NEW BOOKS

Laboratory Manual of General Inorganic Chemistry. By M. CANNON SNEED, Professor of Chemistry, University of Minnesota, and RAYMOND E. KIRK, Assistant Professor of Chemistry, University of Minnesota. Ginn and Company, 15 Ashburton Place, Boston, Massachusetts, 1927. xvii + 181 pp. 61 figs. 14 × 21.5 cm. Price $1.20.

This manual follows the order of Sneed's "General Inorganic Chemistry." More experiments are included than will normally be performed by any single class. Topics of a diversified nature have been selected to give the instructor a choice of material. Specific directions regarding the amounts of material are given wherever possible. The manual contains directions for 246 experiments divided into 44 divisions or chapters, which deal with the usual groups of the periodic table and special topics such as atomic theory, gas laws, molecular weights, calculations, solution, equilibrium and speed, ionization, periodic system, oxidation and reduction, thermo-chemistry, colloids, chemistry of living processes and many special directions for inorganic preparations. The manual contains many excellent line drawings of apparatus.

EDWARD MUELLER

Laboratory Manual of Inorganic Chemistry and Elementary Qualitative Analysis. By C. C. HEDGES, Head of Department of Chemistry and Chemical Engineering, and H. R. BRAYTON, Professor of Inorganic Chemistry in the Agricultural and Mechanical College of Texas. D. C. Heath and Company, 239 West 39th Street, New York City, 1927. 233 pp. 16.5 × 23 cm. Price $1.48.

This manual is intended for college students who receive from three to five hours weekly of laboratory instruction. It is printed on one side of gummed, perforated paper (interleaved with paraffined sheets) and parts of directions may thus be torn out to paste in the notebook in which the student records his data. For convenience the work is outlined by weeks and it is suggested that the "start-stop" method of instruction be used: when a number of experiments have been performed emphasizing a general principle the entire group is halted for a discussion; then new experiments are begun. The manual indicates considerable effort to solve the problems of "mass-education."

The manual is divided into two parts. The first deals with general principles and common materials such as oxygen, hydrogen, valence, acids, bases, salts, various non-metallic elements, ionization, some proximate tests of textiles, of vegetable oils, of soap, etc. The second part deals with the properties of metals, and qualitative analysis. The experimental work is simple; no complicated or expensive apparatus, an important factor with large classes, is required. This manual will interest particularly those teachers who are confronted with the handling of large classes in elementary chemistry.

EDWARD MUELLER

The Constitution of Glass. A series of Papers Reprinted from the Journal of the Society of Glass Technology. Edited by W. E. S. TURNER, D.Sc. The Society of Glass Technology, Darnall Road, Sheffield, England, 1927. vii + 191 pp. 62 figs. 14 × 22 cm.

As the title indicates, this is not a new work, but a reprint, including ten papers by thirteen authors. Eight of the papers, including the leading article by Professor Turner himself, formed part of a general discussion held in 1925 on the "Constitution of Glass," while two others were contributed later. They are here assembled, repaged and indexed for convenience of reference.

ROBERT B. SOSMAN

Kinetic Theory of Gases: Being a Text and Reference Book Whose Purpose Is to Combine the Classical Deductions with Recent Experimental Advances in a Convenient Form for Student and Investigator. By LEONARD B. LOEB, Associate Professor of Physics in the University of California. First edition. The McGraw-Hill Book Company, Inc., 370 Seventh Avenue, New York City, 1927. xvi + 555 pp. 76 figs. 15.5 × 23.5 cm. Price $5.50.

The author has been "much hampered by lack of a handy reference book containing a collection of the classical and more modern aspects of the kinetic theory." The book was written "in an attempt to meet this situation." The reviewer finds no reference in the acknowledgments made in the preface to J. H. Jeans' fine treatise now in its fourth edition, although in the text this most important work in the field is referred to abundantly.

The book reviews in six chapters the classical kinetic theory in elementary fashion. A chapter is devoted to the interesting investigations of Knudsen and there is also included a brief discussion of the "Brownian" movement. The chapter of the "Handbuch der Radiologie," vol. 6, written by P. Debye entitled "Theorie der electrischen und magnetischen Molekulareigenschaften" has been partially translated and makes an appropriate addition to the volume. The concluding chapter on the application of kinetic theory to the conduction of electricity in gases is in the field of the author's work and is well and interestingly written.

The important problem of the distribution of velocities in a molecular stream is touched upon by the author and some confusion may disturb the mind of the reader regarding the quantity "average velocity of the molecules in the stream." The author computes (p. 99) the root mean square value $\sqrt{\bar{c}^2} = \sqrt{4kT/m}$ but designates it the average value which can be found to be $\bar{c} = \sqrt{9/8\ \pi\ kT/m}$. The discussion of the equation of state which is of particular interest to the physical chemist is of the usual textbook variety and all reference to the work of the last fifteen years is lacking. Even the fact that the Joule experiment has been successfully performed has escaped the author's notice. In this connection

also it is noted that the calculation of the cohesive pressure as a/v^2 is made to depend on an integral $2\pi/3\ n^2 \int_0^\infty \phi(r)\ r^3 dr = a$. This integral has passed from one book to another for a long time, although it is clear that the lower limit must be from the distance of contact of the molecules, as for example the diameter, for spheres. The treatment of the properties of real gases is on the whole perfunctory.

The treatment of the viscosity of gases is of the standard elementary type and the rather illusory "Sutherland theory" is reproduced, which is disappointing in view of the elegant treatment of the temperature dependence of gaseous viscosity given so long ago by Enskog and Chapman. Passing on to the subject of the viscosity of liquids the author states that, "Hence the viscosity in liquids is governed by cohesive forces entirely and shows little dependence on density." This is odd since the cohesive pressure is mainly a function of the volume. Moreover, Figs. 36, 37 and 38 show immediately that the viscosity is very much a function of the volume. The author has evidently overlooked entirely H. B. Phillips' interesting treatment of the viscosity of liquids now some six years old.

The most important problem of the theory of gaseous diffusion is treated in twenty pages and the Fourier series formula (p. 233) is incorrectly given.

The review of low pressure phenomena is very welcome and the thoughtful reader will be impressed with the great amount of work both theoretical and practical which remains to be accomplished. The review of the question of so-called "Thermal Transpiration" is well done and it is hoped will be improved in a future edition because of its very fundamental connection with molecular forces.

The author has discussed the magnetic deflection of atomic streams but the treatment leaves much to be desired. It is hoped that few readers will prove as naïve as the author in supposing that a final and unambiguous decision has been reached regarding the quantization of magnetic moments which it is stated has "been definitely proved by a direct and unmistakable experiment." Certainly many serious minds will be relieved if it turns out that the "switch into position" of the elementary magnets is caused by the existence of a stray field of a few gauss in the "oven chamber." It is interesting to note in this connection that for the moment the analogous electric-field experiment shows no quantization of molecular dipoles.

It would be ungracious not to commend the final chapter on electrical conductivity of gases. The author is evidently more at home in this field and one can only regret that more space was not given to this subject where the problem fairly bristles with difficulties which should intrigue the interest of the really interested student of nature.

F. G. KEYES

Statistical Mechanics with Applications to Physics and Chemistry. By RICHARD C. TOLMAN, Ph.D., Professor of Physical Chemistry and Mathematical Physics, California Institute of Technology. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 419 Fourth Avenue at 29th Street, New York, 1927. 334 pp. 15.5 × 23.5 cm. Price $7.00.

The author has never demonstrated his courage more conspicuously than in the present successful attempt at a presentation of the much abused subject of Statistical Mechanics; a subject which however and by whomever belabored has never refused to yield at least what was already well known. Professor Tolman has evidently "lived with" his subject long enough to know its pitfalls, its elegancies and its possibilities. Indeed its richness in possibilities must remain, at least for a long time yet, one source of its intriguing interest. The chemist in particular must ultimately cultivate the subject seriously since, as the author points out, certain chemical phenomena are often especially susceptible to the mode of thought.

Professor Tolman's treatment of mechanics (classical) is brief but the work of the English masters in this subject is readily available and the eight pages suffice. The properties of "Statistical Ensembles" is in the opinion of the reviewer too brief, certainly, for chemists who as a class are only beginning to formulate their ideas in symbols. The Ergodic hypothesis (most readers would perhaps prefer Maxwell's term "principle of continuity of path") receives deserved and competent discussion and the author's form of statement should prove acceptable. The reviewer hopes the treatment in the next edition will be expanded.

The introduction into statistical mechanics of the so-called quantum theory (Chapter 7) gives rise to many problems, especially in the absence of any final form of the quantum theory. The difficulties, however, detract but little from the usefulness of the development since, as the author points out, Einstein's general considerations relative to absorption and emission and Bohr's energy level relations provide much of the solid material required for the extension of statistical mechanics.

The subject of gaseous specific heats is treated and for hydrogen in particular. The general subject is of the most fundamental and practical importance to chemists. Why the directly observed values of the specific heat of hydrogen at higher temperatures (1600–2000°) should continue to be "explained" quantum-wise is still puzzling since too much is explained in view of the fact that a considerable fraction of hydrogen's apparent specific heat at these high temperatures is absorbed by dissociation of the molecules. The whole theory of gaseous specific heats is, however, in its infancy.

The presentation relative to the most probable state of a system is based very largely on the treatment of Ehrenfest and Trkal, the notation of which is not altogether enticing. The method of deducing the value of the special Dirichlet integral $\int \ldots \int dx_1\, dx_2\, dx_3 \ldots dx_m$ is also in-

elegant. A proof of some generality, modeled for example after that in Augustus de Morgan's "Differential and Integral Calculus," p. 678, might perhaps appeal more to many readers.

The vapor pressure of crystals, glasses and gaseous equilibrium follows. The latter treatment only makes progress under the limitation of constant specific heat capacities. Many readers will undoubtedly leave the demonstration (Chapter 14) with the feeling that the difficult problem of calculating a gaseous equilibrium by statistical mechanics is far from solved.

Chapters 15, 16, 17, with those dealing with chemical reaction rate, are in the writer's best vein. The Chapter 19 as relates to transport problems could well have been omitted. The reference to Knudsen as the discoverer of the relation $p_2/p_1 = \sqrt{T_2}/\sqrt{T_1}$ is an error (section 251, page 207), as a reference to Maxwell's papers, Vol. 2, p. 708, will show. The discussion of reaction rate theory is frankly from the particular point of view of the author, which requires no apology.

The volume is an important and welcome addition to the American Chemical Society Series of Scientific Monographs.

F. G. KEYES

Tabellen zur allgemeinen und speziellen Mineralogie. (Tables for General and Special Mineralogy.) By DR. PAUL NIGGLI, Professor of Mineralogy at the University of Zürich. Gebrüder Borntraeger, Berlin, Germany, 1927. xvi + 300 pp. 228 figs. 17 × 25 cm. Price, bound, 9.3 M. ($2.25).

Niggli's comprehensive three-volume "Textbook of Mineralogy"[1] is too expensive to be owned by every worker in the subject, much as he would like to have it always at hand; while the Departmental Library's copy of so useful a work is always likely to be in the temporary possession of some borrower. Hence these tables, condensing and making readily accessible the principal facts and classifications of the larger work, have been issued at a price within the reach of all. There are seven tables (25 pp.) in general crystallography, followed by 161 pages of determinative tables, based primarily upon crystallographic criteria and secondarily upon habit and luster. This is the core of the book. Next follow classifications of the common minerals, based upon color and hardness, streak, density, forms of growth, and manner of occurrence (28 pp.). Tables of the uses of minerals (25 pp.) make an interesting digression. A well-illustrated grouping of the rock-forming minerals according to optical properties and certain other features observable under the microscope (52 pp.) completes the book. If one were assembling a half-meter shelf of books to stand beside the petrographic microscope, this book should certainly be among them.

ROBERT B. SOSMAN

[1] For reviews of Vols. 1 and 2 see *Nature*, **119**, 595 (1927); THIS JOURNAL, **49**, 1389 (1927). Vol. 3 is in preparation.

Annual Survey of American Chemistry. Vol. II. July 1, 1926 to July 1, 1927. Edited by CLARENCE J. WEST, Director, Research Information Service, National Research Council. Under the auspices of the Division of Chemistry and Chemical Technology, National Research Council, William J. Hale, Chairman. The Chemical Catalog Company, Inc., 419 Fourth Avenue, New York, 1927. 415 pp. 13.5 × 21.5 cm. Price $3.00.

In the preparation of the first volume of the "Annual Survey of American Chemistry" the unique plan was adopted of dividing the science into a large number of topics of limited scope and having experts, active in research, report on the work in their particular fields. The plan led to well balanced, authoritative reviews and proved to be more satisfactory than the procedure adopted in similar publications in which the authors covered a wide range of subjects often far from their own intimate experience. The second volume of the survey is a marked improvement over the first as the result of the extension of the subjects treated. Physical chemistry is now covered more adequately. The present volume contains chapters on theories of solution, gases and gas mixtures, phase rule equilibrium data, thermodynamics, colloids, catalysis, photochemistry, crystal structure and x-rays. The recent advances in inorganic and organic chemistry both pure and applied are well covered. Fifty-one of the leading research workers in the country have contributed to the volume. An author index adds to the value of the book. As a similar index was not prepared for the first volume it is included here.

The book will be of great value to everyone interested in the growth of chemical knowledge. In these days of extreme specialization and high pressure activity no one can find time to read adequately and broadly. It is a privilege to have an expert tell us what has been done in his own particular field.

The only adverse criticism the reviewer has heard of the annual surveys is that they cover American research only; chemistry knows no national boundaries; why should the scope be limited? Very practical reasons, which must be self-evident to any one, led to the restriction imposed. It is to be earnestly hoped that the success of the present venture will lead to an annual survey of world chemistry prepared as the result of international coöperation, and following the plan of having limited fields reviewed by a large number of active investigators.

An examination of the book will give the reader a large amount of information of value, because American chemists are taking a leading place in research. He will learn what our universities and great industrial research organizations are producing—what his friends, acquaintances and men whose names are known to him are doing in chemistry. The study of the survey by graduate students is much to be desired. Their interest in chemistry will be developed. Their desire to attend scientific meetings will be aroused if they know who are the active workers and

what they are doing. In short they will be inspired to read more and do more; and every good teacher preparing men for a life work in chemistry has this ideal continuously before him. "The Annual Survey of American Chemistry" will help.

JAMES F. NORRIS

Anleitung für das organisch-chemische Praktikum. (Laboratory Manual of Organic Chemistry.) Third, revised edition. By Dr. FRANZ WILH. HENLE, former lecturer at the University of Strassburg. Preface by Prof. Dr. J. Thiele. Adakemische Verlagsgesellschaft m.b.H., Leipzig, Germany, 1927. xii + 308 pp. 55 figs. 14.5 × 22.5 cm. Price, unbound, 12 M; bound, 14 M.

Mistakes which appeared in the second edition have been eliminated in this new edition. Additional sketches of apparatus, directions for ten new preparations and rewritten directions for a number of others have been included. Numerous new literature references appearing since 1920 have been added to the various experiments.

Most instructors who have had other than very beginning classes in organic laboratory are familiar with one of the earlier editions of this book. In case there are those who do not know it, it may be stated that the manual includes ninety preparations of widely varying type. A large number of references are given after each preparation, which have to do not alone with the individual preparation involved but with its homologs and with its more important reactions with which a student should be familiar. It is noticeable that the author has, for the most part, limited his references to the German literature, though in many instances pertinent investigations have appeared in the foreign literature.

Anyone who has occasion to teach organic chemistry laboratory classes should have this volume at hand.

ROGER ADAMS

The Methods of Organic Chemistry, a Laboratory Manual. By C. W. PORTER, T. D. STEWART and G. E. K. BRANCH, Members of the Faculty of the College of Chemistry in the University of California. Ginn and Company, 15 Ashburton Place, Boston, Massachusetts, 1927. vi + 311 pp. 35 figs. 14.5 × 21.5 cm. Price $2.00.

The appearance of a new laboratory manual in organic chemistry is of such common occurrence that a reviewer is inclined to read it rather critically to determine what it may contain that is novel. This book, designed either for a one or two semester course, is divided into five parts—(I), Mechanical Operations; (II), Organic Preparations; (III), Class Reactions—a System of Qualitative Analysis; (IV), Acids, Bases and Indicators; (V), Quantitative Analysis.

Part I, which covers distillation, extraction, filtration, etc., describes not only how the operations are carried out, but at the same time it is written in such a way as to impress the reader with the fundamental principle involved in each operation. Great care has been taken to go

into such detail that a perfectly clear understanding of what is meant by vapor pressure, boiling point, fractional distillation, etc., is made possible. This chapter appeals to the reviewer as superior to others which are found in manuals of this sort.

Part II on Organic Preparations does not appear to have anything characteristic about it. The preparations are, of course, selected to cover a wide range of type reactions. Two experiments might be mentioned which are not found in one or another of the laboratory manuals now available—the preparation, illustrating a Grignard reaction, of diphenylcarbinol from benzophenone and ethylmagnesium bromide, and the preparation of tetraphenylpinacol by the action of ultraviolet light on an alcohol solution of benzophenone. Each of the approximately fifty experiments is followed by questions pertinent to the preparation involved.

Part III on Qualitative Analysis consists of over 100 pages and is designed, as is stated by the authors, for the primary purpose not of identification of individual compounds, but for the determination of characteristic groups or radicals and the development of a thorough understanding of class reactions. The usual manual attempts to give only a very little space, or none at all, to this important part of organic chemistry. In this chapter the discussion of the various reactions as to general applicability and limitations is excellent. From the experimental standpoint the value of the chapter is doubtful. After a student is familiar with the material presented it is questionable whether, if given an unknown, he would be in a position to identify the class of substances to which it belongs. Certainly he would have to use an undue amount of time or to have a large amount of help from the teacher.

A few points of interest in connection with the material in this chapter might be mentioned. For determining the Du Claux constants on volatile acids, previous writers have always advised phosphoric or sulfuric acids. These authors use nitric acid. It is surprising that this acid does not occasionally lead to difficulties on account of the low boiling point, 120°, of the constant boiling mixture with water. The authors have used hydroxylamine for identifying aldehydes and ketones; it has been found in the laboratory of the reviewer that in general phenylhydrazine is easier to use and more often gives good results. Nitrous acid has been selected for distinguishing primary, secondary and tertiary amines, whereas in the reviewer's experience benzene sulfonyl chloride has been found in general to be more suitable for this use. Frequently the tests are based on titrations and other quantitative methods, when in many instances the same information could be obtained by simple qualitative tests. Naturally, a procedure developed along the quantitative line will require much more time to produce the same results.

Part IV, a valuable addition to the book, discusses in detail acids,

bases and indicators, and brings out as is done in no other elementary organic manual the important facts and principles involved.

Part V on Quantitative Analysis is comparatively brief and no attempt is made to go into great detail about the various procedures.

ROGER ADAMS

Lehrbuch der Cellulosechemie. (Textbook of Cellulose Chemistry.) By DR.-ING. EMIL HEUSER, Hon. Professor at the Technical High School of Berlin. Third Edition. Gebrüder Borntraeger, Schöneberger Ufer 12a, Berlin W. 35, Germany, 1927. xi + 278 pp. 3 figs. 16 × 24.5 cm. Price 16.80 M.

The appearance of a third edition within seven years is some index of the popularity and general excellence of Dr. Heuser's textbook on cellulose chemistry. The author maintains his previous position in dealing with cellulose as a chemical individual, in stressing the fundamentals and in relegating empiricism and technology to a subordinate place. Again (in this edition) we find chapters on alcoholate formation, on cellulose esters and ethers, on the oxidation and degradation of cellulose and on the constitution of cellulose—but all of these chapters (with the exception of the introduction) have been rewritten and enlarged and are replete with references to the newer literature which covers most of the advances in the cellulose field through August, 1927. One brief but very timely chapter on the investigation of cellulose by means of x-rays has been added. It is little more than a synopsis but gives a valuable bibliography and is written by Professor R. O. Herzog, eminent director of the Kaiser Wilhelm Institut für Faserstoffchemie at Berlin-Dahlem.

Dr. Heuser is to be congratulated on the thoroughness with which he has reviewed most of the literature and on the terseness with which his material is presented. Especially interesting are the chapters on alcoholate formation and on the cellulose esters wherein the author's own researches on the mercerization and viscose reactions are clearly described. The chapter on the constitution of cellulose is, however, a bit disappointing. Apart from the error in reproducing Hibbert's formula on p. 245 (an obvious misprint), it appears to the reviewer that the author has not maintained quite the proper balance and sense of proportion in dealing with constitutional formulas for cellulose. A number of the older formulations (like those of Tollens and Green) hardly merit the amount of space allotted to them. They are historically important and interesting, but (as Dr. Heuser himself shows) they are not in harmony with the more recent experimental data. On the other hand, constitutional formulas such as those proposed by Schorger and by Gray deserve at least a fleeting mention. However, these are minor defects in an excellent, clearly-written book which in its third edition cannot fail to aid and stimulate research workers and technologists interested in the chemistry of cellulose.

LOUIS E. WISE