

and we shall then discuss in detail the important implications which follow from this result.

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L. N. OWEN
J. L. SIMONSEN

RECEIVED AUGUST 15, 1942

THE TEMPERATURE COEFFICIENT OF THE CONDUCTANCE OF POTASSIUM CHLORIDE SOLUTIONS

Sir:

In THIS JOURNAL, **64**, 1544 (1942), Li and Fang give conductance data for aqueous solutions of potassium chloride at temperatures from 15 to 40°; they were apparently unaware, understandably enough, of our results both for potassium and sodium chloride solutions at temperatures from 15 to 45° (Gunning and Gordon, *J. Chem. Phys.* **10**, 126 (1942)). Their conductances at 25° are in moderate agreement with those of Shedlovsky, Brown and MacInnes [*Trans. Electrochem. Soc.*, **66**, 165 (1934)] and our own, and their 15° numbers are also in rough agreement with the measurements of Thompson and his associates [THIS JOURNAL, **59**, 2372 (1937); **61**, 1219 (1939)] and ourselves. For 15°, however, they employ a linear extrapolation of the Shedlovsky function Λ_0^c ; Shedlovsky, Brown and MacInnes showed that a $c \log c$ term was required for potassium chloride at 25°, and we showed that it was even more important for 15°. It is for this reason that the value Li and Fang give for Λ_0 at this temperature (120.88) is considerably less than the one we obtained by an extrapolation from much lower concentrations, *viz.*, 121.09.

The values of Λ_0 at 30° and 40° reported by Li and Fang are, however, about 0.25 and 1.1% less than those obtainable by interpolation in Gunning and Gordon's Table V. From LeRoy, Allgood and Gordon's transference data [*J. Chem. Phys.*, **8**, 418 (1940)] t_{-}^0 is 0.5103 at 30° and 0.5120 at 40°; combining these with Li and Fang's values of Λ_0 , one obtains 84.00 and 99.42 as the limiting mobility of chloride ion at these temperatures; Gunning and Gordon's Table VI, which resulted from a consideration of the transference and conductance measurements for *both* salts, gives 84.22 and 100.52. Interpolation of Owen and Sweeton's results for hydrochloric acid solutions [THIS JOURNAL, **63**, 2811 (1941)] gives 84.3 and 100.9; these are in agreement with Gunning and Gordon's values within the uncertainty of the transference numbers Owen and Sweeton were forced to employ.

If the discrepancy be ascribed to error in the temperature, this would correspond to a difference of 0.1° at 30° and to 0.6° at 40°; Li and Fang give no information about their temperature scale beyond stating that they used standard thermometers; our temperatures were determined by platinum resistance thermometer with N. B. S. certificate. It would therefore seem that Li and Fang's 30° and 40° data should be considered, for the moment at any rate, with reserve.

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A. R. GORDON

RECEIVED JULY 29, 1942

NEW BOOKS

Introduction to the Theory of Relativity. By PETER GABRIEL BERGMANN, Member, Institute for Advanced Study, 1936-1941; Assistant Professor of Physics, Black Mountain College. With a Foreword by Albert Einstein. Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y., 1942. xvi + 287 pp. Illustrated. 15.5 × 23.5 cm. Price, \$4.50.

This book not only appears with the *imprimatur* of Albert Einstein, but contains, p. 253, some hitherto unpublished work by Einstein and Bergmann. The proof-reading has been astonishingly thorough: "mass" for "velocity" on p. 92, and superscript "s" for "5" in equation (18.24) on the very last page of the text, are the only errors the reviewer has found; he has, however, some differences of opinion with the author. The distinction between

Riemannian and Lobachevskian spaces should be preserved, even if it is not of particular interest to the present discussion. The author recognizes, p. 60, that "only when n is 3 is the 'conjugate' tensor density to a tensor of rank 2 a vector density," but still adheres to Hamilton's definition of the vector product. (To one reader, at least, tensor densities seem "excess baggage.") The treatment of relativistic electrodynamics in Chapter VII is distinctly less elegant than that of E. B. Wilson and G. N. Lewis (1912), principally because the author has given the Cartesian interpretation of the derivation, step by step; to the reader who is not prepared to *think* in tensor terms this will not seem a defect.

The convention of calling tensors of negative rank "covariant" and those of positive rank "contravariant" is

not original with Dr. Bergmann, but that does not make it any less confusing.

In view of the use of subscript comma and semicolon to denote, respectively, ordinary and covariant differentiation, it is unfortunate that the equations have been punctuated. The hazards of combining punctuation with mathematical symbols are most amusingly illustrated by the caution on p. 239 "(do not sum over the index r !)." "

"*The Euclidean character of a space depends only on the metric*," p. 162, seems a bit of an overstatement. An observer who found it possible, in a cylinder, to draw infinitely many geodesics between two given points, or who, in a cone of less than 60° vertex angle, found a geodesic intersecting itself, would have ground for questioning the Euclidean character of his space, in spite of the patently Cartesian metric tensor. Similarly on p. 74, "In . . . Riemannian spaces . . . there is, in general, a uniquely determined shortest connecting line between two points." This is certainly not the case for time-like intervals in *de Sitter* hyperspace.

In the matter of gravitational waves, p. 189, it might have been pointed out that in a gravitational collision, as in an electromagnetic collision between particles of like charge and equal mass, there is a first-order compensation of the components of the radiation field.

As for the "Schwarzschild singularity," p. 203, or the absence of plane-wave solutions of the *rigorous*, non-linear field equations, p. 189, what fails is, presumably, the fiction that either the field or the test particle can be unaffected by such extreme conditions.

It is refreshing that "from the point of view of . . . general formalism, there is no difference between the theories of Kaluza, Veblen and Hoffmann, and Pauli" (p. 268).

The book has both a synoptic table of contents and an index, and is so arranged as to suit readers of all grades of interest in the theory of relativity.

ELLIOT Q. ADAMS

Organic Analytical Reagents. By JOHN H. YOE, Ph.D., Professor of Chemistry, University of Virginia, and LANDON A. SARVER, Ph.D., Director of Research, Roanoke Plant Laboratory, American Viscose Corporation. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1941. ix + 339 pp. 2 figs. 15.5 × 23.5 cm. Price, \$4.00.

Analytical Chemistry being a very old branch of the science, it would indeed be difficult to decide who first used an organic derivative or reagent to help identify or determine an element; the use of acetate, tartrate, citrate and other organic groups is far from new, as also are the ether extraction of iron and dimethylglyoxime for nickel. Modern pure analytical, industrial, biochemical and applied medical research, however, has vastly stimulated the application of organic compounds in analytical processes, and this book is an attempt to collect in one place the widely scattered literature dealing with this many-phased subject.

After an introductory Chapter (I), the authors proceed in Chapter II to group the compounds considered into a number of classes, according to their properties or functions: Solvents and Wash Liquids, Substances Used in

Neutralizations, Organic Oxidizing Agents, Organic Reducing Agents, Indicators, Primary Standards (for volumetric analysis), Acidic Salinogenic Compounds, Basic Salinogenic Compounds, Photometric Acids and Substances for the Control of Adsorption, Diazotization and Coupling Agents (for nitrites), Alkaloids and Natural Products. In subsequent chapters are given more detailed theory and discussion of the major type groups of compounds, with many examples.

Organic solvents and wash liquids (Chapter III) may be used for washing and drying vessels and precipitates, lowering solubilities, extracting components of solid and liquid mixtures, displacing equilibria, aiding in distillation or other processes and serving as protective coatings. Most such compounds are hydrocarbons and their derivatives, such as thiols, halides, alcohols, glycols, ethers, aldehydes, ketones, esters, ester acids, amines (23 pp.). Chapter IV on organic acids and bases opens with a section on dissociation constants, lists typical acids and their properties, considers constants of bases and similarly lists a number of them. Organic oxidizing and reducing agents are taken up in six pages (V).

The subject of Indicators is discussed rather lengthily in Chapter VI, on the theory that these compounds are weak acids or bases and their salts, in colored or colorless form, containing chromophore groups which tautomerize or resonate. Many illustrative structural formulas are given, and tables of color changes and other properties, as well as numerous examples. Primary standards in volumetric analysis (Chapter VII) is an old field in which much profitable research has been done; the chapter is not long, since not many organic primary standards are in use. A number are described for alkaline and acid solutions, and a few for oxidimetry (for permanganate, iodine and thio-sulfate).

Chapter VIII on valence and complex compounds seems to begin rather irrelevantly as one reads through a number of pages on the electronic theory of valence, types of linkage, Werner theory, complex compounds and their dissociation, and chelate groups, all this building up to a brief climax of compounds which form characteristic colored products with metals, such as various oximes, oxine, aurin, cupferron and nitrogen and sulfur compounds (with brief mention of isomerism of Werner complexes).

Salinogenic Reagents (Chapter IX) are defined as compounds capable of forming salts with metal or acid ions. The acidic ones are various types of ionizable $-\text{OH}$, $-\text{COOH}$, $-\text{NH}$ and $-\text{SH}$ compounds, while the basic ones are practically all trivalent nitrogen derivatives. Several pages are devoted to a discussion of ionization of the agents, the electronic and strain limitations on ring size and formation, covalent radii, planetary configuration of metal electrons and parachor; the remaining 40 pages list and describe the individual compounds in major and sub classes.

Chapter X (10 pp.) is entitled Photometric Aids: Colloids and Colorimetric Stabilizers, and deals briefly with protective colloids and their uses, the preparation, stabilization and precipitation of nephelometric suspensions. Miscellaneous Organic Reagents are grouped in Chapter XI (9 pp.), listing and describing compounds useful in electro-analysis, titration and a number of special analyses.

Part II consists of the Glossary and Bibliography. Chapter XII (22 pp.) is a listing of the reagents for various metals, ions and processes. Chapter XIII (53 pp.) is an alphabetical listing (with properties and uses) of the reagents considered. The book ends with a Bibliography of 2419 references, many of them as late as 1940, and a subject index. The descriptive theoretical parts of the book are neither extensive nor exhaustive; the rest of the work seems to succeed quite well in achieving its purpose. The typographical design and execution are good (except for a difficult block of matter in Chapter II), and obvious errors are scarce. The book should prove useful to a variety of readers and workers.

ALLEN D. BLISS

Chemical Dictionary. Compiled by F. H. CAMPBELL, D.Sc., F.A.C.I. Chemical Publishing Co., Inc., Brooklyn, N. Y., 1942. 85 pp. 15 × 22.5 cm. Price, \$2.50.

In his introduction Dr. Campbell writes that terms which are known or can be found in textbooks are not included, while on the paper jacket the publishers state, "All chemical terms most commonly used are included." The compiler appears to have tried to effect a compromise between these two aims, for this list does indeed comprise many terms that perhaps should appear, but his obvious interest in physical chemistry has led to the retention of many also that should be replaced as being too rarely encountered to warrant inclusion in so small a volume. Thus enthalpy evaporation, Kurrol salts (but not Graham salt), liminal, and even some German terms are listed, while such new and important terms as co-polymer, chemurgy, precursor, molecular distillation and chemical warfare are omitted. The reference "Hydroxide, see Hydrate" does not conform with recommended practice. A valence table for pre-college students is included as a two-page appendix.

The definitions are often explanatory and informative. A student of chemistry in high school or college would be able to add considerably to his store of special knowledge by a careful study of this book page by page.

WILLIS A. BOUGHTON

War Gases. Their Identification and Decontamination. By MORRIS B. JACOBS, Ph.D. Interscience Publishers, Inc., 215 Fourth Avenue, New York, N. Y., 1942. xiii + 180 pp. 8 illustrations. Cloth. 15.5 × 23.5 cm. Price, \$3.00.

This book is a timely and concise compilation of the properties of chemical warfare agents and the methods for their analysis and destruction in areas and materials polluted by them. The subject matter is drawn from competent sources, including the most recent literature issued by American and British war and defense agencies. Many of the data are given in convenient tabular form.

Chapter I on Classification of the Chemical Agents gives a list of the war gases used or proposed in the last war and the recognized classifications of these gases based on their physiological action, their chemical composition, their physical properties or their tactical use.

Chapter II follows with a paragraph on the important physical and chemical properties and physiological action

of each of the war gases arranged in order of their physiological classification. Further information on chemical properties is given in Chapter III which deals with their effect on water, food and other materials.

Chapter IV on Scheme of Analysis contains a useful table of data from several sources on the minimum detectable odor of war gases and the immediate physiological effect produced by them. The literature on field and laboratory tests appears to be well covered and procedures are concisely stated.

Chapter V (10 pages) is devoted to methods for the detection and estimation of arsenic, with special reference to foods suspected of contamination by Lewisite or other arsenical warfare agents.

Chapter VI gives the confirmatory tests for the identification of agents which have been chemically classified by the scheme of analysis given in Chapter IV. The qualitative procedures given are supplemented by reference to quantitative procedures in the literature.

Chapter VII is a well-arranged and concise description of methods for the decontamination of road surfaces, buildings, household articles, vehicles, clothing, water and food. Proper emphasis is given to the destruction of persistent gases such as mustard gas and the poisonous arsenicals. This chapter and the last one on the protection of foods are based on very recent publications issued by American and British defense agencies.

The book is well printed in legible type and should be very useful to anyone who has had some chemical education and has to deal with chemical warfare agents as an air warden, gas-identification officer or a decontamination officer. War gas chemists will find it a convenient manual for their work.

A. C. FIELDNER

The Physical Examination of Metals. Volume II. Electrical Methods. By BRUCE CHALMERS, D.Sc., Ph.D., F.Inst.P., Physicist, Tin Research Institute, and A. G. QUARRELL, A.R.C.S., Ph.D., F. Inst. O., Lecturer in Metallurgy, University of Sheffield. Longmans, Green and Co., Inc., 55 Fifth Avenue, New York, N. Y., 1941. viii + 280 pp. Illustrated. 14 × 22 cm. Price, \$6.00.

The second volume of "The Physical Examination of Metals, Electrical Methods," carries forward the purpose set forth in "Volume I, Optical Methods." It presents a non-mathematical exposition and discussion of the techniques which have already proved of value to metallurgists or others to whom the examination of metals is important, as well as a discussion of new techniques which show promise. As a series, these volumes will form a convenient and valuable reference.

Under the general title of "Electrical Methods," the authors discuss magnetism, electrical measurements, X-ray diffraction, electron diffraction, the electron microscope and radiography. Each section presents a brief review of theory and general methods and then proceeds to discussion of the application of these methods to specific testing problems. Original references are given for the techniques discussed.

The section on magnetism and magnetic measurements is

introduced by a lucid and rapid review of magnetic theory followed by a description of precision apparatus for making magnetic measurements. Ballistic, oscillographic and general ferrometric methods are discussed. With respect to specific testing, the section on the Magnaflux method is particularly good, there being a detailed analysis of the applicability and limitations of Magnafluxing as well as of variations in technique. Of particular interest to metallurgists will be the sections on ferrographic metallography, the measurement of internal friction, the rapid determination of carbon content and the excellent section on thermomagnetic measurements which supplement routine metallography and are valuable in the identification of new phases. Measurement of the thickness of coatings and platings is also discussed.

In the section on electricity, the authors include a rather complete exposition of methods for making precision electrical measurements. These methods are applied to resistance thermometry, thermoelectricity, thermo-electric pyrometry, piezo-electricity, photo-electricity and electrical measurement of thickness from one side.

The longest and otherwise the most important section of the book is devoted to X-ray diffraction, but the treatment suffers from an attempt to present so much material in the space allotted. In the first place, the authors set up the diffraction problem with a non-vector formulation of the three Laue conditions—a procedure which is always somewhat involved and which, when treated in brief as it is here, adds nothing to the rigor or elegance of the presentation. The simpler Bragg formulation would perhaps have served the purpose better. On the other hand, many of the most important aspects of the diffraction technique are mentioned only in passing—particularly those aspects having to do with interpretation of diffraction patterns, the calculation of relative intensities of pattern lines, and other calculations of practical importance.

The experimental X-ray techniques are quite clearly presented, as are the various aspects of the particle size problem, and there is a very lucid treatment of the solid solution, superlattices and the order-disorder phenomena. Phase diagrams and intermetallic compounds are treated in a brief recapitulation of the work of Hume-Rothery and associates. There is also a short discussion of orientation effects and the effect of deformation upon diffraction patterns.

The section on electron diffraction is interesting and comprehensive. Principles, techniques, apparatus, particularly the Finch Diffraction Camera, are presented in detail. The application of electron diffraction to studies of basal-plane pseudomorphism, oxide layers, surface coatings, the Beilby layer and bearing surfaces is very enlightening. The discussion of the scope and limitations of the technique should be helpful.

Electron microscopy is a new technique which metallurgists are watching closely. Thus far it has proved difficult to adapt the microscope to metallographic use because reflection from a massive specimen has not been possible. The use of transparent surface replicas is at best a cumbersome and uncertain procedure. The authors present an account of the work that has been done in this field and give a detailed discussion of the construction of electron microscopes.

With respect to radiography the authors discuss the requirements for making satisfactory radiographs and the nature of flaws and defects which can be revealed.

The appendix contains data on electrolytic brightening, X-rays, crystal structure, spacing formulas, etc., and wave lengths associated with electrons. The index appears to be adequate.

J. N. HOBSTETTER

A Symposium on Respiratory Enzymes. Addresses given at an Institute held at the University of Wisconsin, September 11-17, 1941 (27 Contributors). The University of Wisconsin Press, Madison, Wisconsin, 1942. xii + 281 pp. Illustrated. 15.5 × 24 cm. Price, \$3.00.

This book contains the following principal articles: Intermediate Carbohydrate Metabolism, O. Meyerhof; Oxidative Mechanisms in Animal Tissues, E. G. Ball; Pasteur Effect, F. Lipmann; Oxidases, Peroxidases and Catalase, K. G. Stern; Nicotinamide Nucleotide Enzymes, F. Schlenk; The Flavoproteins, T. R. Hogness; Cytochromes, E. Stotz; Phosphorylation of Carbohydrates, C. F. Cori; Metabolic Cycles and Decarboxylation, E. A. Evans, Jr.; and Transamination, P. P. Cohen. It also records discussions on hydrogen transport (Potter, Elliott, Ball and Lipmann, Stern and Haas, and Stotz), phosphorylation (Kalckar, Meyerhof, Johnson and Lipmann), tumor respiration (Baumann, Elliott, Potter, Burk and Kensler), bacterial respiration (Peterson, Wood and Burris, Werkman, Barron and Wilson, and Nord and Wilson), and animal tissue respiration (Elvehjem, Shorr, Elliott, Potter, Axelrod, Bernheim, Barron and Stare).

This symposium on respiratory enzymes fulfills the functions of a volume of this type. First, it reflects the best judgment of specialists in various branches of the subject in respect to the interpretation of data now available, and attempts to define the limits to which interpretations of physiological and pharmacological activities may safely be carried in terms of oxidative enzymes; secondly, it provides an up-to-date bibliography of the more important chemical, biochemical, and physiological literature in the field of biological oxidations and records, very satisfactorily in most instances, the advances which have been made in this field since the Cold Spring Harbor Symposium of 1939. During these three years there have been two major advances.

The first deals with the importance of phosphate transfer as a method of biological synthesis and has now reached the stage where phosphorylation can account for a number of chemical mechanisms underlying physiological activities. The paper by Cori and the discussion on phosphorylation supplement the earlier reviews of Kalckar and of Lipmann in bringing out the importance of phosphorylation in the control of carbohydrate metabolism.

The second major advance has been in the use of radioactive and other isotopes in tracing the chemical reactions concerned in the breakdown and utilization of carbohydrate, particularly the utilization of inorganic carbon dioxide by animal tissues to synthesize more complex carbon compounds. Various phases of this subject are here discussed by E. A. Evans, H. G. Wood and R. H. Burris.

The remarks of the latter two investigators should be particularly valuable to chemists and physicists desirous of applying such techniques to biological problems.

The article by F. Schlenk brings together a considerable amount of practical information regarding the properties of diphosphopyridine nucleotide and triphosphopyridine nucleotide which is not otherwise readily available in English.

The discussion on tumor metabolism will no doubt prove interesting to many, since it assembles for the first time much of the data currently available on the metabolism of butter yellow tumors and on the possible mechanism of formation of such tumors.

The book closes with a discussion of methods of handling tissue in metabolic experiments, including reference to certain techniques which have not been mentioned in earlier books on respiratory processes. The remarks of E. Shorr and K. A. C. Elliott on this subject should prove especially useful to chemists and physiologists who are anxious to study the relation of biological oxidations to their particular problems.

M. E. KRAHL

The Stone that Burns. By WILLIAMS HAYNES. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y., 1942. xii + 345 pp. 14.5 × 22 cm. Illustrated. Price, \$3.75.

This timely and readable book is a history of the American sulfur industry. Mostly, it is the story of one man's flash of genius; of Herman Frasch's idea that sulfur deep down in the earth could be melted by steam and while still molten brought to the surface by an air lift. The book covers in detail Frasch's long and almost vain struggle to make this idea work, of his final success and of the great development which this process has experienced in later years.

In the current textbooks of chemistry Frasch's process is presented as something simple and easy. Nothing could be further from the truth. This book is illuminating in making clear the difficulties which even an apparently simple idea encounters in actual large-scale operation.

The latter part of the book, dealing with the period of the first world war and thereafter, is particularly valuable from an historical point of view. It traces in detail the development of the European sulfur cartel, one of the first representatives of this phenomenon destined to play so great and ominous a role in the subsequent economic life of the world. Moreover, it records in detail with abundant documentation the steps in the creation and growth of the great American sulfur companies of today.

This book, however, is more than a monograph on a special chapter of chemical engineering. The story it tells illustrates in a striking way the functioning of our economic system based on the profit motive. Naïve persons are often impressed with the philosophical weakness of this motive and it is true that as society develops this motive requires control. However, the particularized information and factual account of the development of the sulfur industry as given in this book cannot but impress the thoughtful reader with the ceaseless, multifarious, indomitable and ultimately successful operation of the profit motive. So

long as individual initiative can function, so long as men are free, the lure of profit, of useful gain, operates. Driven by it men are unabashed by the most formidable obstacle; they attack first here, then there, again and again and again until it is at last overcome!

ARTHUR B. LAMB

Advances in Colloid Science. Edited by ELMER O. KRAEMER, Ph.D., Biochemical Research Foundation of the Franklin Institute, Newark, Delaware, in Collaboration with FLOYD E. BARTELL, Ph.D., Professor of Chemistry, University of Michigan, Ann Arbor, Michigan, and S. S. KISTLER, Ph.D., Associate Director of Research, Norton Company, Worcester, Mass. Volume I. Interscience Publishers, Inc., 215 Fourth Avenue, New York, N. Y., 1942. xii + 434 pp. 161 figs. 15.5 × 23.5 cm. Price, \$5.50.

Colloid science is not an isolated subdivision of science; rather it cuts across many sciences. The breadth and diversity of its applications are perhaps responsible for the large number of devotees and their almost evangelistic enthusiasm.

The present volume, an outgrowth of this enthusiasm, is the first of a series intended to present new discoveries in colloid science, either experimental or theoretical, in a more comprehensive and unified fashion than is possible in the regular technical periodicals. As to the manner of presentation, the editors say in the Preface, "Since in each instance the author (or authors) will have been closely identified with the development under discussion, it is to be expected that the contributions should have an individualistic point of view, and should show a definite emphasis upon the author's own part in the development in question. The contributions are thus not intended to be reviews or compilations from the literature in the usual sense, and the editors are willing to share any censure that readers may be inclined sometimes to level at an author because he has apparently failed to do adequate justice to other investigators in the field."

This volume contains twelve chapters, as follows:
 "The Measurement of the Surface Areas of Finely Divided or Porous Solids by Low Temperature Adsorption Isotherms," by P. H. Emmett.
 "The Permeability Method for Determining Specific Surface of Fibers and Powders," by R. R. Sullivan and K. L. Hertel.
 "A New Method of Adsorption Analysis and Some of its Applications," by Arne Tiselius.
 "Solubilization and Other Factors in Detergent Action," by James W. McBain.
 "Recent Developments in Starch Chemistry," by Kurt H. Meyer.
 "Frictional and Thermodynamic Properties of Large Molecules," by R. E. Powell and Henry Eyring.
 "The Constitution of Inorganic Gels," by Harry B. Weiser and W. O. Milligan.
 "The Creaming of Rubber Latex," by G. E. van Gils and G. M. Kraay.
 "Streaming Birefringence and its Relation to Particle Size and Shape," by John T. Edsall.
 "Synthetic-Resin Ion Exchangers," by Robert J. Myers.

"The Study of Colloids with the Electron Microscope," by Thomas F. Anderson.

"Anomalies in Surface Tensions of Solutions," by Ernst A. Hauser.

These chapters are all excellently done and are of the greatest interest. Indeed, it is stimulating to see what great progress has been registered recently in every one of the fields covered. Moreover, the fields are so diverse that any reader can be sure to find much that is novel and illuminating.

The editors and contributors are to be complimented on the success of this volume, and the promise that it affords of similar volumes in the future.

ARTHUR B. LAMB

A Course of Instruction in the Qualitative Chemical Analysis of Inorganic Substances. By ARTHUR A. NOYES, Late Professor of Chemistry, and ERNEST H. SWIFT, Associate Professor of Analytical Chemistry, California Institute of Technology. Tenth edition, Revised and Rewritten. The Macmillan Company, 60 Fifth Avenue, New York, N. Y., 1942. xv + 418 pp. 13 figs. 14.5 × 22 cm. Price, \$2.75.

Previous editions of this well known text by the late Professor Arthur A. Noyes have established a standard of excellence that has seldom been duplicated by other texts in the field of qualitative analysis, and in this new edition Professor Swift has wisely retained those features that have been responsible to such a great degree for the success of the previous editions. To quote from the Preface: "The division of the book into two main Parts, entitled The Course of Instruction and The System of Analysis has been retained, and as in the past the laboratory operations of the System of Analysis are described with as great definiteness as possible in short paragraphs entitled Procedures; and each of these is followed by Notes in which are given detailed facts regarding the operations, suggestions as to technique, the precautions necessary and the difficulties encountered in special cases, optional procedures for certain of these cases, and the indications frequently afforded of the presence of various constituents." "As a major change from previous editions, the treatment of the principles and more fundamental chemical facts connected with the procedure have been separated from the Notes and are given as Discussions immediately before the Procedure."

Although the revising author employs modern chemical principles liberally in the Discussions, and the method of treatment follows the best current usage, he has happily preserved a viewpoint that is realistic in its recognition of the complexity of many inorganic reactions and that thus avoids the pitfalls of too extensive and thoughtless application of hyper-simplified principles. For example, in his discussion of hydrogen sulfide separations the author quite correctly relegates to a minor role the dubious conclusions that so often result from the application of over-simplified solubility product reasoning, and stresses instead other important factors, such as complex ion formation, rate of precipitation, absorption and coprecipitation phenomena, which so frequently determine the success or failure of these separations.

Some noteworthy improvements in the Procedures include the use of potassium hydrogen sulfide for the separation of the Copper and Tin Groups, an improved scheme for the analysis of the Tin Group, the employment of isopropyl ether for the extraction of iron in the analysis of the Ammonium Sulfide Group, the complete precipitation of magnesium with the Alkaline Earth Group by means of solid ammonium carbonate, and the use of perchloric acid as a source of hydrogen ion in the Scheme of Analysis for Acidic Constituents, to mention only a very few. Considerable emphasis is placed on the analysis for acidic constituents, and provision is made for the detection of twenty-four anions (in addition to silicate, chromate, and permanganate) by a scheme whose degree of systematization approaches that of the scheme of analysis for the basic constituents, and which involves a minimal number of "side tests." An outstanding improvement in many of the Procedures has been attained by providing for the optional use of centrifugation to eliminate time-consuming filtrations.

During actual class use of this text for a semester the reviewer found only a surprisingly small number of errors, either typographical or otherwise, and only a few minor imperfections in procedural details. The book can be recommended to all those who believe that the primary purpose of a first course in qualitative analysis is to teach inorganic chemistry, rather than specialized techniques.

JAMES J. LINGANE

Annual Review of Biochemistry, Vol. XI. By JAMES MURRAY LUCK, Editor, and JAMES H. C. SMITH, Associate Editor. Annual Reviews, Inc., Stanford University P. O., California, 1942. ix + 736 pp. 16 × 23 cm. Price, \$5.00.

With this volume, the Annual Reviews begins its second decade of a lifetime which has been of inestimable value to the biochemical research worker. The foresight of the original editorial committee is reflected in the unchanged editorial policy and subject matter of the series.

The present volume, in common with those earlier, deals with enzymes, vitamins, carbohydrates, proteins and various aspects of their metabolism. There are additional reviews of topics not so frequently considered. The following, which fall in this category, may be especially recommended: The Chemistry of Visual Substance, by S. Hecht; Avian Biochemistry, by T. H. Jukes and H. J. Almquist; Plant Tissue Cultures, by P. R. White; and Microbiology, by R. Dubos.

WILLIAM F. ROSS

Chemistry and Physiology of the Vitamins. By H. R. ROSENBERG, Sc.D. Interscience Publishers, Inc., 215 Fourth Avenue, New York, N. Y., 1942. xix + 674 pp. 25 figs. 15.5 × 23.5 cm. Price, \$12.00.

This is the first attempt which has been made to cover the chemistry and physiology of all the vitamins in a single volume, and a very successful attempt it is, too. The book is beautifully arranged. There is first an introductory chapter on the vitamins in general, which contains precise

definitions of all of the terms to be used (although a definition of "enzyme" is, curiously enough, not given), a brief account of the history of the discovery of the vitamins, an explanation of nomenclature in this field, a list of the identified and unidentified vitamins and an outline of the methods of attack which various scientists, in their coöperative efforts, use to discover and elucidate the nature of a vitamin, together with the most important procedures that are employed. The specificity of the vitamins is here handled in a general way, along with the analytical methods which must be used, and then follows a brief discussion of the physiology and pathology which are connected with the vitamins. This first chapter is, in itself, an excellent general discussion of the whole subject of vitamins; with very minor changes it could be read with great profit by any individual who had no training in science but who wished to know something about what vitamins are, how they are discovered, how prepared, and how used, together with the "whys" of these questions.

Then follow separate chapters covering each of these vitamins: The A's, B₁, B₂, B₆, Nicotinic Acid, Pantothenic Acid, Inositol, *p*-Aminobenzoic Acid, C, the D's, the E's, H (Biotin), the K's, P, the non-identified Vitamins (the other B's, the L's, all the various factors such as T, U, Folic Acid, the Grass Juice Factor, etc.). Next come chapters on the Vitagens—Essential Fatty Acids, the Essential Amino-Acids, the Essential Carbohydrates and Choline, and the Essential, Transferable Methyl Group.

Within each major chapter, the material is systematically arranged into sub-topics, in general as follows: 1. Chronology, a brief table giving the "highlights" in connection with the development of the vitamin; 2. Occurrence; 3. Properties; 4. Isolation; 5. Chemical Structure; 6. Synthesis; 7. Industrial Methods of Preparation; 8. Biogenesis; 9. Determination; 10. Specificity; 11. Physiology; 12. Hypo- and Hyper-vitaminoses; and 13. Requirements. These topics are discussed in an authoritative and very entertaining manner. The citations are extremely numerous and are numbered by chapters, and there are over three thousand of them. The book closes with three very excellent indexes—patent, author, and subject—the preparation of which is a considerable achievement in itself.

It is possible that some specialists might consider their particular specialties to be treated in too elementary a manner, all the more so since books of approximately this same size could be written about almost any one vitamin, and have been written about some of them. But the reviewer found that those vitamins with which he is most familiar were treated comprehensively enough, and he thought these particular chapters were all the better for not having been written too exhaustively. It must be remembered that this is a book on "The Vitamins," and it is the first book of its kind to appear. Nowhere else is there, between the covers of one volume, so much information covering all the aspects of the whole field.

Dr. Rosenberg has worked in the laboratories of Ruzicka and of Reichstein; he was present in Zürich when Karrer announced the successful isolation of essentially pure vitamin A; and he has been, since 1936, engaged in researches on vitamins and hormones at the Jackson Laboratory of E. I. du Pont de Nemours and Company. Thus he has

been active in this field for about fifteen years. It seems almost incredible, yet this short time has witnessed almost the whole of the development of the true chemistry of the vitamins. Although the pace is no longer quite as rapid as it was, yet it is still rapid enough, for almost literally while the ink was drying on the pages of this book, many important contributions in the field of the vitamins appeared. Thus, to mention only a few, it was shown that vitamin A₂ was definitely devoid of any activity and a new structure was proposed,¹ a new synthetic vitamin E factor was announced,² α -tocopheryl acetate was crystallized,³ and new and accurate determinations of vitamin B₁⁴ and of α -tocopherol⁵ were published. One has to be daring, and to be possessed of a spirit of great eagerness, even to think of writing a book covering the whole of such an active field, and Dr. Rosenberg has done the job very well indeed. One could say, of course, that "this book fills a long-felt want," and he would be telling the truth—but it is even more than that. If the tired and busy chemist would like to have something he can read while relaxing and thoroughly enjoying himself; something authoritative and important, but which at the same time is easy to read and is exciting—this is it.

There are few errors in the book, and those few are, for the most part, rather obvious. Such things, for instance, as the use of "hydrocyanic" where "isocyanic" is meant on page 388; the use of "active" instead of "inactive" on page 409; and a few obvious mistakes in correcting the structural formulas. The printing and binding are excellent, and the only real criticism the reviewer has concerns the price of the book. Here is a book which merits a very wide circulation, but it is to be feared that the high price will effectively bar it from the libraries of the younger scientists and the general scientific reader, where it really belongs. This is a pity.

(1) Karrer, Geiger and Bretscher, *Helv. Chim. Acta*, **24**, 161E (1942).

(2) Smith, Renfrow and Opie, *THIS JOURNAL*, **64**, 1082 (1942).

(3) Robeson, *ibid.*, **64**, 1487 (1942).

(4) Kirch and Bergelm, *J. Biol. Chem.*, **143**, 575 (1942).

(5) Mayer and Sobotka, *ibid.*, **143**, 695 (1942).

LEE IRVIN SMITH

The Dynamic State of Body Constituents. By RUDOLF SCHOENHEIMER, M.D., Late Associate Professor of Biological Chemistry, Columbia University. Harvard University Monograph in Medicine and Public Health, Number 3. Harvard University Press, Cambridge, Mass., 1942. x + 78 pp. 6 figs. 15.5 × 23.5 cm. Price, \$1.75.

The death of a scientist at the height of his intellectual powers and while engaged upon a problem of great importance is a tragic thing. In the case of Rudolf Schoenheimer, it is especially tragic since the problem had been brought so far toward solution that the results he had attained have already modified the current course of biochemical thinking.

The use of isotopes in the study of intermediary metabolism will, of course, continue, and probably at a rapidly accelerating pace. The application of these new techniques is a matter of such fundamental importance as far

to transcend the fate of the individual, whatever this may be. Accordingly it is fortunate that an opportunity was presented to Schoenheimer, by the invitation of Harvard University to deliver the Edward K. Dunham Lectures in the autumn of 1941, to bring together the whole of his labors with deuterium and the heavy isotope of nitrogen into a brief and simple account, unobscured by technical details.

These lectures have now appeared in the present slim volume. The first deals with the reactions of the body fats, the second with the state of the body proteins, and the third with the role of structural elements in the formation of excretory products. The thesis is developed that all components of the tissues are in a dynamic state and are constantly involved in rapid chemical reactions. If suitable starting materials are provided, all chemical reactions which the animal is capable of performing are carried out continually. No other conclusion is possible from the evidence afforded by the behavior of the isotopes used to trace the fate of various compounds administered to animals maintained in a state of nutritional equilibrium.

A brief preface explains that the printed lectures represent revisions by his colleagues from drafts prepared by the author, and there is, in addition, a biographical note and appreciation of Schoenheimer by Professor Hans T. Clarke who delivered the lectures and edited the manuscript.

H. B. VICKERY

The Nature of Thermodynamics. By P. W. BRIDGMAN, Hollis Professor of Mathematics and Natural Philosophy in Harvard University. Harvard University Press, Cambridge, Mass., 1941. xii + 229 pp. Illustrated. 21 X 14 cm. Price, \$3.50.

Fifteen years ago in "Logic of Modern Physics" Bridgman made a notable contribution to epistemology by emphasizing that physicists, and similar scientists, actually acquired knowledge by operational procedures. Philosophers have been too much impressed with the finished products of the older and more theoretical sciences and have given too little attention to the ways in which scientists actually learn. Thus he joined the group containing C. S. Peirce, Wm. James, H. Poincaré, and L. J. Henderson, of scientists who philosophize, who for the most part do not labor their philosophies so much as the professional philosophers, but who bring to them the new ideas suggested from actual acquaintance with concrete phenomena.

In "The Nature of Thermodynamics" the author applies his operational analysis in detail to this difficult field. One can hardly fail to gain the impression that the sledding is a bit harder, but he is making a further and very useful effort to make clear whether the operations involved are instrumental or "paper and pencil" procedures. Especially to be noted is the discussion of the light thrown on methods of treating some irreversible phenomena by Bridgman's own researches. Those looking for "finality" and "finish" will be disappointed at such a frank assertion as: "I believe that no epistemology can be logically rigorous, but between rival epistemologies it can only be a question of which is logically the most tolerable in a particular set-

ting." This is, however, true pragmatism, it is the method of getting ahead with the business of acquiring science; everything breaks down if pushed too far and practically no theory, surely no working hypothesis, subsumes all the known facts of its subject matter but shuts its eyes to some which are too stubborn.

Whether agreeing with him or not, every student of thermodynamics, that perplexing subject where things may not be too large without failing to satisfy equilibrium conditions nor yet too small without revealing fluctuations, will profit by the study of Bridgman's treatment of its nature.

EDWIN B. WILSON

BOOKS RECEIVED

August 10, 1942–September 10, 1942

ROGER ADAMS, Editor-in-Chief. "Organic Reactions." Volume I. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 391 pp. \$4.00.

DONALD E. H. FREAR. "Chemistry of Insecticides and Fungicides." D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. 300 pp. \$4.00.

REYNOLD C. FUSON and H. R. SNYDER. "Organic Chemistry." John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 506 pp. \$3.50.

ANTONIO P. GUERRERO. "New Commercial and Technical Dictionary, Spanish-English, English-Spanish." Chemical Publishing Company, Inc., 234 King Street, Brooklyn, New York. 600 pp. \$10.00.

HARRY N. HOLMES. "Strategic Materials and National Strength." The Macmillan Company, 60 Fifth Avenue, New York, N. Y. 106 pp. \$1.75.

KURT H. MEYER. "Natural and Synthetic High Polymers." (High Polymers, Volume IV, edited by H. Mark, E. O. Kraemer and G. S. Whitby.) Translated by L. E. R. Picken. Interscience Publishers, Inc., 215 Fourth Avenue, New York, N. Y. 690 pp. \$11.00.

WILLIAM RIEMANN, III, JACOB D. NEUSS and BARNET NAIMAN. "Quantitative Analysis. A Theoretical Approach." McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York, N. Y. 496 pp. \$3.50.

C. A. ROJAHN. "Preparación de Productos químicos y químico-farmacéuticos." ("Preparation of Chemical and Chemical-Pharmaceutical Products.") 2 Volumes. Translated and considerably amplified by Professor Francisco Giral. Editorial Atlante, S. A., Mexico. D. F. 1002 pp. \$11.00.

LEE IRVIN SMITH, Editor-in-Chief. "Organic Syntheses." Volume 22. John Wiley and Sons, Inc., 440 Fourth Avenue, New York, N. Y. 114 pp. \$1.75.

"Studies of the Institutum Divi Thomae." Volume III, No. 1, November, 1941. Published by Institutum Divi Thomae of the Athenaeum of Ohio, Cincinnati, Ohio. 222 pp.