

- reaction center preparations is expected to deprive the primary photochemistry of the upconversion mechanism which is activated by the annihilation of the antenna BChl a S₁ by the reaction center BChl a T₁.^{22,23} The observed requirement of in vivo BChl a photosynthesis is 2 quanta/electron.^{1a}
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Received April 14, 1978

Book Reviews*

Energy. Volume II. Non-nuclear Technologies. By S. S. PENNER and L. ICERMAN. Addison-Wesley, Reading, Mass. 1976. xxx + 673 pp. \$19.50 (cloth); \$13.50 (paper).

This book is one of a three-volume, "set of lecture notes". It contains chapters on recovery of oil from shale and tar sand, coal technologies, hydrogen fuel economy, energy storage systems, techniques for direct energy conversion, solar energy utilization, windmills, tidal energy, geothermal energy, and production and transmission of electricity. There are 20 pages of problems and an index.

Environmental Dynamics of Pesticides. Edited by R. HAQUE and V. H. FREED. Plenum Press, New York, N.Y. 1975. viii + 387 pp. \$29.50.

This book is the proceedings of a symposium sponsored by the Division of Pesticide Chemistry at the April 1974 meeting of the American Chemical Society. Eighteen papers are included. They cover distribution and accumulation of pesticides, physiological effects, detoxification, and methods of chemical estimation. There is a substantial index.

La Chimie Organique. By ROBERT PANICO. Presses Universitaires de France, Paris. 1975. 128 pp. Price not stated.

This small, paperbound book provides a simple overview of organic chemistry, including general principles from bonds to physical methods, and descriptive chemistry from hydrocarbons to compounds of biological importance. A one-page bibliography contains mostly textbooks, the majority of which, curiously, are in English.

Methodicum Chemicum. Volume 6. C-N Compounds. Editor-in-Chief: F. KORTE. Edited by F. ZYMALKOWSKI. Academic Press, New York, N.Y. 1976. viii + 858 pp. \$165.00.

This series, begun just a few years ago, deserves to be better known. It is a systematic presentation of reviews of proved methods, generally of analysis or synthesis, oriented toward organic chemistry. Very well known methods are generally described briefly, with references to the more important reviews that have been published, in order to allow a more detailed treatment to be given of new methods, or older ones that have not previously been adequately reviewed.

This volume is concerned with synthesis: methods by which carbon-nitrogen bonds are formed, along with some information on transformation of one type of nitrogen function into another. It is arranged according to the type of compound ultimately formed, in 18

contributed chapters. Major subdivisions of each chapter are included in the Table of Contents with their page numbers, in order to make it easy to find just what one wants. Within the chapters, there are further logical subdivisions, with clear headings, as well as tabular presentations of types of reactions with key to the pages on which they are treated. An index of 58 pages is another great aid to easy access.

The documentation is marvelously thorough, and there must be over 10,000 references. Coverage of the literature is through 1971, but for a work of permanent reference value such as this, this fact is not detracting. Although most of the contributors are German, the text is entirely in English. This fact has produced some slightly awkward usages that occasionally require re-reading (e.g., "... phenolates can be reacted to cyanates . . ."). This is a trivial annoyance compared to an editorial characteristic, by which introductory phrases that are not the subject of the sentence are rarely set off by commas, even when they are quite long; this practice too often requires the reader to stop in puzzlement in midsentence.

The careful and thorough compilation of the material in this book is matched by the high quality of its production (layout, printing, paper, and binding). It is an invaluable work of reference, and no organic chemist concerned with synthesis will want to be without access to it.

Global Chemical Cycles and Their Alterations by Man. Edited by WERNER STUMM. Dahlem Konferenzen/Abakon Verlagsgesellschaft, Berlin, 1976. 347 pp. Price not stated.

This book is the report of a "workshop" conference held in Berlin in 1976 with an international group of invited participants. The goal of the conference was "to assess our understanding of the global chemical cycles and their alterations by man as a basis for describing our future environment and for projecting research needs." The content consists of a series of review papers on specific facets of chemical and energy cycles, and four "group reports", in which the available information is assessed, major questions are identified, and recommendations are made.

The papers make very sober reading, and the depth of documentation provided makes them both useful and persuasive. Such simple facts that manmade nitrogen fixation now approaches natural nitrogen fixation in magnitude, and that atmospheric CO₂ concentration is expected to double in the next 50 years, pose chemical questions of enormous importance to mankind. It is good that these serious matters have been brought to our attention in such substantial form so soon after the conference.

* Unsigned book reviews are by the Book Review Editor.

Rodd's Chemistry of Carbon Compounds, Second Edition. Volume IV, Part E: Six-Membered Heterocyclic Compounds with a Hetero Atom from Groups IV, VI or VII. Edited by S. COFFEY. Elsevier Scientific Publishing Co., Amsterdam and New York. 1977. xviii + 494 pp. \$79.75.

Most of this book is occupied by two chapters by R. Livingstone, one devoted to pyran and related systems, and the other to analogs of the pyran ring with sulfur, selenium, tellurium, silicon, germanium, tin, lead, or iodine in place of oxygen. The 345-page length of the first of these is testimony to the mass of new research in the area since the First Edition. The method used for references, incorporating them into the text, does not permit them to be counted easily, but the number is evidently enormous. By contrast, cyclic iodonium compounds, first prepared in 1956, require only a page and a half of text.

The last chapter, "Brazilin and Haematoxylin", is a verbatim reprint of the late Sir Robert Robinson's chapter in the First Edition, and is a tribute to his memory.

As is customary in this series, this volume is provided with an independent subject index.

Cane Sugar Handbook. Tenth Edition. By G. P. MEADE and J. C. P. CHEN. Wiley/Interscience, New York, N.Y. 1977. xvii + 947 pp. \$48.95.

This handbook can properly be called venerable, for it is now 88 years since the first edition appeared, and it has seen most of the original contributors pass away. It is concerned with manufacture and refining of sugar, analytical procedures, and chemical control. Some new sections appear in this edition, largely on technical processes and standards, and there has been some rearranging. Many new contributors have been engaged to keep the content abreast of recent developments.

Residue Reviews. Volume 67. Edited by F. A. GUNTHER and J. D. GUNTHER. Springer-Verlag, New York, N.Y. 1977. x + 139 pp. \$16.80.

This volume contains but a single contribution: "The Citrus Reentry Problem," by Gunther, Iwata, Carman and Smith. Since "reentry" has become a key-word for evoking thoughts of astronautical exploits, it can be forgiven if the initial effect of reading this title is visions of oranges and lemons hurtling into the upper atmosphere, homeward bound from the latest cosmic horticultural experiments. However, the Introduction defines these problems as illness in workers caused by residues of pesticides encountered in the fields they tend. It is a serious problem primarily with organophosphorus pesticides, used largely in citrus orchards, but to some extent also in cotton and tobacco fields, and perhaps other leafy crops. This volume is concerned with detection and estimation of such residues, their dissipation by chemical and other means, the magnitude of their effects on health, legislative aspects, etc. There is the usual good bibliography and index. Chemists will particularly appreciate a table of 31 important pesticides, in which their generic and trade names are matched to their systematic chemical names.

Coal Desulfurization. By ROBERT A. MEYERS (Systems Group of TRW Inc.). Marcel Dekker Inc., New York, N.Y. 1977. xii + 254 pp. \$29.75.

One of the most important objections to greater use of coal as a source of energy is pollution of the atmosphere, mostly due to the sulfur content. United States coal deposits in the eastern region generally have a high sulfur content, which is largely in the form of pyrite, FeS₂.

This book is a survey in depth of actual and potential ways to remove sulfur from coal before use. Although a large amount of the sulfur can be removed as pyrite mineral by physical means, chemical methods are required to complete the process. These methods involve oxidation, reduction, thermolysis, solvent partition, etc. The author of the book devotes much attention to a method that he originated: treatment with ferric sulfate.

The great value of this book is that it brings together so much information available only in reports to government agencies, in patents, and in other sources not always easily accessible. The comprehensive scope of the book gives it value as a stimulus for research on methods of potential but undemonstrated value. Its shortcomings are that some parts are much outdated; the chapter on coal structure, for example,

gives a model proposed for coal structure published in 1960, and no references more recent than 1968 except one on the Meyers' process for desulfurization.

Coal Processing Technology. Volume 3. Prepared by the Editors of "Chemical Engineering Progress". American Institute of Chemical Engineers, New York, N.Y. 1977. 198 pp. \$20.00.

This book has no preface or introduction, and it is therefore hard to see what it is intended to be. In subtitle, it is stated to be a "technical manual"; however, its content consists of 33 short papers, each by a different author or group, describing the authors' work on a particular subject. There is thus no comparison of one subject or method with another, and no critical analysis. Some of the papers resemble abstracts of a presentation at a meeting, and indeed, in some instances, the reader is invited to send a remittance to obtain the full text, and some papers include a "summary of results". A lot of expense and space have been devoted to pictures of each contributor, but the useful feature of an index has apparently been forgotten. Although the subject is an important one, and much information relevant to applied chemistry is given, this book falls unsatisfyingly short of the expectations evoked by its title.

Energetic Materials. Volume 1: Physics and Chemistry of the Inorganic Azides. Volume 2: Technology of the Inorganic Azides. Edited by H. D. FAIR and R. F. WALKER (U. S. Army Armament Research and Development Command). Plenum Press, New York, N.Y. 1977. Vol. 1: xv + 503 pp. \$75.00. Vol. 2: xiv + 296 pp. \$49.50.

Notwithstanding the scope implied by the title, this work is apparently limited to the two volumes reviewed here, and its content is more accurately revealed by the subtitles. It is a unified collection of reviews which concentrate on more recent research, and emphasize the investigations done under U.S. Army auspices. The contributors are largely from the Energetic Materials Division, Armament Research and Development Command (formerly Picatinny Arsenal).

The first volume covers preparation of all manner of azides, from hydrogen to bismuth, their chemical properties, crystal structures, solid-state properties, slow and fast decomposition, and stability. The discussions are characterized by the presence of much primary information, so that the need to consult the original articles is reduced; the bibliographies, however, are very large, and include not only journal articles, but symposia and government reports.

Volume 2 takes up manufacture but confines its attention to lead and silver azides, which are important as detonators, and ignores sodium azide, which is of more general industrial importance, and the preparation of which is mentioned in Volume 1. Analysis and assay, handling, storage, and disposal are also discussed in detail, but with a preoccupation with lead and silver azides. Sensitivity of these substances to impact, friction, electrostatic effects, heat, and nuclear radiation is treated in three chapters. The final chapter discusses the role of azides in explosive chains.

These volumes will be a very useful reference, primarily to chemists concerned with explosives, but Volume 1 especially will have a wider appeal. The volumes are separately indexed.

Chemical Education in Europe. Edited by P. J. FARAGO, M. J. FRAZER, and S. D. WALKER. The Chemical Society, London. 1977. vi + 380 pp. \$7.00.

This is a book about how chemistry is taught at secondary and university levels in the various countries of Europe, and the structure and characteristics of the different national education systems as they pertain to chemistry. One-half of the book consists of 13 chapters contributed by as many people, each of whom has had teaching and research experience in more than one country. These are very varied in their subject matter and approach, and are intended to give the reader a feeling for European chemical education that is not obtainable from tabulated information. The other half is a systematic description of the education systems, with numerous tables and charts, information on the selection of students, explanations of degrees, etc. A most gratifying feature is the translation and explanation of the multitudinous national terms and abbreviations associated with education. The meaning and significance of academic titles in each country are delineated in a special section. However, specific names of institutions and their faculties are not included.

This should be an invaluable book to chemists having occasion to work with European chemists, whether as host or guest, and to those who must assess the qualifications of chemists educated in Europe.

It should be especially gratefully received by those who may be responsible for protocol at international gatherings and at institutions that receive visitors from abroad. Where else could one so readily learn that a chemist who is a member of the V.C.V., has the title Odborný Asistent at a Czechoslovak university, and has the degree Fil. Kand., actually belongs to the faculty of professorial rank, and has a bachelors degree from a Scandinavian university?

Survey of Organic Syntheses. Volume 2. By C. A. BUEHLER and D. E. PEARSON. Wiley/Interscience, New York, N.Y. 1977. x + 1105 pp. \$25.00.

Volume 1 of this work was an almost instant success when it came out in 1970. This new volume continues the critical discussion of synthetic methods and embraces the period 1969-1975. It is an essentially independent work, although frequent references to Volume 1 are made.

Few readers will be surprised that this is a large book, even though it covers only a seven-year period, for the art of organic synthesis has taken great jumps in recent years. New methods are not infrequently buried as one step in a many-stage synthesis, and chemists must be more dependent than ever on compilations, whether of specialized or general scope. A simple compendium is always welcome, but when, as in this volume, some evaluation is included, so as to bring attention to methods of choice, the result is especially valuable.

Accessibility of information is of great importance in a book of this size and breadth. The first stage is the chapter heading; the rearrangement is according to class of substance to be synthesized. The second stage, finding one's way in the rather larger chapters, is greatly facilitated by the substantial tables of chapter contents at the start of each. Finally, there are two very large indexes: Subject and Reaction. The latter is based on an interesting and apparently original codification of transformations by Paul F. Hudrlik. It embraces both Volumes 1 and 2.

A Dictionary of Chromatography. By R. C. DENNEY (Thames Polytechnic, London). Wiley/Halsted, New York, N.Y. 1976. xi + 191 pp. \$14.50.

This dictionary is part of the same series as the one on electrochemistry also reviewed here, and has the same general characteristics. It is intended to be a reference for students, technicians, and general scientists, rather than the specialist and, accordingly, includes explanations of the main equations, common terms and abbreviations, and instrumentation. It even includes references to journals and books, as well as many graphs and diagrams. It is not perfect, for one can find omissions, such as "AFID" (alkali flame ionization detector), but that is not a serious criticism, and this dictionary should be very useful to the intended audience.

A Dictionary of Electrochemistry. By C. W. DAVIES and A. M. JAMES. Wiley/Halsted, New York, N.Y. 1976. x + 246 pp. \$22.50.

This book gives considerably more than simple definitions, and many of the entries somewhat resemble brief encyclopedia entries. "Electrode reaction mechanisms", for example, takes up nearly three pages, and "corrosion" occupies 4½ pages. The entries are lucidly written and contain many cross references, figures, and equations. The utility of this dictionary is enhanced by an extensive list of principal symbols and several pages of "tables of useful data".

Ligand Field Energy Diagrams. By E. KÖNIG and S. KREMER. Plenum Press, New York, N.Y. 1977. viii + 454 pp. \$49.50.

The material in this book is meant to complement the diagrams published some 20 years ago by Tanabe and Sugano. Those diagrams were for d^N electronic configurations but were limited by the fact that they could be used only for octahedral symmetry and for a limited number of terms. The present authors have produced field energy diagrams "for the more important geometrical arrangements of d^N compounds". They were obtained by use of irreducible tensor operator methods, which are explained in a 46-page introductory section. The diagrams themselves are reproduced in large format, one to a page.

Polymer Rheology. By LAWRENCE E. NIELSEN. Marcel Dekker, Inc., New York, N.Y. 1977. x + 203 pp. \$17.50.

Books on rheology are often of little help to the uninitiated, and especially to the organic chemist who is used to thinking phenomenologically, for rheologists seem to be unable to resist the

temptation to revel in the delights of a euphoric orgy of arcane mathematics. It is therefore a pleasure to read a book that is designed to lead the outsider into the subject. This book might almost have been titled "Rheology for Chemists", for it should have a wider appeal than just polymer specialists, and the first three of the ten chapters lay the foundation for the subject with a nice balance between physical models and mathematical abstractions. There is also a substantial amount of discussion of practical matters, such as effects of plasticizers and lubricants, melt fracture, die swell, etc., of concern to industrial polymer people. Two chapters are said to be unique in providing the only available treatment of rheology of suspensions, lattices, plastisols, and powders. A five-page appendix gives a most useful glossary of the many symbols used in the field.

Tables of Wavenumbers for the Calibration of Infrared Spectrometers. Second Edition. Compiled by A. R. H. COLE (University of Western Australia). Pergamon Press, Elmsford, N.Y. 1977. ix + 219 pp. \$22.50.

This book is sponsored by the Commission on Molecular Structure and Spectroscopy of IUPAC. The first edition appeared in two parts in 1961 and 1973. The subject is now embraced in one volume, in which the far-infrared data are integrated with the higher frequency values. The tables are divided into two parts: one for calibration of high- to medium-resolution spectrometers, and the other for low-resolution spectrometers. It is in Part I that the greatest changes occur, the tables having been completely replaced with new material. Most of the calibrants are gases, in accordance with the Commission's recommendations, but some liquid calibrants are included for smaller spectrometers.

Proceedings of the Sixth International Congress on Catalysis. Volumes 1 and 2. Edited by G. C. BOND, P. B. WELLS and F. C. TOMPKINS. The Chemical Society, London. 1977. xv + xi + 1133 + xiii pp. \$70.00.

The title Congress took place in London in July 1976. This book contains the texts of the 109 papers presented, together with tables, figures, and references. The papers are accounts of original research, presented in some detail; each is preceded by an abstract. Some papers not actually read are included, together with a transcript of the discussion that took place. The subjects range from biological to industrial, and from theoretical to experimental. An author index and a subject index of key words in the titles are included in each volume.

Characterization of Powder Surfaces. Edited by G. D. PARFITT and K. S. W. SING. Academic Press, New York and London. 1976. x + 464 pp. £13.80.

This book is intended for chemists in industry who are concerned with the use of powders, especially those used as pigments and filters in paints, inks, plastics, fibers, etc. The first two chapters deal with the general types of characterization, such as adsorption characteristics, porosity, area, spectroscopy, surface reactions, and electrochemical properties. Chapter Three is devoted to the flow of powders and its relation to surface properties. The remaining six chapters take up important classes of powders, such as clays, carbon blacks, inorganic and organic pigments, and silicas. The chapters are contributed by industrial chemists from Britain, Germany, and the United States. Bibliographies are extensive and the index is good.

Tranersonic Flow Problems in Turbomachinery. Edited by T. C. ADAMSON, JR., and M. F. PLATZER. Hemisphere Publishing Corp., Washington, D.C. 1977. xix + 660 pp. \$39.50.

This book is the proceedings of a workshop-symposium dealing with aerodynamic problems encountered at high-speed operation of engines. Although it is essentially engineering in emphasis, physical chemists interested in viscosity of gases, fluid flow, and shock waves may find parts of it useful.

Electron Movement: A Guide for Students of Organic Chemistry. By DANIEL P. WEEKS (Seton Hall University). W. B. Saunders, Philadelphia, Pa. 1976. xv + 133 pp. \$4.95.

This is a soft-bound workbook, using a programmed approach, designed for self-teaching, to help the student who arrives at organic chemistry fresh from the theoretical and quantitative atmosphere of general chemistry, only to find himself "in a new world where equations are seldom balanced, where there is an enormous factual content, and where mathematics is a dirty word."

Pesticides and Human Welfare. Edited by D. L. GUNN and J. G. R. STEVENS. Oxford University Press, New York, N.Y. 1977. xii + 278 pp. \$11.00 (cloth); \$4.00 (paper).

This is a book about chemicals, or rather their role in agriculture, and not chemistry. It is aimed at the problem of providing adequate food for the population, especially in undeveloped countries. A large and very much international group of contributors in 20 chapters discuss the impact, positive and negative, on the use of pesticides in food production, and attempt to put the subject in perspective.

BOOKS RECEIVED

Scientific Analysis in the Pocket Calculator. Second Edition. By JOHN M. SMITH. Wiley/Interscience, New York, N.Y. 1977. xii + 445 pp.

This book aims to enable the owner of a pocket calculator to make the most of its capabilities, even if it is a simple instrument.

H II Regions and Related Topics. Edited by T. L. WILSON and D. DOWNES. Springer-Verlag, New York, N.Y. 1975. xii + 488 pp. \$16.00.

The proceedings of a symposium on interstellar spectroscopy.

Mixing: Principles and Applications. By SHINJI NAGATA. Wiley/Halsted, New York, N.Y. 1975. xviii + 458 pp. \$9.

About mixing and processing of liquids in agitated vessels.

One. By OREST. Strawberry Hill Press, San Francisco, Calif. 1977. xi + 127 pp. \$4.95.

A metaphysical work aiming to demonstrate that "the same fundamental law governs the atom and all life."

Essays in Biochemistry. Volume 10. Edited by P. N. CAMPBELL and F. DICKENS. Academic Press, London. 1974. xi + 156 pp. \$7.00.

New Parts for Old. By JOHN G. DEATON. Franklin Publishing Co., Palisades, N.J. 1975. 160 pp. \$7.40.

A popularly written account about replacement parts for the human body.

Hormones in Human Blood: Detection and Assay. Edited by HARRY N. ANTONIADES. Harvard University Press, Cambridge, Mass. 1976. xvii + 810 pp. \$49.50.

There has been an almost explosive advance in our knowledge of the chemistry and biological function of the hormones. The impetus for this has come from the development of radioimmunoassay and related specific binding assays for the extremely small concentrations of these molecules occurring naturally. As with any development which provides a powerful new analytical probe, the rush to use the technique sometimes leads to pitfalls which are not at first apparent. Sufficient time has now elapsed so that a more objective view can be taken. This book represents a selective but at the same time comprehensive discussion and is, in fact, very much more than is implied by the title. The book is divided into four parts. The first two are excellent reviews of the use of modern isolation and purification methodology and the basic elements of radioimmunoassay techniques. The later two parts are devoted to more detailed descriptions of the application of these techniques to the assay of specific polypeptides, steroids, catecholamines, and thyroid hormones. Detailed procedures are given throughout as concrete examples along with critiques evaluating limitations. The authors of the 46 individual chapters are all experts and in most cases pioneers in the areas they cover. A well-organized bibliography is provided at the end of each chapter. Extension of the competitive binding principle to the study of hormone-protein receptor interaction for a number of hormones is discussed. More emphasis needs to be placed on correlation of receptor binding with specific biochemical reactions in the target cells. Uncritical assignment of such binding components as the biological site of action of a hormone can cause difficulty, particularly with broken cell preparations.

This book should be required reading for anyone expecting to obtain meaningful results in the assay or study of structure-function relationships of hormones.

John E. Stouffer, *Baylor College of Medicine*

Characterization of Metal and Polymer Surfaces. Edited by LIENG-HUANG LEE (Xerox Corporation). Academic Press, Inc., New York, N.Y. 1977. Vol. I: xiv + 517 pp. \$26.50. Vol. II: xv + 465 pp. \$24.00.

This book is a collection of the papers and related discussions presented at the Symposium on Advances in Characterization of Metal and Polymer Surfaces held in April 1976 as part of the Centennial Meeting of the American Chemical Society, in two basically independent volumes.

Volume I is devoted to the study of metal surfaces. In its five sections papers and discussions concerning the role of (i) atom-probe and Mossbauer spectroscopy, (ii) auger electron spectroscopy and electron microprobe, (iii) low-energy electron diffraction (LEED), (iv) secondary ion mass spectrometry, and (v) photoelectron and electron tunneling spectroscopy, as surface sensitive probes, are presented. Volume II considers the characterization of polymer surfaces. Its four experimentally oriented sections consider (i) electron spectroscopy for chemical analysis, (ii) infrared and laser Raman spectroscopy, (iii) microscopy for polymers, and (iv) surface-chemical and radiation analyses, as methods of characterizing polymer surfaces.

Approximately one-third of the first volume is devoted to a well-balanced exposition of the theory and application of LEED, which is testimony to its current importance as a surface probe. As with any work in such a dynamic area as surface science, the most recent advances in some areas are necessarily absent. In particular, the recent advances from both theoretical and experimental directions in the area of angle-resolved photoemission spectroscopy are absent, although it should be noted that an exemplary contribution in this area by Rhodin and Brucker is contained in Volume I. To the volumes' credit are, an interesting historically based introduction by the editor and the "authoritative overviews" which begin each section.

David R. Yarkony, *Johns Hopkins University*

Theory of Simple Liquids. By JEAN-PIERRE HANSEN (Université Pierre et Marie Curie) and IAN R. MCDONALD (University of London). Academic Press, London. 1976. xv + 395. £14.

This book describes the study of the structure and dynamics of liquids composed of chemically inert molecules. Equilibrium properties are analyzed using distribution functions and perturbation theories while dynamical processes are discussed using hydrodynamic equations with frequency and wavenumber dependent coefficients. In general the emphasis tends to be on techniques and models rather than extensive discussions of results. The writing is clear and concise; it is descriptive though not always expository.

One of the most significant recent developments in the equilibrium theory of liquids is the quantitative formulation of the van der Waals picture of a liquid as a system whose structure is determined mainly by the strong repulsive forces between the closely packed atoms. The perturbation theories which have been developed to take into account the effect of attractive forces are described in considerable detail, and comparisons are given between numerical calculations and computer simulation experiments.

The treatment of time-dependent correlation functions, the quantities which play such an important role in current research in non-equilibrium statistical mechanics, is quite comprehensive. Fundamental properties of these functions as well as the various methods of their analysis are fully discussed. However, the authors do not go into kinetic theory which would provide the natural link between this work and the long-established theory of transport coefficients. More importantly kinetic theory offers a means of calculating the correlation functions directly in terms of a prescribed potential, an approach that would be parallel to the preceding treatment of equilibrium properties, at least in the case of hard-sphere fluids.

Although this is not a book on computer studies, computer results generated by Monte Carlo and molecular dynamics simulation are used almost exclusively in the comparison with theoretical calculations. The point of view that computer data rather than laboratory measurements provide the more definitive test of models and approximations has become prevalent in the current research in simple liquids. One can expect that the successes described in this book will stimulate similar developments in the study of more complicated physical systems.

Sidney Yip, *Massachusetts Institute of Technology*

Proceedings of the Third International Biodegradation Symposium. Sessions XVIII and XXI. Edited by J. M. SHARPLEY (Sharples Laboratories) and A. M. KAPLAN (U.S. Army Research and Development Command). Applied Science Publishers Ltd., London. 1976. v + 111 pp. \$18.00.

The biodegradability of synthetic compounds has emerged as a major subject of concern to regulatory agencies and the chemical industry because of the increasing attention being given to the environmental effects of chemicals deliberately or inadvertently released into waters and soils. Although the topic has been the subject of considerable inquiry with regard to pesticides since some of the insecticides and herbicides persist for long periods in nature, the evidence for the longevity of toxic substances such as the PCBs and the enactment of the Toxic Substances Control Act are prompting still more research and monitoring of the microbial attack on and destruction of a variety of classes of molecules.

This volume includes papers from two sessions of the biodegradation symposium held at the University of Rhode Island. One group of papers deals with synthetic polymers of a number of types; the second group focusses on a number of pesticides and trinitrotoluene. Inasmuch as the reports represent short technical papers, there is little in the way of a common theme, and no large picture emerges. However, it is evident that the field is still in need of generalizations since no guiding principles or common patterns are evident from these papers and others presented at the symposium. Thus, in view of the undoubted deleterious effects that at least some chemicals have because of their resistance to microbial decomposition and the enormous number of compounds in use at the present time, generalizations relating structure to biodegradability in natural ecosystems are sorely needed. This book makes a small contribution in this direction, but, alas, the contribution is minute in light of the need.

Martin Alexander, Cornell University

Theoretical Chemistry (Advances and Perspectives). Volume 2. Edited by HENRY EYRING (University of Utah) and DOUGLAS HENDERSON (IBM, San Jose). Academic Press Inc., New York, N.Y. 1976. xi + 298 pp. \$30.00.

This volume contains three essays, two of which strike me as peripheral to the interests of chemists, even the theoretically oriented. In particular, the nonrelativistic ground state of an electron gas in a magnetic field is not of substantial importance to chemistry even if, as the editors remark in the preface, the properties of such a gas in a very high magnetic field do have relevance to matter in collapsed stellar objects. In addition, the essay is highly technical—it employs without preface the notions of Landau gauge and Green's functions—and generally requires a sophistication uncommon to students, certainly, and to most practicing chemists, almost certainly.

A better case can be made for the exposition by Josef Paldus of the structure of groups and their application to the many-electron correlation problem. This essay will probably be read by those interested in practical questions of quantum chemistry, but it will doubtless be of value to others who may wish to learn something of Lie groups, tableaux, and pattern calculus. It is not an easy essay, however, and naive readers may wish to wade elsewhere before plunging in here.

Amos and Crispin, on the other hand, do a craftsmanlike job in presenting the current state of the art for "Calculations of Intermolecular Interaction Energies". The treatment is systematic and moves smoothly from the basic principles through problems of increasing complexity. The level is advanced but not beyond the grasp of anyone who has studied, thoroughly, a robust introductory course in quantum chemistry. Students, in particular, will appreciate an especially clear appendix devoted to the bipolar expansion.

Absent from the presentation are serious discussions of quasi-spherical polyatomic molecules and of nonadditive three-body forces. The latter is especially disappointing since the authors do treat in some detail the hydrocarbons, both saturated and unsaturated, and there is ample evidence that significant nonadditive corrections are required to describe these systems. Nonetheless, this essay is to be recommended.

The first volume in this series was an interesting contribution to the literature of theoretical chemistry. We may hope that Volume 3 again achieves that standard.

Andrew G. De Rocco, University of Maryland

Molecular Connectivity in Chemistry and Drug Research. By LEMONT B. KIER (Massachusetts College of Pharmacy) and LOWELL H. HALL (Eastern Nazarene College). Academic Press, New York, N.Y. 1976. xiii + 257 pp. \$27.00.

Are there relationships between the ways atoms are interconnected in organic molecules, and the physical, chemical, and biological

properties of molecules? The authors of this book, which is both an eclectic historical survey and a research treatise, suggest an affirmative answer to this question. Kier and Hall first introduce graph theory and many of the topological indices which have been proposed in the literature. For example, if a molecule is considered a graph, and a connectivity matrix (e.g., 1 for atoms connected in a Lewis structure, 0 for atoms not connected) is constructed, the resulting matrix can be manipulated in various ways to obtain a single number, or topological index, to represent the connectivity of the molecule. In practice, there are many ways of doing this, and a series of indexes can be obtained. Kier and Hall have chosen to expand on the Randić formulation and also to introduce a formalism for handling heteroatomic systems.

Statistical correlations between the various connectivity indexes and molecular properties such as heats of atomization and molar refraction, or properties depending upon molecular interactions, such as boiling points or partition coefficients, are then demonstrated. The last five chapters are devoted to a description of correlations between connectivity indexes and various types of biological activity. This is clearly the purpose of the authors' enquiries, and the demonstration of correlations between biological activity and connectivity indices is quite impressive. However, as the authors state: "The absence of a clear mental picture of what each term is describing should in no way preclude its use". This book does not give insight into the fundamental reasons for molecular interactions and reactivities, but the authors have provided an indispensable guide to the graph theoretical approach to correlating structure with biological activity.

K. N. Houk, Louisiana State University

Symmetry Rules for Chemical Reactions. Orbital Topology and Elementary Processes. By RALPH G. PEARSON (Northwestern University). Wiley-Interscience, New York, N.Y. 1976. ix + 548 pp. \$26.00.

Filled with interesting facts and qualitative molecular orbital symmetry treatments of structures and rates of reactions of both organic and inorganic molecules, this book is essentially Professor Pearson's personal perspective on chemistry (P⁴C). The first two chapters contain illuminating discussions of group theory, potential energy surfaces, perturbation and MO theory, various symmetry rules, orbital and state correlation diagrams, and relationships between these and spectroscopy. Clearly, the coverage of this many meaty subjects in so few pages marks P⁴C as a book by an expert, for experts. The second-order Jahn-Teller effect and the "bond-symmetry rule" are the basis of this book, but although the theory is rigorous, the applications are qualitative: some rationales are more equal than others! After the stage is set, Pearson discusses pericyclic reactions and more qualitative approaches to the understanding of reaction rates, such as the frontier orbital method of Fukui. The shapes of AX_n (n = 1-8), and more complex molecules are discussed from the viewpoint of second-order Jahn-Teller effects, and the remaining chapters discuss mechanisms of inorganic and organic addition, elimination, and substitution reactions, pericyclic reactions, organometallic reactions, and transition metal-catalyzed processes. Finally, the last chapter discusses photochemical reactions.

The book is a unique mixture of group theoretical rigor, on the one hand, and "colorful" opinion, on the other. For example, in the discussion of IF₇ on page 206: "... there is a ρ_{0k} of (E₂' × E₁') = (E₁' + E₂') symmetry. . . there is probably a fairly substantial gap between e₂' and 2e₁'. For example, the molecule is colorless". Such abrupt transitions from formality to familiarity give the reader the impression of taking part in a personal conversation with Pearson, but will make it difficult for the inexperienced to learn from this book. Principles of great importance and generality are frequently buried in paragraphs otherwise containing specific information of less general significance.

Even the qualitative discussions in P⁴C use group theoretic terminology quite extensively, although ample use of "dumbbell" drawings of orbitals make this somewhat more palatable. Inorganic chemists, who generally think of symmetry in group theoretic terms, will find the book more readable than will organic chemists, who, having been educated through Woodward-Hoffmann theory, are most comfortable with S's and A's.

P⁴C will bring research chemists closer to the insights that Pearson has so often brought to chemistry.

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