crotyl alcohol, while the 3.7 *N* acid had produced less ether and more alcohol, 7 g. of each. Since the problem requires a careful study of the effect of the acid concentration on the proportion of hydration, ether formation and alcohol rearrangement, we wish to record the fact that mobility may be induced in this supposedly stable allylic system even at low temperatures. The possibility that butenyl sulfates are involved in the rearrangement is being investigated.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CALIFORNIA AT LOS ANGELES
LOS ANGELES, CALIFORNIA
WILLIAM G. YOUNG
KENZIE NOZAKI
RUTH WARNER

RECEIVED JULY 31, 1939

NEW BOOKS

Lehrbuch der organischen Chemie. (Textbook of Organic Chemistry.) By PAUL KARRER, Professor in the University of Zurich. Sixth, revised and enlarged edition. Georg Thieme Verlag, Rossplatz 12, Leipzig C 1, Germany, 1939. xxiii + 689 pp. 6 figs. 17.5 × 24 cm. Price, RM. 34; bound, RM. 36.

The sixth German edition is practically identical with the English edition recently reviewed in these pages [THIS JOURNAL, 61, 756 (1939)]. The new subject matter in the sixth edition (which is also incorporated in the English translation) includes only the section on organic deuterium compounds (five pages), a page on ergot alkaloids and half a page on phthalocyanins. Other topics have been brought up to date, especially in the active fields of natural products. In the preface the author calls attention to a greater inquiry into reaction mechanisms than in previous editions. The change in this regard seems slight, the text retaining its almost purely descriptive character.

PAUL D. BARTLETT

The Oxidation States of the Elements and their Potentials in Aqueous Solutions. By WENDELL M. LATIMER, Ph.D., Professor of Chemistry, University of California. Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y., 1938. xiv + 352 pp. 16 × 24 cm. Price, $3.00.

The usefullness of thermodynamic data is determined by the carefullness with which they have been obtained, the clearness with which they are presented and the convenience with which they may be used. Judged by these criteria Latimer has achieved a remarkably successful volume. The author has endeavored to include references to all works published up to 1938. The results of these investigations are presented concisely in a series of tables in the appendix. The first two give E^0 values for several hundred half cell reactions, one for acid solutions and one for alkaline solutions. Then follows a table of free energies of formation and one giving equilibrium constants, arranged alphabetically by the elements. The next table gives values for the activity coefficients of strong electrolytes and the last gives values for the entropy of elements, compounds and ions. If the volume contained only these thirty pages of tables it would be invaluable.

For the convenience of students who are not working in the field of physical chemistry, the first two chapters give an introduction to the use of the tables. These chapters discuss the subject of units, conventions, general methods employed in the determination of oxidation–reduction potentials, ionization potentials, electron affinities, lattice energies, and their relation to standard oxidation–reduction potentials. A section of the appendix serves as a guide in the use of activity coefficients and the concept of the ionic strength. Although these chapters of a general nature are designed to make the remainder of the volume useful they will also serve as a convenient review of the most often used portions of thermodynamics for students of organic and inorganic chemistry.

Nineteen chapters follow these first two general sections, taking up in detail the chemistry of the elements arranged by families. Here an investigator interested in any particular element will find gathered together the available thermodynamic data and references to the literature. These data are interpreted and applied to the chemical behavior of the element. Where no data are available the author frequently has given estimates, which will be useful guides to those without a background of long experience in this field.

This volume will not only constitute an essential part of every chemist's reference library but will also introduce students who wish to use physico-chemical data to the elements of thermodynamics.

HENRY E. BENT

Inorganic Quantitative Analysis. By HAROLD A. FALES, Ph.D., Columbia University, and FREDERIC KENNY, Ph.D., St. Francis College. Second edition. D. Appleton-Century Company, Inc., 35 West 32nd Street, New York, N. Y., 1939. xiii + 713 pp. 132 figs. 15 × 22.5 cm. Price, $4.00.

The educational philosophy of this excellent book is contained in the following sentences from the preface: "It has been the aim of the authors, in preparing this work, to apply the principles of Physical Chemistry to the theory of Quantitative Analysis in a detailed and thorough manner. In stressing this point of view, it has not been forgotten, however, that the two other

aspects of the subject, namely, technique and methods, play an equally important part in the education of the analyst." This is the pattern of nearly all the recent books in Analytical Chemistry and therefore such a book must be judged by the ratio of theory to techniques and methods. No one, however, knows what the correct ratio is, and therefore authors should not be criticized for using a given ratio. In this book there is a full measure of theory and as far as possible the techniques and method of analysis are presented from the standpoint of theory. This is also followed in the arrangement of the subject matter, as is shown by the departure from the traditional division into gravimetric and volumetric analysis.

The general techniques and the detailed procedures for carrying out the laboratory exercises are well done. At the end of each chapter is a list of problems, and there is a long appendix with a table of five-place logarithms, specific gravity tables and tables of equivalent units of the metric and English systems of weights and measures. The appendix also contains such mathematical derivations as are deemed too advanced for the text.

The chapters on precision, weighing and calibration of weights are particularly good in the wealth of information they contain. The use of organic reagents and solvents is presented in a chapter of 22 pages, and 38 pages are given to a chapter on Photometry. So much space to these subjects is unusual in a book of this kind, and, to the reviewer at least, the chapter on Photometry seems out of balance. It is nearly all theory with only one laboratory exercise, the determination of free ammonia in water. There are no exercises in turbidimetric or nephelometric methods. In the excellent chapter on electrometric methods there is no mention of the simple and accurate differential and dead-stop end-point systems of titration which require scarcely more electrical equipment than a galvanometer. The old method of determining sodium by difference is given but there is merely a literature reference to one of the triple acetate methods. These points, however, are but differences of opinion between the reviewer and the authors. Perhaps the authors are right. At any rate the reviewer likes the book and commends it heartily to students of analytical chemistry.

C. W. FOULK

Kinetik der Phasenbildung. (Kinetics of Phase Formation.) By Dr. MAX VOLMER, Professor and Director of the Division of Physical and Electrochemistry of the Institute of Technology of Berlin. Verlag von Theodor Steinkopff, Residenzstrasse 32, Dresden-Blasewitz, Germany, 1939. xii + 220 pp. 61 figs. 15.5 × 22.5 cm. Price, RM. 14.25; bound, RM. 15.

This book presents a new case—older ones are the phase rule, the Donnan equilibrium, the galvanic cell, the correlation between adsorption and surface tension—where a seed sown by Willard Gibbs and fallen, as it were, on barren land, begins to grow after many years, when touched by the moisture of true understanding. An equation given by Gibbs for the formation of a first droplet of a second liquid phase in the interior of an infinite mass of another one, which was independently re-derived by Volmer, is one fundament on which the book is based. Some others are: a molecular kinetic formulation of the continuous formation and growth of liquid nuclei and of the discontinuous formation and growth—already preconceived by Gibbs—of crystalline nuclei.

As important results of this theoretical treatment may be mentioned: a quantitative agreement as to the rate of nuclei formation in vapors of different liquids on adiabatic expansion and as to the influence of pressure upon the temperature to which a liquid may be overheated; Wilhelm Ostwald's "metastable limit" and his frequently observed rule, that the newly formed phase is generally an instable one, may be understood; the production of nuclei is enormously favored at interfaces;—this explains that "cavitation," *i. e.*, the disrupture of a liquid under the influence of supersonic waves, also occurs mainly at interfaces (reviewer's remark).

It may be hoped that many puzzling phenomena in meteorology and, particularly, in the formation of Liesegang's rings (*e. g.*, the influence of light, the similarity of complicated ring systems with wave patterns) will soon become clearer, when attacked by these new methods.

Volmer's most interesting book is very lucidly arranged: 1, a historic survey; 2, the transport of molecules from one phase to another; 3, general theory of supersaturation and of nuclei formation; 4, special kinetic treatment and comparison with experimental results (droplets in gases, bubbles in liquids, formation of crystalline nuclei in the interior of phases and at interfaces, etc.); 5, nature of new phase (primary formation of instable phases); 6, structure of new phase (growth of nuclei, etc.). Nevertheless, this book is no easy reading, because exactness of theoretical conception and derivation is the author's first law and because his "thermodynamical dialect," mainly based on Gibbs' thermodynamical potential μ, is somewhat unusual.

H. FREUNDLICH

Lehrbuch der anorganischen Chemie. (Textbook of Inorganic Chemistry.) By Prof. Dr. ERNST H. RIESENFELD. Second, revised edition. Verlag von Franz Deuticke, Helferstorferstrasse 4, Wien, Germany, 1939. xxvii + 706 pp. 90 figs. 17.5 × 25.5 cm. Price, M. 14; bound, M. 16.

The reviewer found this textbook most useful when looking up recent developments of general and inorganic chemistry. Chapters which have been treated with particular thoroughness are those on the structure of atoms (isotopes, natural and artificial radioactivity, etc.), on metals and their compounds, on crystal structure, and on complex salts. The author frequently refers to the biochemical importance of the elements. Many recent technical applications are described.—The age in which the book has been published has left a rather curious mark: gas masks are mentioned no less than five times in different chapters.

The book is well arranged and well written; an abundance of facts has been collected. There were only very few, where the reviewer did not find the information he looked for: the polarographic method, now used more and more in analytical chemistry, is not mentioned; Brönsted's conception of acids and bases has been treated rather too briefly.

H. FREUNDLICH

The Chemistry of Organic Compounds. A Year's Course in Organic Chemistry. By JAMES BRYANT CONANT, President of Harvard University, Revised with the Assistance of MAX TISHLER, Ph.D., Merck and Co. The Macmillan Company, 60 Fifth Avenue, New York, N. Y., 1939. x + 658 pp. 35 figs. 15 × 22 cm. Price, $4.00.

This admirable text, the first edition of which appeared six years ago, has now been revised with due consideration, not only to the useful newer chemical reactions, but also to the trends of organic chemistry in the direction of industry, and of biological chemistry and physical chemistry. Actually there have been added but thirty-five additional pages, yet this fact does not in any sense indicate the extent of revision, as the book has been modernized in a very effective and pleasing manner. There is a commendable choice of industrial applications. The electron theory of valence has been extended. The concept of resonance has been interestingly introduced in connection with the guanidinium ion, and elaborated further in the treatment of aromatic compounds. Indeed, wherever appropriate, there has been shown the importance of physical chemistry to organic chemistry. New and interesting information has been given on topics of biochemical significance including hormones, vitamins, sugars and proteins. The chapter on heterocyclic compounds has been enlarged. The last two chapters dealing with "Plant Pigments" and with "Advanced Topics in Stereochemistry" should certainly be provocative of interest and thought to students looking forward to advanced courses.

This is a scholarly, well-written book, which should take a front rank position among the newer organic chemistries. It is refreshing to read a text which, like the present one, departs from the stereotyped.

ARTHUR J. HILL

Photochemistry and the Mechanism of Chemical Reactions. By GERHARD K. ROLLEFSON, Ph.D., Associate Professor of Chemistry, University of California, and MILTON BURTON, Ph.D., Instructor in Chemistry, New York University. Prentice-Hall, Inc., 70 Fifth Avenue, New York, N. Y., 1939. xiv + 445 pp. 58 figs. 16 × 23.5 cm. Price, $5.75.

An excellent comprehensive survey of modern photochemistry. Following a brief introductory chapter, the authors summarize those portions of the quantum theory of atomic and molecular spectra which are necessary for an empirical understanding of spectral notation, selection rules, and potential energy curves. Fluorescence and photodissociation are discussed in two well-written chapters on the physical and chemical effects following the absorption of light. A chapter on photochemical kinetics summarizes the principles and methods used in the determination of secondary reaction mechanisms, and gives particular attention to the reactions of free atoms and radicals. In the next chapter, on photolysis in the solid state, the authors assume the de Boer "perforated lattice" model and interpret existing data, chiefly on the alkali and silver halides, on the basis of this model. The remaining two-thirds of the book is devoted to a critical summary and discussion of existing data on a large number of photochemical reactions. Most of the cases discussed involve reactions in gases, but chapters on reactions in solution and on heterogeneous reactions are included. Photography and photosynthesis, considered as photochemical processes, are interestingly discussed in the chapter on heterogeneous reactions. Useful appendices on spectral notation, bond and dissociation energies, and activation energies are included.

The experimental technique of photochemistry is not systematically discussed, although certain specialized techniques are referred to at various places in the book. Owing to the order of discussion which the authors have adopted, certain reactions will be found treated in part in one chapter and in part in another. Thus, the mercury sensitized dissociation of hydrogen is discussed in chapter 3 and again in chapter 10, the photolysis of hydrogen bromide is taken up in chapter 7, its synthesis in chapter 11, and the discussion of the photographic latent image is divided between chapters 6 and 15.

The book reflects very clearly the extent to which modern photochemistry is interrelated with spectroscopy on the one hand, and the elementary reactions of free atoms and radicals on the other, and the change in emphasis in the subject during recent years is illustrated by the fact that the law of photochemical equivalence is mentioned at only two places, while these interrelations receive much attention throughout. The book is authoritatively and clearly written and the reviewer agrees with the contention of the authors that it is possible for a person using it to "find himself with a working understanding of what has been done and an appreciation of what is still needed" in photochemistry.

PHILIP A. LEIGHTON

Calculations of Quantitative Chemical Analysis. By LEICESTER F. HAMILTON and STEPHEN G. SIMPSON. Third edition. McGraw-Hill Book Company, Inc., 330 West 42d Street, New York, N. Y., 1939. 293 pp. Price, $2.50.

Among the more difficult parts of chemistry for the elementary student to grasp thoroughly are the calculations involved in analytical work. Hamilton and Simpson have attempted to remedy this by presenting all the types of calculation concerned in a clear and concise manner under one cover, with such success that the previous editions of this book achieved wide popularity. Almost every imaginable type of problem is covered, both in explanation and in the many problems which accompany the text.

The present third edition retains the good features of the old with many improvements. The chapter on oxidation and reduction has been considerably modernized, and the sections dealing with electrolytic processes and with indicators have undergone a needed expansion. A discussion of methods of weighing also has been added, which omits, however, the method of single swing weighing. The calibration of weights also has been left out. One might also have wished for some consideration of the relative concentration of ions in solution at the end-point in oxidation–reduction titrations. The rules for balancing equations seem needlessly complicated and do not appeal to me.

On the whole, however, the book is excellently written, and should continue to be a standard text for teaching and student reference in this field.

J. C. MORRIS

Experimental Methods in Gas Reactions. By A. FARKAS and H. W. MELVILLE. The Macmillan Co., 60 Fifth Ave., New York, N. Y., St. Martin's Street, London, 1939. 389 pp. Price $7.50.

Until now the graduate student and research worker in the field of gaseous reaction kinetics have had to depend largely upon verbal exchange and chance gleanings from the literature for their information as to the techniques available in the field. Too often valuable methods have been confined to individual laboratories or have suffered untimely burial in the back files of magazines. It is true that there have been monographs on special phases such as the technique of achieving and measuring vacua, but before this there has been no attempt to provide a volume on technique in this entire field in which technique plays such an important role.

Because of this the present book by A. Farkas and Melville is an important and noteworthy one, the more especially so when the general excellence of the work is considered. Hardly a stone has been left unturned to make it a complete compendium. All the common problems of experimental method in connection with homogeneous, photochemical, and catalytic gas reactions, and many of an unusual nature have been covered. The chapter headings, Kinetical Gas Theory, Apparatus for Control of Pressure and Temperature, Preparation and Analysis of Gases, Photochemical Technique, and Experimental Methods for the Investigation of Chemical Reactions, do not give an adequate picture of the wealth and variety of material contained in the book. For example, the last chapter covers such widely varied and important topics as the construction of reaction vessels, measurement of the progress of the reaction, the theory and operation of flow systems, production and reactions of free radicals, preparation of catalysts and operation of catalytic systems, electrical activation, and the investigation of explosions and flames. Other chapters are as rich in the material considered. The procedure of the book is to present some of the major methods in considerable detail and to give many others in concise, though generally adequate form, with appropriate literature references in case further information is wanted. This allows a greater coverage than would be otherwise possible. The value of the book is further increased by the inclusion of many tables of properties of gases and gaseous systems, arranged in convenient form for the kineticist.

It is naturally difficult in a book of wide scope to maintain the same high plane throughout, particularly in one which is a pioneer. In the present instance the discussions on the construction of furnaces for high temperature work, and the automatic control of high temperatures is rather inadequate. For example, the use of solid metallic blocks for attaining even temperature distribution at elevated temperatures is not considered, nor are photoelectric devices for the regulation of temperature, of which at least one excellent type is on the market. In some instances the methods given for the preparation of gases seem not the best available, or are rather incomplete. There are other less important omissions. All these, however, are minor flaws.

One's guess is that graduate students should welcome this book with open arms, and that more mature research workers should find it of considerable inspiration and assistance. Although by its nature it will serve chiefly as a reference work for the solution of specific problems, nevertheless a straight through reading gives a fine conception of general possibilities, and may, as in the case of the reviewer, furnish suggestions for improvement of technique in unexpected places.

The book is quite free from typographical errors in the text itself, but it should be noted that in several instances the labelling on diagrams does not agree with the text explanation of them.

J. C. MORRIS

Respiratory Enzymes. Compiled under the direction of C. A. ELVEHJEM and P. W. WILSON, University of Wisconsin. Burgess Publishing Company, Mimeoprint and Photo Offset Publishers, 426 South Sixth Street, Minneapolis, Minn., 1939. x + 236 pp. 21.5 × 27.5 cm. Price, $3.28.

Different individuals in several Departments at the University of Wisconsin, interested in respiratory enzymes, were assigned, for seminar purposes, topics such as, the oxidases, dehydrogenases, hydrogen-carriers, coenzymes, etc. Their reports make up the different chapters in the book.

In gathering together the material from the current literature sufficient background from older work has been included so as to furnish an appropriate perspective for setting forth that which seems most significant in recent contributions. The presentation is well done and quite complete bibliographies are given. The authors have rendered a valuable service in bringing together in one volume a convenient survey of the current knowledge in this field of research.

J. M. NELSON

Textbook of Organic Chemistry. By E. WERTHEIM, Professor of Organic Chemistry in the University of Arkansas. P. Blakiston's Son and Company, 1012 Walnut Street, Philadelphia, Pennsylvania, 1939. xiv + 830 pp. Illustrated. 16.5 × 24 cm. Price, $4.00.

There is need for a variety of textbooks of different kinds so that the teacher may select the one adapted to his particular needs. At one end we have an outline which is to be filled in and supplemented by the teacher as he wishes; at the other end a book which comprises a large amount of information from which the teacher may select. The present text is an example of the latter kind. Comprehensiveness is its outstanding characteristic. In its 800 well-printed pages there is a deal of information, much more than can possibly be assimilated by any one student in his first year. This gives the teacher the opportunity for selection and provides the exceptional student with additional information which will interest him and

lead him on. The book is succinctly but clearly written; its size is due to the amount of material included.

The first 374 pages deal with aliphatic compounds, the next 230 with aromatic. Then come terpenes, dyes (36 pp.), alicyclic, heterocyclic, alkaloids, proteins, chemistry of the human body (12 pp.) and identification of organic compounds (14 pp.). There are a number of features not usually found in textbooks. Scattered throughout the book, without any relation to the context, are pictures with biographical sketches of 46 chemists besides Emil Fischer as a frontispiece. These are mostly moderns. The U. S. is represented by Remsen, Franklin, Baekeland, Gomberg, Stieglitz, Bogert, G. N. Lewis, Nieuwland, Whitmore, Adams, Adkins, Conant, Gilman and Kharasch.

At the back of the book there are flow sheets of a number of industrial processes, a list of books on organic chemistry, a glossary of chemical terms and a table of physical properties of some 600 organic compounds. At the end of each chapter there are a number of review questions and also literature references.

The book will make a useful text for teachers who like an abundance of material and will be useful to students and others as a compendium of information on organic chemistry. It includes many new developments such as vitamins and sex hormones.

E. EMMET REID

Fortschritte der Chemie organischer Naturstoffe. Eine Sammlung von Zusammenfassenden Berichten. (The Chemistry of Natural Products. A Collection of Review Papers.) Edited by L. ZECHMEISTER. Vol. I. Verlag von Julius Springer, Linkstrasse 22–24, Berlin W 9, Germany, 1938. vi + 371 pp. 41 figs. 16 × 24 cm. Price, RM. 28.

This timely collection contains comprehensive surveys to the middle of 1938 of the following subjects: Neuere Richtungen der Glykosidsynthese, by G. Zemplén, The Component Glycerides of Vegetable Fats, by T. P. Hilditch, Recent Advances in the Chemistry of Sterols, by I. M. Heilbron and F. S. Spring, Cozymase, by F. Schlenk and H. v. Euler, Nucleinsäure, by H. Bredereck, Chlorophyll, by H. Stoll and E. Wiedemann, and Anwendung physikalischer Methoden zur Erforschung von Naturstoffen, by O. Kratky and H. Mark.

It fills a real need for an organ for the presentation of current advances in that field of organic chemistry closely related to physiological processes. Although the chemistry of such investigations gradually finds its way into advanced organic texts, this normally occurs after the topic has been fully developed. For the presentation of subjects still in a fluid and developing state this medium is well suited.

The reviewer feels that more emphasis might be placed on the biological functions of the compounds considered, the few pages devoted to this phase of cozymase or coenzyme I being quite inadequate for the proper presentation. But he might well turn to the more biological publications, as the Ergebnisse der Enzymforschung, for their detailed treatment, and leave this publication for their chemical consideration. Thus have the editors, perhaps wisely, decided.

The fortunate choice of authors to discuss each of the fields selected for the first volume, supported by the good workmanship of the publisher, makes certain the scientific success of this volume, and it is sincerely hoped by the reviewer that it may be feasible to continue the series.

WILLIAM F. ROSS

Handbuch der Lebensmittelchemie. A. BÖMER, A. JUCKENACK and J. TILLMANS. Fünfter Band. **Getreidemehle, Honig, Zucker, Früchte, Gemüse.** (Handbook of Food Chemistry. Vol. V. Flour, Honey, Sugar, Fruits, Vegetables.) Edited by A. JUCKENACK, F. BAMES, B. BLEYER AND J. GROSSFELD. Verlag von Julius Springer, Linkstrasse 22–24, Berlin W 9, Germany, 1938. 1048 pp. 332 figs. 17.5 × 26 cm. Price: RM. 135; bound, RM. 138.60.

This volume represents the collaborative efforts of ten authors, all of them well known as contributors to *Zeitschrift für Untersuchung der Lebensmittel.* Eight chapters are devoted to the five foods which form the subject matter of this member of the *Handbuch.* Four are unique in that there is appended to each a sub-chapter on the microscopy of the food, or food product, in question. This feature is the work of one author, C. Griebel, who has written also the separate chapter (29 pages) on the microscopical examination of vegetables, potherbs and edible mushrooms.

The chapter headings and the authors responsible for the contents of each are: cereals, legumes and flour (116 p.) and bakery products (42 p.) by K. Täufel; alimentary pastes (37 p.) by R. Strohecker and R. Vauble; fruits and fruit products (198 p.) by A. Beythien; honey and imitation honey (63 p.) by W. Bartels; sugar and sugar products (121 p.) by J. Grossfeld; vegetables and vegetable products (78 p.), and fungi and mushrooms (15 p.) by O. Windhausen. Griebel, besides his contribution already noticed, treats in a masterly manner the microscopy of the starches and flours (93 p.), honey (18 p.), bakery products and baker's yeast (9 p.), and fruits, fruit products and the diseases of fruits (35 p.). The book closes with digests, written by F. Bames, of the foreign (31 p.) and Austrian food laws (7 p.). At greater length are presented the pertinent German laws (108 p.) by H. Holthöfer.

Space does not permit of a critical review of each chapter; all constitute in themselves a literary accomplishment and an authoritative presentation of the subject with a liberal use of literature citations and illustrations. Comment on a typical one, however, will suffice to illustrate the general excellence of this work.

Bartels has done food chemistry, and the honey industry in particular, a grateful service by bringing together the scattered and often times not readily accessible, newer information on the composition of honey. Griebel's use here of his original microphotographs of pollen grains adds greatly to the value of the whole chapter. The analytical aspects of the subject are given full treatment to the end that the whole constitutes an invaluable aid to the analyst.

This volume, also, rightfully deserves a place among its six predecessors in the series, for by collecting and collating the vast amount of authoritative scientific and technical matter on the several subjects in question it has performed a service not only for food chemistry in

particular, but for its allied fields of botany, biology, physiology, and agriculture as well.

H. A. SCHUETTE

Annual Review of Biochemistry. Vol. VIII. Edited by JAMES MURRAY LUCK and JAMES H. C. SMITH. Annual Reviews, Inc., Stanford University P. O., California, 1939. ix + 676 pp. 16 x 23 cm. Price, $5.00.

Volume VIII of this very useful publication continues the high standard that has been set by the previous volumes. The editor and editorial committee have shown excellent judgment in their choice of topics and have been unusually successful in their efforts to keep the size of the individual articles within reasonable bounds without sacrificing clarity of presentation or omitting mention of papers of real importance. Several of the contributors point out that exhaustive review is quite impossible within the space available, but add lists of papers not otherwise mentioned which serve to extend the ground actually covered. In spite of their deprecatory statements, little that is of moment to the average biochemist has been overlooked.

The excellent policy of frequent change in the authorship of the reviews has been continued. Owing to the appearance of a companion volume, Annual Review of Physiology, reviews of purely physiological topics are this year restricted in number while the field of biochemical topics is extended. Thus the present volume contains articles on Polysaccharides and Lignin, by K. Freudenberg; Ruminant Nutrition, by H. R. Marston; X-Ray Studies of the Structure of Compounds of Biological Interest, by W. T. Astbury; Growth Hormones in the Higher Plants, by F. W. Went; The Biochemistry of Yeast, by E. I. Fulmer; and Animal Poisons, by C. H. Kellaway; none of which has been dealt with recently if at all. The field of enzymes is divided, K. Linderstrøm-Lang having prepared the review of the Proteolytic Enzymes and K. Myrbäck that on Nonproteolytic Enzymes.

It is interesting to note the increase in space occupied by the proteins. Whereas in Volume III, in 1934, two articles were sufficient, in the present volume there are five if the two enzyme reviews may be included in this field with Astbury's paper already mentioned, A. Tiselius' article on The Chemistry of Proteins and Amino Acids, and R. W. Jackson and J. P. Chandler's on the Metabolism of Proteins and Amino Acids.

Several subjects receive attention every two years. In Volume VIII, these are The Chemistry and Metabolism of the Compounds of Sulfur, by G. Medes; Metabolism of Brain and Nerve, by J. H. Quastel; The Alkaloids, by L. Small; Chemical Aspects of Photosynthesis, by H. Gaffron; Mineral Nutrition of Plants, by J. W. Shive and W. R. Robbins; and Immunochemistry, by M. W. Chase and K. Landsteiner. Mineral Metabolism, by D. M. Greenberg has not been reviewed since 1936 and is restricted to Calcium, Magnesium, and Phosphorus, and choline has not been dealt with since 1935: the present review by C. H. Best and J. H. Ridout of Choline as a Dietary Factor is of particular interest since most of the work on this aspect of choline chemistry has been accomplished since that date.

The lipids are discussed in two sections, that on Lipid Metabolism by W. M. Sperry and that on The Chemistry of the Acyclic Constituents of Natural Fats and Oils, by R. J. Anderson and L. F. Salisbury. Carbohydrate Metabolism is reviewed by I. L. Chaikoff and A. Kaplan, Hormones by J. Freud, E. Lacqueur and O. Muhlbock, The Water-Soluble Vitamins by C. G. King, and the Fat-Soluble Vitamins by E. M. Nelson and C. D. Tolle. The review of Biological Oxidations and Reductions was prepared by M. Dixon.

A subject and an author index are included, and an errata sheet for several previous volumes is prefixed. The Editors regret that a review of Nucleic Acids, Purines and Pyrimidines failed to arrive in time for inclusion. The international aspect of this publication is emphasized by the fact that only 13 of the 25 contributions are from American laboratories; three are from English, two from Australian, and one from a Canadian source, while Germany and Sweden each provide two, Denmark and Holland each one.

H. B. VICKERY

An Introduction to Crystal Chemistry. By R. C. EVANS, M.A., Ph.D., B.Sc., Demonstrator in the Department of Mineralogy and Petrology, University of Cambridge. Cambridge University Press: The Macmillan Company, 60 Fifth Avenue, New York, N. Y., 1939. xi + 388 pp. 113 figs. 14.5 × 22.5 cm.

Since von Laue's discovery of the diffraction of X-rays by crystals in 1912, the study of atomic arrangement in solids has gone through three stages. In the first stage the laws of X-ray diffraction were developed and methods of structure analysis established. Next, the structures of an enormous number of crystalline materials were worked out, and the most important features of each structure tabulated in reference works such as Wyckoff's "Structure of Crystals" and the "Strukturbericht." In the third stage, an attempt is made to find correlations in these results, to seek out the fundamental principles which determine the structures, to relate the structures to fundamental properties of the atom and theories of chemical bonding, and to find the relationship between crystalline structure and physical properties. It is this third stage of the work which is called crystal chemistry.

The present book is an excellent introduction to this field. The author has carefully avoided making it a Strukturbericht, that is, describing structures, and as a secondary matter pointing out principles. Instead he has written the book around fundamental principles, and described only those structures which are well adapted to illustrate the principles. It is very evident that the author has put in a great deal of care and thought in the organization of the material. In a book on crystal chemistry, which is to remain of reasonable size, it is obviously impossible to include everything which various readers might desire. The Pauling–Slater theory of directed valence bonding could have been given in more detail, and a number of examples, which are here treated from the purely ionic point of view, could be shown to be equally amenable to treatment as homopolar bonding with the bond directions given by the theory. The intricate arrangement of the hydrogens in ice proposed by Bernal and Fowler is presented, but no mention is made of Paul-

ing's result that a randomness in the arrangement gives the correct entropy discrepancy.

The book is very readable, and the figures and printing are clear. It can be highly recommended as a textbook or for reading by anyone interested in the present status of the structural chemistry of solids.

B. E. WARREN

Crystalline Enzymes. The Chemistry of Pepsin, Trypsin and Bacteriophage. By JOHN H. NORTHROP, Rockefeller Institute for Medical Research. Columbia University Press, 2960 Broadway, New York, N. Y., 1939. xv + 176 pp. Illustrated. 16 × 23.5 cm. Price, $3.00.

Dr. Northrop's book is an elaboration of his Jesup Lectures, delivered at Columbia University in 1938. It brings together for the first time the studies by which he and his associates have fundamentally clarified the nature and kinetics of enzyme action. The book should be reviewed by a chemist as well as by a biologist, since the latter must take much for granted which his experimental experience is not adequate to appraise with precision. However, in the case of an investigator of Dr. Northrop's distinction, such blind acceptance is not a risk.

The part of Northrop's work which has aroused the greatest interest among biologists is that which deals with the isolation and crystallization of enzymes. After Willstätter's preparations of highly purified enzymes in 1928, it was generally believed that, since his active solutions did not give protein or carbohydrate reactions, neither of these substances was concerned with enzyme activity. But since that time, much evidence has been presented which indicates that Sumner's crystallized urease, Northrop's crystallized pepsin, trypsin and chymo-trypsin, and Anson's carboxypeptidase, as well as the amylase, papain and lysozyme preparations of other investigators, are simple proteins. Warburg's respiratory ferment is a conjugated protein and, unlike the others, has been shown to contain a prosthetic group.

Northrop is, of course, more than others less experienced in protein chemistry, aware of the fact that constant composition after repeated crystallization is not alone proof of purity in the case of proteins, and that the usual criterion of purity—melting point determination—is not applicable, since proteins decompose before melting. He has, therefore, added to his crystallization studies solubility measurements, based on Willard Gibbs' phase rule (for the conclusiveness of which this bacteriologist is unfortunately compelled to take Dr. Northrop's word); rate of sedimentation in the ultracentrifuge; quantitative relation between protein and proteolytic activity; parallelism between alkali-denaturization and loss of activity; proportionate recovery of activity with reversal of alkali-denaturization on standing near neutrality (Anson and Mirsky); constancy of activity per milligram of protein as pepsin solution is slowly inactivated at 50° and *p*H 1.8, conditions under which protein is rapidly hydrolyzed; and parallelism between inactivation and loss of native protein under ultraviolet light. He has thus followed Pasteur's historic advice and neglected no available methods to prove himself wrong—that is, to disprove the identity of his crystallized enzymes and the protein molecules comprising them. To the present reviewer it appears that there is no question of the truth of his conclusions and, indeed, their validity is no longer disputed except by isolated critics who must assume the "burden of disproof" against a mass of affirmative evidence adduced with precise experimentation and authoritative knowledge of protein chemistry.

Among the most significant of Northrop's results are his experiments on the reactivation of purified enzymes after inactivation by simple chemical and physical procedures. The most interesting of these are the acetylation experiments with pepsin. Purified pepsin was acetylated by treatment with ketene and the activity observed to decrease as the acetylation proceeded. An acetylated preparation was obtained in crystalline form which had only 60% of the original activity. When such material was subjected to treatment with $N/1$ sulfuric acid under suitable conditions the specific activity increased to the value of pure pepsin while the acetyl contents decreased from nine to four acetyl groups per molecule. The experiments, which cannot be dealt with in detail, appear to indicate that acetylation of the primary amino groups changes the activity by 10% or less, whereas addition of acetyl groups in other places causes marked decrease.

The demonstration that enzyme activity—which, in the last analysis, is the fundamental factor of metabolic activity and therefore of life processes—depends upon molecular alterations of apparently pure proteins (of molecular weights ranging from 35,000 to 70,000), is obviously a matter of fundamental importance to science in general. To the bacteriologist, however, who is dealing with problems of parasitism and with infections by ultramicroscopic virus agents, these studies are of particular importance. There can, of course, be no question that these "active" enzyme proteins are products of synthetic cell metabolism. And considering the specific nature of the enzymes produced by cells in various locations of the animal body, one must assume a chemical "director" which in each cell type determines the nature of the synthesis which leads to the building up of each particular enzyme. From this, considering the crystallization of at least one type of virus agent ("mosaic," by Stanley), it is not an intellectual trapeze act to postulate the possibility that virus agents, which have been shown experimentally to depend for multiplication on the metabolism of the living susceptible cell, may be products of abnormal autocatalytic action initiated by seeding an active enzyme system (a living cell) with small amounts of the end-product. The conception of such a "directed" synthesis is actually demonstrable in the study of bacterial dissociation; the best example being that observed with pneumococci. It has been possible in this group, for instance, to suppress by suitable manipulation the synthesis of the type specific carbohydrate of the virulent organisms, producing thereby a relatively non-virulent "rough" organism. By subjecting this rough culture to contact with dead virulent organisms containing its own or another type carbohydrate, these organisms can be made to resume the synthesis and grow out as virulent cultures of the original type or of some other, according to that of the dead organisms added. In other words,

carbohydrate synthesis is re-established and chemically directed by the addition of the respective "type" polysaccharide under suitable conditions. There is much that points in the same direction for virus agents, which play such an increasingly important role in medicine and which exhibit many of the properties of enzymes—except that they are immensely larger (10,000,000 molecular weight and above) and have not so far been observed to increase except by "seeding" living cells with pre-existing virus. Northrop has worked along these lines with bacteriophage, the formation of which—probably a nucleoprotein—from the bacterial cell he compares to the rapid increase of pepsin when small amounts of pepsin are inoculated into pepsinogen solutions. The analogy is an apt one, though as far as virus agents are concerned, the crucial experiments are still lacking. Moreover, among the virus agents, where the variation of size and chemical complexity ranges from the crystallizable probably pure protein of Stanley to the visible elementary bodies of vaccinia ($m\mu$ 200+) which appear to contain protein, carbohydrate and lipin, it is by no means clear whether we are confronted with synthetic or polymerized cell products, or with parasites that have degenerated to the extent of losing their own enzyme systems. However, until decisive experiments can be devised, it is wise to discourage speculative garrulousness which, in this zone between the "animate" and "inanimate" too often spreads from the legitimate ground of the biochemical or biophysical into what we may call the bio-metaphysical.

In pursuit of the analogy between enzymes and virus agents, immunological phenomena are of considerable importance, since there is no longer any doubt about the fact—whether one favors the intrinsic autocatalytic origin of virus or conceives them as extraneous parasites degenerated to the point of "borrowing" their metabolic enzymes, that these agents are "antigenic"—that is, sufficiently alien to the body chemistry as a whole to stimulate antibody response. Enzymes have long been regarded as possessing such "antigenicity," resembling in this sense "organ specific" proteins such as those of the lens of the eye, spermatozoa, etc. For Kunitz and Northrop's trypsin, Ten Broeck has shown such antigenic activity, as has Seastone for crystallized pepsin. These experiments, while not entirely satisfactory, still indicate adequately that, in producing enzymes, the cells are capable of building up within themselves a protein antigenically foreign to the general species antigen.

A review of this book by anyone except an experienced protein chemist must necessarily be incomplete. To the biologist it represents an achievement that cannot help making him happy to be living in an era in which biochemistry and biophysics are carrying biology out of its vagueness into the precision of chemical definition and quantitative methods.

HANS ZINSSER

BOOKS RECEIVED

July 15, 1939, to August 15, 1939

ARTHUR K. ANDERSON. "Essentials of Physiological Chemistry." Second edition. John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y. 323 pp. $2.75.

WALLACE R. BRODE. "Chemical Spectroscopy." John Wiley and Sons, Inc., 440 Fourth Ave., New York, N. Y. 494 pp. $6.00.

NEIL CAMPBELL. "Qualitative Organic Chemistry." D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y. 213 pp. $2.60.

JAMES ARNOLD CROWTHER. "Ions, Electrons and Ionizing Radiations." Seventh edition. Longmans, Green and Co., Inc., 114 Fifth Ave., New York, N. Y. 348 pp. $4.00.

LOUIS DE VRIES. "German-English Dictionary." McGraw-Hill Book Co., Inc., 330 West 42d St., New York. N. Y. 473 pp. $3.00.

RALPH E. DUNBAR. "Visual Outline of General Chemistry." Longmans, Green and Co., Inc., 114 Fifth Ave., New York, N. Y. 348 pp. $0.75.

THOMAS C. GREGORY, Editor. "Uses and Applications of Chemicals and Raw Materials." Reinhold Publishing Corp., 330 West 42d St., New York, N. Y. 665 pp. $10.00.

FRANCIS CLINT GUTHRIE AND JOHN TRENGOVE NANCE. "Cumming-Kay: A Textbook of Quantitative Chemical Analysis." Seventh edition. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, N. Y. 496 pp. $5.00.

ROZELLE PARKER JOHNSON. "Compositiones Variae. From Codex 490, Biblioteca Capitolare, Lucca, Italy. An Introductory Study." University of Illinois Press, Urbana, Ill. 116 pp. $1.50.

H. R. MAUERSBERGER AND E. W. K. SCHWARZ. "Rayon and Staple Fiber Handbook." Third edition. Rayon Handbook Co., 303-305 Fifth Ave., New York, N. Y. 832 pp. $4.50.

PERCY MAY AND G. M. DYSON. "Chemistry of Synthetic Drugs." Fourth edition. Longmans, Green and Co., 114 Fifth Ave., New York, N. Y. 370 pp. $6.00.

HARIDAS T. MAZUMDAR. "Gandhi Triumphant." Universal Publishing Co., 20 Vesey St., New York, N. Y. 103 pp. $1.00.

CARL OPPENHEIMER, KURT G. STERN AND W. ROMAN. "Biological Oxidation." Nordemann Publishing Co., Inc., 215 Fourth Ave., New York, N. Y. 317 pp. $8.25.

LINUS PAULING. "The Nature of the Chemical Bond and the Structure of Molecules and Crystals." Cornell University Press, 124 Roberts Place, Ithaca, N. Y. 429 pp. $4.50.

J. F. THORPE AND M. A. WHITELEY. "Thorpe's Dictionary of Applied Chemistry. Vol. III. Chemical Calculations-Diffusion." Fourth edition. Longmans, Green and Co., Inc., 114 Fifth Ave., New York, N. Y. 608 pp. $25.00.

RAYMOND FRANCIS YATES AND S. A. PELLERANO. "How to Make and Use a Small Chemical Laboratory." Norman W. Henley Publishing Co., 2 West 45th St., New York, N. Y. 140 pp. $1.00.