BOOK REVIEWS

Kwantykulowa Teoria Wiazania Chemicznego. By Prof. Dr. KAZIMIERZ FAJANS. Walter J. Johnson, Inc., 111 Fifth Avenue, New York 3, N. Y., 1961. 145 pp. 17.5 × 24.5 cm. Price, $1.50.

The title of the book can be translated into English as "Quanticule Theory of Chemical Bonding." It is actually a monograph devoted to the chemical bonding theory developed by Professor Fajans during his long scientific and teaching career in Europe and the United States.

The quanticule is defined by Fajans as a group of electrons quantized in a definite manner with respect to certain nuclei or atomic cores. The quanticule demonstrates its specific behavior in intramolecular processes and reactions with other molecules. The quanticule theory emphasizes the significance of the electrostatic forces of attraction and repulsion within the quantized groups of electrons and between the quantized electrons and respective nuclei.

This theory combined with the phenomenon of deformation of electron boundary surfaces in ions and molecules allows Fajans to derive stereochemical properties of the molecule and crystalline lattice. Consequently, Fajans is able to present the structure of any molecule by a single formula. In this respect, the quanticule theory contradicts the theory of mesomerism or resonance which, for any molecule, assumes the existence of a number of molecular structures (resonance hybrids) as a result of electron exchange among various atoms.

The book is divided into four parts.

In Part A the basic theories of molecular and crystalline structures are compared. A number of molecular structures are represented in terms of the theory of valences, of electron pairs and octets, of electron pairs and atomic cores, and of quanticules. The principles of the quanticule theory and its application to a variety of chemical compounds are also explained.

Part B is devoted to mutual polarization (deformation) of ions in molecules and crystals, resulting from the action of electrostatic forces between the ions. This is a decisive phenomenon in the application of the theory of quanticules.

The general principles of formulation of the quanticular structure of matter are given in Part C. In this part numerous examples of quanticular formulas of inorganic and organic compounds are shown and many chemical reactions are presented in terms of the quanticule theory.

Part D summarizes publications relating to the theory of chemical bonding written by Fajans and his co-workers during the period 1919–1960.

The quanticule theory developed by Fajans should be of great interest to students of chemical bonding, and translation of the book into English might well be an important contribution to this field of science.

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Cosmic Rays. By A. W. WOLFENDALE, B. Sc., Ph. D., F. Inst. P., Senior Lecturer in Physics, Durham College in the University of Durham, with Foreword by Professor G. D. Rochester, F. R. S. Philosophical Library, Inc., 15 East Fortieth Street, New York 16, N. Y. 1963. 14.5 × 22.5 cm. 222 pp. Price, $10.00.

The author states in the preface that "the purpose of this book is to give an introduction to the subject of Cosmic Rays suitable for students at undergraduate level and scientists working in other fields." The level of the book and the tone in which it is written are certainly in keeping with his aim and generally speaking the book accomplishes its stated purpose. It would certainly be easy to find "carping" fault with the contents with respect to subject matter omitted; Prof. Wolfendale is clearly aware of the dangers of writing a book in a field which is in a state of constant flux due to the advent of satellites as platforms for cosmic ray experiments and rather than attempt a partial portrayal of data, much of which is as yet undigested, he has wisely restricted himself to rather well defined and fairly well understood areas. Essentially he is portraying the state of affairs prior to the advent of the large scale scientific programs utilizing satellites and has one very brief chapter on the radiation belts which is completely qualitative. In a certain sense (which is somewhat unfortunate) the book is "classical" in its approach to the subject in that a significant part of its contents are devoted to the secondary aspects of cosmic rays, that is their behavior in the atmosphere, rather than focusing on the primary properties. In this vein the balloon observations on solar X-rays and the correlation of various geophysical phenomena with cosmic ray phenomena are either not mentioned or only alluded to in passing reference.

The mathematical level of the book is quite elementary and the author endeavors to make it as self-contained as possible, including chapters on basic ideas of nuclear physics, electromagnetic interactions, nuclear interactions, and cosmic ray detectors. The nonphysicists or the undergraduate with a good physics course in his background will be able to obtain a good introductory knowledge of the field *ca.* 1958 from this book, and to this audience the book is recommended.

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Advances in Heterocyclic Chemistry. Volume 1. Edited by A. R. KATRITZKY, University Chemical Laboratory, Cambridge, England. Academic Press, Inc., 111 Fifth Avenue, New York 3, N. Y. 1963. xi + 467 pp. 16 × 24 cm. Price, $15.00.

First-rate editing is clearly reflected in this outstanding and modestly priced collection of up-to-date reviews, in which almost all the writing is good and much is conspicuously original. Reader interest and preference naturally vary, so this reviewer will avoid invidious comparisons as well as the temptation of citing the rare misprint. The slim subject index proves serviceable, although more numerous and detailed entries would be a great convenience.

The contents of this volume are: S. Gronowitz: Recent Advances in the Chemistry of Thiophenes. R. M. Acheson: Reactions of Acetylenecarboxylic Acids and Their Esters with Nitrogen-Containing Heterocyclic Compounds. D. Beke: Heterocyclic Pseudo Bases. J. Gut: Aza Analogs of Pyrimidine and Purine Bases of Nucleic Acids. W. L. F. Armarego: Quinazolines. A. R. Katritzky and J. M. Lagowski: Prototropic Tautomerism of Heteraromatic Compounds: I. General Discussion and Methods of Study. II. Six-Membered Rings.

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Leybold Vakuum-Taschenbuch. Herausgegeben von K. DIELS und R. JAECKEL, Zweite neubearbeitete und erweiterte Auflage. Springer-Verlag, Abteilung VI, 1 Berlin-Wilmersdorf, Heidelberger Platz 3, West Berlin. 1962. xii + 366 pp. 16.5 × 23.5 cm. Price, DM 56.

This enlarged and revised second edition of the Leybold vacuum handbook is a welcome addition to the rapidly expanding literature on vacuum technology. Fortunately, the uniqueness of the first edition is preserved in the second; that is, the presentation is *concise* and *clear*. There is a prodigious amount of data displayed in a well organized and readily understandable manner. The book abounds with equations, tables, graphs, nomographs, and references.

The first section of this handbook is devoted to vacuum physics. It includes terse but generally accurate definitions of terms encountered in vacuum technology. Important formulas from the kinetic theory of gases are listed. Tables and graphs display, as a function of temperature, the average velocity, mean free path, collision frequency, etc., for H_2, N_2, O_2, air, He, Ne, Ar, Kr, Xe, Hg, H_2O, CO, CO_2, HCl, SO_2, Cl_2, C_2H_5OH, and NH_3. Viscosities, thermal conductivities, and ionization potentials are listed for these gases.

Viscous and molecular flow in tubes are summarized with the usual approximate formulas. Graphs and nomographs make it possible to estimate rapidly conductances of long and short pipes and apertures. The thermodynamics of supersonic flow through nozzles is treated with special emphasis on the design of mercury and oil diffusion pumps.

Vacuum pumps, baffles, gages, and partial pressure measuring devices are considered briefly; however, magnetic deflection mass spectrometers are neglected.

Ultrahigh vacuum technology, unfortunately, is given only a very limited (four pages) and sometimes misleading coverage. There is no mention, for example, of motion seals.

The second section, vacuum engineering, begins with 36 pages of detailed drawings and lists of specification of Leybold components. Much of this information can be put to good use in designing equipment. It is unfortunate that the authors felt it necessary to waste space by repeating five previous figures on flange design in this section.

Seventy-one pages are devoted to a summary of the properties of materials of construction commonly used in vacuum systems. Data are presented in tabular and graphical form on the outgassing properties, permeability, composition, electrical characteristics, and stability of metals, glasses, quartz, mica, ceramics, plastics, and rubbers. Vapor pressures, melting points, and boiling points are given for most of the elements, pump oils, greases, and high boiling organic liquids.

The properties and performance of metallic getters are covered in some detail.

The third section (92 pages) is extremely valuable. Most of the pertinent literature (books and journal articles) in vacuum technology and allied fields has been tabulated according to subject for the period 1948–1959. It is too bad that only a few references since 1959 appear.

The subject index is quite complete.

In conclusion, this book is heartily recommended to any chemist, physicist, or engineer who uses vacuum technology. It contains a great deal of material in an attractive, readily accessible, and concise form.

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Comprehensive Biochemistry. Volume 4. Separation Methods. Edited by MARCEL FLORKIN, Professor of Biochemistry, University of Liege (Belgium), and ELMER H. STOTZ, Professor of Biochemistry, University of Rochester, School of Medicine and Dentistry, Rochester, N. Y. American Elsevier Publishing Company, Inc., 52 Vanderbilt Avenue, New York 17, N. Y. 1962. xiii + 282 pp. 16 × 23 cm. Price, $13.00, single copy; $10.50, series price.

A volume on separation methods is clearly welcome in a series entitled "Comprehensive Biochemistry." Furthermore, the editors have chosen authors whose competence is unquestioned. What is disappointing in this volume is the selection of subjects to be considered as separation methods. The volume consists of chapters on countercurrent distribution (L. C. Craig); adsorption, ion exchange, and partition chromatography (E. Lederer and M. Lederer); and gas chromatography (P. Chovin). There are no sections on electrophoresis, gel filtration, membrane dialysis, sedimentation, or techniques for homogenization and extraction. While electrophoresis and sedimentation will be considered in the volume on proteins (Vol. 7), it seems unfortunate to this reviewer that so few topics have been included under the general title of separation methods.

The articles which have been included are excellently done. The treatments all emphasize principles rather than specific applications, but even so they are quite practical in orientation. Derivations are given for quantitative relationships, and good explanations are given for theoretical and empirical factors which are useful in choosing and controlling conditions and in designing experiments. The authors give just enough examples of application to be helpful without being distracting. This reviewer finds such a treatment of methods the most helpful for imparting to a nonexpert biochemist an understanding and sensitivity for advanced techniques. A further advantage to these treatments is their compactness: the same subjects have been treated by some of the same authors at greater length elsewhere.

There were places in which this reviewer felt there was inadequate emphasis (*e.g.*, cellulose resins were considered for only two pages), or omission (*e.g.*, the contributions of F. H. Carpenter to the theory of partition systems for chromatography), but these were few, and probably are matters of personal taste. The styles of writing were all clear and easy, even though a few spots of awkward translation were found in the last chapter.

This volume ought to be of great value to nonexpert biochemists who are interested in the particular subjects covered.

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Lectures in Materials Science. The Cornell Materials Science Center Lecture Series. Edited by PAUL LEURGANS, with P. J. W. DEBYE, P. J. FLORY, N. BLOEMBERGEN, and F. BITTER. W. A. Benjamin, Inc., 2465 Broadway, New York 25, N. Y. 1963. viii + 109 pp. 16 × 23.5 cm. Price, $7.00 clothbound and $3.95 paperbound.

Four lectures, given at the Cornell Materials Science Center in the spring of 1962, are recorded in this volume. The subjects vary widely. Each deals with a very limited aspect of "the science of materials," but does it very ably.

Professor Debye, as always, deals masterfully with the fundamental ideas underlying very complex phenomena, making a reader (or a listener) feel that he really understands the subject. In his lecture on "Macromolecules in Solution" Debye discusses the viscosity, osmotic pressure, and light scattering of solutions of linear macromolecules, showing how experimental measurements of these properties can lead to knowledge of molecular properties. His treatment of solution properties near the critical point—with which he has been most concerned in recent years—is especially fine.

Professor Flory, as everyone working in polymer science knows, has contributed a great deal to our knowledge of "Macromolecules in the Solid State," the subject of his lecture. He outlines an elegant statistical mechanical treatment of the configurations of macromolecules, both isolated and in highly concentrated systems, and then discusses phase transitions and the morphology of semicrystalline polymers.

Dr. Bloembergen discusses the basic ideas underlying "Magnetic Resonance and Its Applications," a field which has become of great importance in recent years. He deals with nuclear magnetic resonance and electron spin resonance and with solid state and hydrogen beam masers.

In a lecture on "Flows in a Steady Plasma," Professor Bitter describes and interprets his experiments, with John Waymouth, on discharge phenomena in mixtures of mercury and inert gases.

Each of these four lectures is a useful addition to the scientific literature. The reviewer hopes that those who would profit most from reading them will learn of their existence, in spite of their incorporation in a book with such a very general title.

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Quantum Theory of Molecules and Solids. Volume 1. Electronic Structure of Molecules. By JOHN C. SLATER, Institute Professor, Massachusetts Institute of Technology. McGraw-Hill Book Company, Inc., 330 West 42 Street, New York 36, N. Y. 1963. 16.5 × 23.5 cm. 485 pp. Price, $12.50.

This is the first of what is to be a series of three or more volumes, concerned with molecules and solids. They stand in their own right, but are clearly sequels to the two successful volumes on atomic structure by the same author, published three years ago. The complete set, which will almost form a library on the electronic structure of matter, represents a massive effort, which probably no one but Professor Slater would feel capable of attempting.

There are advantages and disadvantages in a series of this kind. One great advantage is continuity of argument and economy of space. The present volume can begin on the assumption that the reader already knows about atomic orbitals, angular momentum, electron spin, and much of the basis of wave mechanics. In this way an advanced level can be achieved. There are, in fact, only 250 pages of main text, with a further 150 pages of more specialized material in 15 appendices. Professor Slater writes with great confidence and with the clarity that we have come to expect of him.

This is a very workmanlike book, and one well designed to introduce the reader to techniques as well as general theory. Thus even complicated (but highly important) matters, such as the evaluation of two- and three-center integrals, are explained. In fact, the general argument proceeds largely from the full study of a series of special molecules, graded in ascending order of complexity—H_2, LiH, H_2O, CH_4, NH_3, with a final chapter of 20 pages on ethylene and benzene. Emphasis is laid on the molecular-orbital approach, and—for the first time—attention is directed to the significance of one-electron energies.

But, as mentioned earlier, there are certain disadvantages in Professor Slater's plan of a series of volumes. In the present case we could point to an almost complete absence of chemical concepts. There are only passing references to bonds, bond energies, bond moments, bond lengths; hybridization appears largely as an incidental factor in the combination of atomic orbitals and not as an almost regulative factor is determining valence angles and stereochemistry. There is nothing about the inorganic transition compounds, nor the properties of organic π-electron molecules larger than benzene. There is effectively no reference to the immense field of empirical, or semi-empirical, work that is sometimes called theoretical chemistry. The author says, with some justification, that these methods do not give accurate numerical values. What he does not say is that they may nevertheless give considerable chemical insight.

In short, this is a book for physicists. As a collection of the most important work on the nonempirical calculation of ground state (and a limited amount of excited state) energies, it is easily the most complete and readable account now available. The student who has read this volume and the recent *Handbuch der Physik* article on the same subject by Kotani, Ohno, and Kayama will be in a good way to understand any research work in this field and to start calculations of his own.

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