publication of data; and material so uncertain or confidential that an author desires to forbid further consideration of it ought to have been removed from the manuscript before this publication.

UNIVERSITY OF ROCHESTER
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Technique of Organic Chemistry. Volume VII. Organic Solvents. Physical Properties and Methods of Purification. On the basis of the First Edition by ARNOLD WEISSBERGER and ERIC S. PROSKAUER. Completely Revised Second Edition by JOHN A. RIDDICK and EMORY E. TOOPS, JR., Commercial Solvents Corporation, Terre Haute, Indiana. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1955. vii + 552 pp. 16 × 23 cm. Price, $8.50.

This book is a revised and expanded edition of the original which was published in 1935. The objective is the same —to present reliable physical data, criteria of purity and methods of purification for a wide variety of organic solvents for use as a guide in the selection of a solvent for a particular purpose.

The new volume includes 254 organic liquids compared to 157 in the first edition. Of these, 48 are hydrocarbons of various types, 189 have one type of characteristic atom or group (*e.g.*, chlorine, hydroxyl, etc.), and 17 have more than one type of atom or group (*e.g.*, alcohol–ethers, chlorinated amines, etc.). For most of the solvents, 27 physical properties are tabulated, and these data are documented by 2100 literature references.

A new chapter defines the various physical properties and shows the temperature dependence of important properties such as vapor pressure, viscosity, surface tension, etc.

A particularly valuable innovation are index tables in which the solvents are arranged in the order of increasing boiling point, freezing point, dielectric constant and dipole moment. A similar table based on refractive index would be helpful.

Following the tabulated data are chapters on criteria of purity, methods of drying, general methods of purification and specific methods for approximately 230 of the solvents. Included also is a brief mention of hazards, toxicology and flammability. Although the discussion of criteria of purity is brief, it critically evaluates such methods as chemical tests, freezing curves, melting points, etc.

Correct chemical names are used in the text, but the index includes both common and commercial names as synonyms; *e.g.*, 1,2,3-propanetriol, glycerine, glycerol.

A comparison with the recently published "Technology of Solvents and Plasticizers," Arthur K. Doolittle, may be pertinent. This review is primarily concerned with the *use* of solvents and plasticizers. Therefore there is little overlapping of subject matter with "Organic Solvents."

Typography, format and binding are good. This is a most useful reference book for the chemist, chemical engineer and physicist.

WESTERN RESERVE UNIVERSITY
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Introduction to Theoretical Organic Chemistry. By P. H. HERMANS, Ph.D., Utrecht (The Netherlands). Edited and revised by R. E. REEVES, Ph.D., Research Consultant in Chemistry, Tulane University, and Chemist, Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, New Orleans, La. (U. S. A.). Elsevier Publishing Company, 2330 Holcombe Blvd., Houston 25, Texas. 1954. xii + 507 pp. 16 × 23 cm. Price, $9.75.

While this work is rather interesting to read, it is difficult to see wherein it will be of great use to any large group of readers. Since the expressed purpose of the author was the production of a text to supplement the recognized deficiencies in the treatment of theoretical organic chemistry in most elementary texts, it is not surprising that there is little which will be new or technically stimulating to the expert in the field. It is more disappointing to find that the book can be recommended only with severe reservations for study by beginners. It is quite possible that an interested neophyte might wax enthusiastic after a first reading of the book since a pleasingly large variety of subjects is