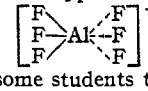
BOOK REVIEWS

Chemische Koordinationslehre. By FRANZ HEIN, o. Prof. für anorganische Chemie an der Universität Jena. S. Hirzel Verlag, Claridenhof, Gotthardstrasse 6, Zürich 2, Switzerland. 1950. xvii + 683 pp. 19 × 24.5 cm. Price, Fr. 44.—.

The intended audience for this book, according to the preface, is students in their last year of chemistry or in graduate school. However, although the book is written primarily to serve as a textbook, it should likewise be of interest to chemists not specifically trained in the field but whose researches may involve coördination compounds. In this respect the book furnishes an excellent description of the general types of complexes which do exist as well as the different classes of organic molecules which tend to chelate. Unfortunately, as is customary with a textbook, only very few references are given.

One may obtain a general impression of the contents of this book from the following chapter titles: A. Introduction; B. Behavior and Structure of Complex Compounds; C. Nature of Secondary Valence Forces; D. Additional Contributions to General Complex Chemistry; E. Element Complex and their Derivatives; F. Complex Compounds with Organic Ligands; G. Organic Compounds of Higher Order (Molecular Compounds); H. Importance of Complex Compounds in Science and Technology; I. The Complex Nature and Peculiarities of Polyacids; J. Unsolved Problems of Complex Formation.

The author assumes the reader is acquainted with the modern concepts of valency and orbital hybridization in complex formation. His approach to the structural proof of various compounds is largely chemical. In fact, the entire contents of the book deal primarily with the descriptive qualitative chemistry relative to coördination. Rarely has the author deemed it necessary to introduce any physical methods which have been used to attack these same or closely related problems. Likewise the compounds discussed are usually those which have been isolated, and one feels too little time is spent with the increasingly important solution chemistry of complex ions.

Typographical errors are relatively few considering the size of this text, and the numerous structural diagrams it contains. One does notice, however, several minor corrections or modifications in the contents of the book which should be made. A few representative examples of this will follow. Perhaps confusing to some students will be the fact that the author insists on distinguishing between bond types in all of the structures represented. A typical example is that of diagraming $[AlF_6]^{-3}$ as  which may be erroneously interpreted by some students to mean that the six fluoro-groups are not held by equivalent valence bonds. The section on nomenclature follows the I.U.C. rules, but only the very simplest of compounds are discussed, and it is felt that some of the more complicated nomenclature problems should be indicated. The reaction represented on the bottom of page 35 may be incorrectly taken to indicate the mechanism of the acid–base reaction between $[Co(NH_3)_5H_2O]Cl_3$ and alkali. It is likewise known that the electrolytic reduction of complexes need not proceed according to the example $[Co(NH_3)_6]^{+3} \rightleftharpoons 6NH_3 + Co^{+3} \overset{+e^-}{\rightleftharpoons} Co^{+2} \overset{+2e^-}{\rightleftharpoons} Co$ as illustrated on page 72. Finally, it is no longer believed that optically active $[Fe(C_2O_4)_3]^{-3}$ had ever been produced (page 84).

In the opinion of the reviewer this textbook represents a very worthy contribution to chemistry. You will note that I purposely chose to omit mentioning a particular field of chemistry for as Hein ably points out the phenomenon of coördination is extremely broad and in a general way touches upon all branches of the science. It is indeed unfortunate for us Americans that this book is written in German and may therefore not be too attractive here because of the language difficulties. However, since there is no English counterpart of this textbook, it certainly fills one of the large gaps in our chemical literature. One is prompted to suggest therefore that this book falls in the category of foreign books which some enterprising publishing company may wish to have translated.

DEPARTMENT OF CHEMISTRY
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Heterocyclic Compounds. Volume 2. Edited by ROBERT C. ELDERFIELD, Columbia University. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1951. vii + 571 pp. 15 × 23.5 cm. Price, $15.00.

Volume 2 of this extensive work on heterocyclic compounds covers five- and six-membered heterocycles that contain oxygen or sulfur and are fused to one or two benzene rings, or in a few instances to naphthalene or anthracene nuclei. The chapter titles and their authors are as follows: Chapter 1, Benzofuran and Its Derivatives, 67 pp., by R. C. Elderfield and V. B. Meyer; Chapter 2, Isobenzofuran, Phthalan, and Phthalide, 55 pp., by R. C. Elderfield; Chapter 3, Dibenzofuran, 22 pp., by W. E. Parham; Chapter 4, Thionaphthene, 19 pp., and Chapter 5, Dibenzothiophene, 9 pp., by D. K. Fukushima; Chapter 6, Coumarins, 44 pp., Chapter 7, Isocoumarins, 12 pp., Chapter 8, Chromones, Flavones, and Isoflavones, 48 pp., Chapter 9, Chromenols, Chromenes, Benzopyrylium Salts, and The Anthocyanins, 66 pp., Chapter 10, Chromanones, Flavanones, Chromanols, Flavanols, Catechin, Brazilin, and Hematoxylin, 50 pp., Chapter 11, Chromans, 26 pp., Chapter 12, Xanthones, Xanthenes, Xanthydrols, and Xanthylium Salts, 82 pp., Chapter 13, Fluorans, Fluoresceins, and Rhodamines, 32 pp., all by S. Wawzonek; Chapter 14, Thiochromans and Related Compounds, 18 pp., by D. S. Tarbell.

The organization within the separate chapters varies somewhat, but usually the methods of preparation and reactions of the parent compounds mentioned in the chapter titles are followed by the methods of preparation and reactions of their derivatives. Tabular lists of naturally occurring compounds and of the recorded applications of general reactions frequently are given. The indexing is good although there are certain lapses. For example, the section headed "Physiological Activity of Chromans" is not represented in the index by either the main entry "Physiological Activity" or by a subentry under "Chromans." Although seven references to the 1949 literature and one to a 1950 article were noted, the coverage in general appears to be as of 1948. The book is remarkably free from typographical errors both in the text and in the formulas. The printing and binding are excellent.

Interest in this volume probably will be less than that in Volume 1. Most organic chemists are less familiar with these polycyclic oxygen and sulfur heterocycles than with furans, thiophenes, pyrroles and pyridines. This lack of familiarity makes it difficult to keep straight the rather confusing common nomenclature, such as the differences between chromanones, chromones and coumarins, or between chromans, phthalans and fluorans, or between isoflavones and isobenzopyrylium salts. It seems to this reviewer that the present work would have been more helpful if the treatment of polynuclear compounds had followed that of the mononuclear compounds for each hetero atom, thus bringing similar heterocyclic structures together in the same volume and having the less familiar follow the familiar. Even within Volume 2 it would have been more logical and less confusing to have followed the order chromans, chromanols, chromanones, chromenes, chromenols, chromones and coumarins, rather than the reverse order.

Although the Editor states in the preface that an effort has been made to avoid repetition, a considerable amount still is present. Moreover where repetition has been avoided by the use of cross references, the organization is such that information which should be in one place is scattered in several places.

The avoidance of theoretical discussions referred to in the face to Volume 1 applies also to this volume. The instances where this policy has not been observed are not particularly enlightening. Thus objection can be raised to the discussion of the action of alkali on phenolphthalein on p. 114, and to the argument on p. 311 that it is preferable to write the formula for a flavylium salt as a carbonium ion at the 2-position rather than as an oxonium ion, because nitration takes place in the 3'-position. The central paragraph on p. 185 is not understandable as it is written. Over a third of page 391 is used for the formulas of two compounds which contain two hetero oxygen atoms and presumably do not belong in this volume. Adverse criticisms such as these are minor, however, compared to the value of the factual data presented.

Although an editor's job undoubtedly is more burdensome and less pleasurable than that of an author, it seems to this reviewer that in coöperative works, more obvious recognition of the authors should be given. In this particular volume two thirds of the book has been written by a single author. A desirable general practice would be the placing of the names of the contributors on the spine and the title page of each volume as well as in the table of contents.

Comparison of the relative prices of Volumes 1 and 2 is of interest. Volume 1 containing 703 pages was published in 1950 at a list price of $11.00, whereas Volume 2 containing 571 pages is listed at $15.00.

DEPARTMENT OF CHEMISTRY
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Principles of Phase Equilibria. By F. E. W. WETMORE, Associate Professor of Chemistry, University of Toronto, Toronto, Canada, and D. J. LEROY, Professor of Chemistry, University of Toronto, Toronto, Canada. McGraw–Hill Book Company, Inc., 330 West 42nd Street, New York 18, N.Y. 1951. x + 220 pp. 16 × 23.5 cm. Price, $3.50.

In the applications of physical chemistry to systems of real importance in the study of nature or the development of technologies, the phase diagram has risen to a position of pre-eminence. It provides a rational and standard method of representing masses of data on equilibria in heterogeneous systems in such a way that many of the simpler implications and interactions are made readily apparent. The last two decades of the nineteenth century and the first two of the twentieth saw the exploration of many multicomponent, multiphase systems and the development of phase diagrams of increasing complexity. During this period, however, a deeper insight into the consequences of the laws of thermodynamics was becoming wider-spread among physical chemists and finally the import of Willard Gibbs' work became adequately appreciated. Phase equilibria were realized to be a part of a broader and more fundamental subject (a fact which was fully realized by Gibbs in 1875), and the stability of phases and their behavior under changes of pressure, temperature and composition were related to other measurable properties of pure substances. Thus today a working knowledge of thermodynamics and its implications is an essential part of the equipment of any educated physical chemist or chemical engineer, and it comes as somewhat of a shock to this reviewer to find a book entitled "Principles of Phase Equilibria" which avoids the use of thermodynamics throughout the text and delegates this part of the subject to two short appendices. In 1925 such a book might have been justifiable. If it is justified in 1950, it seems that an investigation into the progress of chemical education is badly needed.

The book before us presents again the accumulated lore on equilibria in heterogeneous systems starting with the simplicity of one-component systems and progressing in complexity to four-component systems. It does a thorough job; but, except for some new examples of systems, it might well have been written thirty years ago, and even in the presentation the reviewer finds little of novelty to spice what always has been an insipid diet to all but a few enthusiasts. By choosing to emphasize on the experimental approach to the subject, the authors placed themselves in a good strategic position to introduce an appealing flavor by underlining the important geological and industrial problems that have been attacked successfully by phase-rule methods and by describing the many interesting techniques such as microscopy or X-ray spectroscopy, which have been essential in providing data for phase diagrams in the past few decades. However, they did not take these opportunities but confined themselves to generalized descriptions of classical physio-chemical methods.

This book is intended for undergraduate teaching; there is little doubt that it presents clearly the facts about a large number of systems, but we wonder whether such compilations of facts do not belong more properly in the handbook for the specialist, and whether the discipline of mind and broadening of understanding given by thermodynamics and statistical mechanics suitably blended with the facts of chemistry are not more fitting ingredients of the education of the mid-twentieth century undergraduate.

APPLIED PHYSICS LABORATORY
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Fluoreszenz organischer Verbindungen. By THEODOR FÖRSTER, Professor für physikalische Chemie, Max Planck-Institut für physikalische Chemie, Göttingen. Vandenhoeck und Ruprecht, Verlagsbuchhandlung, Göttingen 77, Germany. 1951. 312 pp. 16.5 × 23.5 cm. Brosch., 29.50; Ganzleinen, 32.50 DM.

After a long induction period extending from the beginning of its scientific study in the early nineteenth century, fluorescence, like its relative, phosphorescence, has recently attracted interest outside the growing circle of its own devotees because of the applications now made in technology and in various techniques of chemistry, physics, biology and medicine. Since most fluorescent substances are organic, a book devoted, as this is, entirely to the fluorescence of organic compounds has the merit of timeliness. The author sets out to treat this subject as an independent discipline founded on modern theories of the electronic structure of molecules and the mechanisms of the absorption and emission of radiation and of the radiationless transfers of electronic energy. A great measure of success has attended his efforts. Radiation- and transfer-theory are concisely but adequately treated, mostly in classical terms, with, where appropriate, addenda stating the quantum mechanical result. Classical arguments, in fact, predominate throughout the book, the liberal mathematical treatment involving little beyond elementary calculus, and it is the author's apparent resolution to avoid more than a brief outline of quantum mechanical discussion that makes the description of electronic structure and its spectral connotations rather more sketchy than other parts of the theory. About two-thirds of the contents are concerned with data and theories specifically related to fluorescence in its connection with chemical structure, to the spectrum, quantum yield, decay period and state of polarization of the fluorescent light, and to the various quenching phenomena. A brief chapter on the phosphorescence of organic compounds, a good bibliography including citations to 1950 and a subject index complete the volume. There is no discussion of the luminescence produced in organic compounds by X- and γ-rays and by fast nuclear particles.

The book, as a whole, contains an excellent account of the subject. The author shows very considerable analytical skill in extracting essential relations from sometimes confused masses of empirical data, a nice example being the analysis of concentration quenching into three well-marked categories depending on mechanisms controlled, respectively, by diffusion, static dimerization and dynamic energy-propagation processes. Sometimes, perhaps, explanations are over-simplified; for example, the tendency of ionic dyes to dimerize in aqueous solution against the electrostatic repulsion of the like charges is attributed, as frequently in the literature, to the high dielectric constant of water. In fact, however, the monomeric form of dyes which strongly associate in water may persist in solvents of higher dielectric constant than water, showing the inadequacy of explanations solely in terms of macroscopic dielectric constants, although, no doubt, there is truth in the general idea. As was to be expected from the author's published work, the sections on energy transfer and its significance in depolarization, quenching, and in the fluorescence of the molecular

aggregates of some cyanine dyes are particularly interesting and original.

Technological and analytical applications of fluorescence are not discussed, but the practitioner of applied fluorescence will find material in this volume which he will almost certainly be able to use with advantage in his specialty. The problems of intra- and extramolecular energy transfers are, of course, fundamental in chemical kinetics and photochemistry, and the student of these subjects, novice or seasoned, will find much in this book to savor and ruminate over.

The material and format conform to prewar standards of good German bookmaking. A few errors in formulas have eluded correction in proofreading, *e.g.*, on pages 115 and 142.

RESEARCH LABORATORY
EASTMAN KODAK COMPANY
ROCHESTER 4, N. Y. W. WEST

Chemical Embryology. By JEAN BRACHET, Professor, The University of Brussels, Belgium. Translated from the French by Lester G. Barth, Professor of Zoology, Columbia University, New York. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1950. xiii + 533 pp. 16.5 × 23.5 cm. Price, $8.00.

This book is a translation of the second (1945) edition of Brachet's "Embryologie Chimique." In view of the similarity of the first (1944) and second editions of the French text it should be noted that there is available, in English, a review of the first edition by an embryologist; *cf.* A. Tyler, *Science*, **102**, 337 (1945).

It is stated in the preface to the first edition that the book is intended primarily for biologists. However if chemists are willing to consult a good medical dictionary at frequent intervals they should have no difficulty in following the discussion. Two chapters, namely X and XII, are well worth the time of any chemist who professes to have an interest in the relation of chemical structure to biological activity since these two chapters contain a lucid account of what is implied in the all too vague term, biological activity.

The principal objection that can be raised in respect to Brachet's treatment of his subject is the striking contrast between the admirable objectivity attained in the discussion of the purely biological aspects of the work and the absence of such an attitude in respect to the biochemical phases. This deficiency may in part be due to the greater familiarity of the author with the biological in contrast to the chemical sciences, and in part due to the fact that a substantial portion of his thesis probably could not have been developed if certain conclusions of a chemical nature were denied at the start. It is difficult to accept the idea, given on p. 4, that the techniques of Caspersson can be extended *without difficulty* to the analysis of cellular constituents other than nucleic acids; that Connors and Sheer *have proved* the homogeneity of Mirsky's elongated protein, *cf.*, p. 115; and that mustard gas combines *rapidly and selectively* with –SH groups, *cf.*, p. 182. Also on p. 223 it is difficult to follow the statement that, "the absorption about 2800 Å. is caused by *histones*, proteins rich in basic amino acids," when it is obvious that absorption in this region is clearly due to the aromatic amino acids. In spite of the admonition of the author, in a discussion of several staining techniques, on p. 10, that, "even the ease with which they are carried out makes the dangerous," a large part of the discussion on the role of thiol compounds and nucleic acids is based upon such techniques.

Organic chemists whose contact with the field of chemical embryology has been limited to topics such as, the chemical basis of sex determination, and the nature of the inducing substance, will probably be disappointed to learn that they will have to re-examine their former beliefs. It is clear that anyone who is interested in the chemistry of vital processes, such as the *in vivo* synthesis of proteins, carbohydrates, etc., cannot afford to ignore Brachet's stimulating and provocative monograph. The book is remarkably free of typographical errors, the reviewer noticed only one on p. 77 and several on p. 83. The bibliography of 1242 references, even though admitted by the author to be incomplete, is impressive. The translation appears to be an accurate one.

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BOOKS RECEIVED

July 10, 1951–August 10, 1951

S. R. DE GROOT. "Thermodynamics of Irreversible Processes." Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 242 pp. $4.00.

Z. I. KERTESZ. "The Pectic Substances." Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 628 pp. $13.50.

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GÜNTHER SCHIEMANN. "Die organischen Fluorverbindungen in ihrer Bedeutung für die Technik." Verlag von Dr. Dietrich Steinkopff, (16) Darmstadt, Holzhof-Allee 35, Germany. 1951. 221 pp. Preis brosch. DM 24.-, geb. DM 26.-.

LÉON VELLUZ (Editor). "Substances Naturelles de Synthèse." Volume II. Masson et Cie, Éditeurs, 120 Boulevard Saint-Germain, Paris 6e, France. 1951. 138 pp. 1250 fr.

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RALPH W. G. WYCKOFF. "Crystal Structures." First Supplement and Volume II. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1951. 325 pp. First Supplement $4.00, Volume II with binder $10.00.