

ample room for further research and to predict that in the next few years much progress will be made in this area. It should then be possible to make accurate predictions of polymer compositions which would have a desired set of viscoelastic properties and to predict those properties for an unknown or unavailable polymer.

In closing, it may be noted that the publishers, like the author, have done an outstanding job.

DEPARTMENT OF CHEMISTRY
STANFORD RESEARCH INSTITUTE MAURICE L. HUGGINS
MENLO PARK, CALIFORNIA

Properties and Structure of Polymers. By ARTHUR V. TOBOLSKY, Professor, Department of Chemistry, Princeton University. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1960. ix + 331 pp. 16.5 × 23.5 cm. Price, \$14.50.

This book is primarily concerned with the mechanical properties of polymers, particularly the *viscoelastic* properties. The subject is approached from both the phenomenological and the mechanistic point of view.

The first two sections of the book, entitled "Elasticity and Viscosity" and "Aspects of Polymer Physics," are introductory in character. Basic concepts of statistical mechanics and thermodynamics required in later sections are presented, together with discussions of polymer chain conformations, glass transitions and crystallization, elasticity of rubber networks, and viscous flow of liquids.

The following three sections, entitled "Mathematical Treatment of Linear Viscoelasticity," "Viscoelastic Behavior of Polymers" and "Chemical Stress Relaxation," constitute the core of the book. The material presented is taken largely from the work of the author and his students, a limitation which is made less serious by the wide range and high quality of Professor Tobolsky's research in this field. The viscoelastic behavior of polymers in the glassy region, the transition region and the rubbery region are all thoroughly treated. The role of chemical scission and crosslinking reactions in creep and stress relaxation is given particular attention.

The final section, on "Polymerization Equilibria," has only a tenuous connection with the central theme of the book. It is a brief, interesting discussion of a particular problem in the chemistry of polymerization reactions.

This book is well-written, clear, and thorough within the area covered. It should be of interest to all polymer chemists and physicists.

POLYMER RESEARCH LABORATORY
THE DOW CHEMICAL COMPANY TURNER ALFREY, JR.
MIDLAND, MICHIGAN

Introduction to Solids. By LEONID V. AZAROFF, Associate Professor of Metallurgical Engineering, Illinois Institute of Technology. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 1960. xiv + 460 pp. 16 × 23.5 cm. Price, \$9.50.

The stated purpose of this book is to provide a broad background at an elementary level for "all who are interested in solids." The word "all" is notably treacherous. In fact the author appears to have achieved his purpose for chemists, metallurgists and engineers, but not for physicists, who would require more precision. Certainly all students of chemistry would profit by a careful reading of this book, preferably as advanced undergraduates or beginning graduate students. There is no other book that provides such a lucid introduction to so broad a territory.

The basic approach of the book is by way of the structure of crystals, in theory and practice. The first 86 pages are a succinct review of crystallography. The description of closest packing and the structures based on it is the best I have seen, with clever new illustrations at last replacing Barlow's medieval drawings.

The following chapters are on imperfections, mechanical properties, crystal growth, phase transformations, bonding of atoms, metals, semiconductors and insulators. It would be too much to expect the author to sustain the freshness and cogency of the sections on crystallography as he ventures farther from this field, which is his own. Although the general level of accuracy remains high, occasional errors

have been noted. The section on "elements of thermodynamics" would profit by omission. The distinction between the Gibbs function G and the Helmholtz function A is quite confused, and the student is not warned of the pitfalls attending the choice of F as the symbol for the latter. We find also the optimistic statement that "It can be shown that the electrical conductivity in most metals is completely explained by the so-called free-electron theory that does not take the crystal structure into account." We find wrong values of quantum numbers attached to pictures of d-orbitals and an unduly weak description of the Fermi energy. More careful editing would have caught some grammatical errors and such amusing (E.E.?) jargon as "transient-like."

All quibbling aside, the book deserves to have an immediate success with students. It should give a much overdue impetus to education in the field of the solid state.

DEPARTMENT OF CHEMISTRY
INDIANA UNIVERSITY WALTER J. MOORE
BLOOMINGTON, INDIANA

Photoconductivity of Solids. By RICHARD H. BUBE, RCA Laboratories, Radio Corporation of America, Princeton, New Jersey. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1960. xix + 461 pp. 15.5 × 23.5 cm. Price, \$14.75.

This carefully written treatise on photoconductivity of solids provides a unified physical description and interpretation of photoconductivity, a subject of great importance in the study and understanding of solid state phenomena. It has developed rapidly since the end of World War II. This treatise on photoconductivity in solids deals with the topics: historical survey, electron processes in crystals, photoconductivity processes, preparation of photoconductors, electrode effects, imperfection photoconductivity, energy bands and excitation transitions, free carrier scattering and mobility, traps and trapping effects, recombination processes, theoretical viewpoints on photoconductivity, topics related to photoconductivity and survey of applications of photoconductors.

The author has been a research physicist at the David Sarnoff Research Center of the RCA Laboratories and has been an active experimentalist in the field of luminescence and photoconductivity in the last twelve years.

The book is a valuable handbook to all chemists who are active in the solid state work. Its twenty-two page chapter on the preparation of photoconducting materials is of particular use to synthetic chemists. Chemists cannot claim to a knowledge of solid state phenomena unless they understand photoconductors. Dr. Bube's book is very helpful in gaining such an understanding.

DEPARTMENT OF CHEMISTRY
PRINCETON UNIVERSITY JOHN TURKEVICH
PRINCETON, N. J.

Organometallic Chemistry. ACS Monograph No. 147. Edited by H. ZEISS, Research Associate, Monsanto Chemical Company, Dayton, Ohio. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1960. xiv + 439 pp. 16 × 23.5 cm. Price, \$17.50.

The volume of research in organometallic chemistry is increasing rapidly with new findings of bedeviling interest to organic, inorganic and physical chemists reported daily. It is difficult to write about such a rapidly advancing field. The authors have made no attempt to be comprehensive; the book consists "of a series of research subjects which are under active investigation—at the present time—by their respective authors." The result is a book of fascinating reading and its primary aim—to stimulate further research—is admirably accomplished.

The chapter headings and their authors are: 1. Carbon-Metal Bonding, J. W. Richardson. 2. Benzene Chemistry, R. Huisgen. 3. Vinylmetallics, H. D. Kaesz and F. G. A. Stone. 4. Organoboranes, C. Brown. 5. Organo-Aluminum Compounds, K. Ziegler. 6. Organosilylmetallic Chemistry, H. Gilman and J. S. Winkler. 7. Cyclopentadienyl Metal Compounds, P. L. Pauson. 8. Arene Complexes of the Transition Metals, H. Zeiss. 9. Transition Metal Alkyls and Aryls, G. E. Coates and F. Glockling. 10.

Metal Carbonyls and Related Compounds, J. Chatt, P. L. Pauson and L. M. Venanzi.

The chapters are uniformly excellent and the personality of the authors and their methods of delineating a research problem are evident. In a few cases, the bulk of the work in the field has been done in an author's laboratory, so that coverage is rather complete. This is particularly true of the chapters by H. C. Brown and by H. Zeiss.

Inorganic chemists have entered the field of organometallics with chief emphasis on complexes of the transition elements. This reviewer was particularly impressed with the remarkable new syntheses of organic compounds. From an organic point of view, the best is yet to come. In fact a recent publication by Hubel and Hoogzand describes the synthesis of 1,2,4-tri-*n*-butylbenzene, a compound of a type which has defied synthesis by classical methods. An excellent beginning in the field of organic synthesis *via* transition metal complexes has been made by Zeiss and his co-workers with their syntheses of various methyl-substituted aromatics.

The role of the other metals in organic chemistry is well illustrated in the chapters on benzyne chemistry, organoboranes and organo-aluminum compounds. All these chapters show that each new organometallic provides a unique chemistry with important contributions to both fundamental science and to industry. The newest of these is the elegant hydroboration reaction; this reviewer finds some interesting similarities between hydroboration and the cobalt-catalyzed hydroformylation reaction.

The book is recommended for all chemists. Those interested in catalysis (especially heterogeneous catalysis involving transition metals) would do well to read this book. Some of their postulated intermediates may have been synthesized.

The book is up-to-date with over 1700 references, including many to work published in 1960. The figures and formulas are clear, the type is legible, and the binding is excellent.

BUREAU OF MINES
4800 FORBES AVENUE
PITTSBURGH, PA.

IRVING WENDER

Cahiers de Synthèse Organique. Méthodes et Tableaux D'Application. Volume VII. Cyclisations. By JEAN MATHIEU, ANDRÉ ALLAIS, ET JACQUES VALLS. Published under the direction of Léon Velluz. Masson et Cie., 120 boulevard Saint-Germain, Paris 6, France. 1961. 309 pp. 15.5 × 22.5 cm. Price, broché, 100 NF, cartonné toile, 110 NF.

Cahiers de Synthèse Organique. Méthodes et Tableaux D'Application. Volume VIII. Cyclisations. By JEAN MATHIEU, ANDRÉ ALLAIS, ET JACQUES VALLS. Published under the direction of Léon Velluz. Masson et Cie., 120 boulevard Saint-Germain, Paris 6, France. 1961. 233 pp. 15.5 × 22.5 cm. Price, broché, 75 NF.; cartonné toile, 85 NF.

The organization and objectives of this series of "Cahiers" have been described in reviews of previous volumes: *J. Am. Chem. Soc.*, **80**, 1773 (1958), for Vol. I; **80**, 3802 (1958), for Vol. II; and **80**, 3486 (1958), for Vol. III. The high standards established previously for the series have been maintained in Volumes VII and VIII. Practicing organic chemists, both academic and industrial, will find these volumes interesting and provocative reading and so well-worth careful study that a special point should be made to see that the series is available in their personal and professional libraries. Briefly restated, the series of volumes systematically organizes organic syntheses in terms of reaction possibilities, subdivided into chapters dealing with major reaction types, such as alkylation (Vol. II), acylation (Vol. IV), cleavage (Vol. V), rearrangement (Vol. VI) and migration (Vol. VI).

Volume VII consists of chapter 18 on "monomolecular carbocyclizations" or intramolecular cyclizations in which a carbon-carbon bond is formed. Volume VIII consists of chapter 19 on polymolecular (intermolecular) carbocyclizations. Each chapter (Volume in these two "Cahiers") consists of (1) a synopsis of reaction types indicated by formulas (7 pages, each vol.); (2) a discussion of principles (types of reaction) involved in the classification given in the synopsis (8 pages, each vol.); (3) a discussion entitled mechanism (2 pages, Vol. VIII only); (4) a discussion entitled applications

(18; 25 pages) with comments on various methods, covered in the instant volume only, of forming selected ring types including heterocycles; (5) the main body of the collected and classified syntheses (140; 104 pages); (6) tables of additional examples (89; 48 pages); and (7) a table giving cross references to all preparations of all cyclic compounds in Volumes I-VIII (33 pages). There are several noteworthy features relative to these sections that deserve comment.

The system of classification comes off rather well and this is fortunate because the success of the undertaking depends thereon. There are 20 subdivisions and 54 sub-subdivisions of the classifications of reactions in Vol. VII and in Vol. VIII. 15 and 44. This diversity, a total of 98 separate reaction types, is more apparent than real, however: as of Vol. VII nearly one-third is devoted to the Dieckmann condensation and some closely related aldol-type cyclizations, another third to intramolecular benzenoid alkylations and acylations, and a relatively lengthy section to the Fischer indole synthesis. Some of the minor reaction types are bizarre enough to interest the most unimpressible. Vol. VIII covers the diene synthesis in 60 pages of text and tables (one-third of the volume.) This is supported by a very valuable collection of recent references. Of 206 cited in the appropriate applications section, 100 are since 1950. There are many more references cited in the Table of additional examples. The hazard is that the classification according to formation of bond types presupposes a knowledge of the mechanism of the reaction. Thus, whether A + B combine to give a cyclic compound C or react to give D which cyclizes to C determines whether a reaction will be classified as intra- (Vol. VII) or inter- (Vol. VIII) molecular. The diene synthesis, which appears in Vol. VIII, is an example. How much the ambiguities arising from this situation will hamper the user of the volumes probably will depend on the individual and the type of use he attempts. In fact, the reviewer has found, as he has gone over the system looking for omissions or peculiar classifications, that the absence of some reaction within a given code group where it might appear was an interesting indication of possibly untried reactions. It appears, however, that this type of treatise should be used as a source of collected information about types of syntheses and not about synthesis of a given type of compound. Its function and purpose is to codify reactions—not products—and its utility should be related thereto.

Mechanisms of the reactions are discussed with the reaction itself. Thus, the mechanism of the diene reaction is covered briefly in Vol. VIII, p. 93, and that of the Fischer indole synthesis in Vol. VII, p. 183. The mechanisms of some of the reactions, such as the Dieckmann and aldol types, have been discussed in previous volumes with their acyclic counter-parts. The volumes are replete with examples taken from the literature of the last few years. It should be noted that the formations of many heterocycles are discussed.

These volumes are probably the most useful of their type and all organic chemists will surely be appreciative of the tremendous effort the authors have devoted to the task of assembling this material. It hardly seems appropriate, in view of this, to cite shortcomings and omissions. There is no pretense that these volumes exhaustively compile all of the known data on organic syntheses. They will be very valuable for what they are to students and to academic and industrial chemists.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF LOUISVILLE
LOUISVILLE 8, KENTUCKY

RICHARD H. WILBY

Cobalt: Its Chemistry, Metallurgy and Uses. ACS Monograph 149. Edited by ROLAND S. YOUNG, Consulting Chemical Engineer, Victoria, B.C. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1960. vii + 424 pp. 16 × 23.5 cm. Price, \$15.00.

This monograph contains a good deal of useful information about cobalt chemistry, evidently selected and organized with the applied chemist and metallurgist in mind rather than the pure research chemist or the classroom. A listing of principal chapter headings or contents will serve as an illustration: Occurrence of Cobalt (25 pp.), Chemical and Physical Properties, Simple Compounds, and Coordination Compounds (10, 14 and 69 pp.); Magnetic, Electrical, and Electronic Applications, Cobalt Alloys, Metallurgical Applications (27, 38 and 10 pp.); Cobalt in Biology and Bio-