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- (33) Rotation about the α - γ axis exchanges the orientation commonly associated with the directions of the two principal transition dipole moments of the chlorophylls (labeled X and Y in Figure 1), which would complicate single-crystal polarized absorption studies of these proteins.
- (34) A bacteriochlorophyll-protein complex containing seven bacteriochlorophylls per protein and three identical subunits has been isolated, and the crystal structure determined to 2.8 Å resolution (Matthews, B. W.; Fenna, R. E.; Bolognesi, M. C.; Schmid, M. F.; Olson, J. M. *J. Mol. Biol.*, in press). Of the seven bacteriochlorophylls, five appear to be coordinated to histidine.

In an independent study which appeared after this work was submitted, chlorophyllin (the water-soluble degradation product of chlorophyllide in which ring V is lost) has been combined with apoMb (Davis, R. C.; Pearlstein, R. M. *Nature (London)* **1979**, *208*, 413). The chromophore is photochemically unstable and undergoes a series of interesting, irreversible transformations in the protein. The binding site of the 1:1 complex and the chemical identities of the transformed chromophores have not yet been established. By contrast, we note that the chlorophyll chromophore is stable in the protein.

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Book Reviews

Mathematical Foundations of Quantum Theory. Edited by A. R. MARLOW (Loyola University, New Orleans). Academic Press, New York. 1978. x + 372 pp. \$22.00.

This book consists of presentations to a conference at Loyola University (June 2-4, 1977) by 19 contributors including, most notably, P. A. M. Dirac and John Archibald Wheeler. Wheeler analyzes the "delayed-choice" double-slit diffraction experiment, from which follows some fascinating speculations concerning the organization of the universe. The past, proposes Wheeler, may be determined partly by actions in the present: "present choice influences past dynamics"; "the past has no existence except as it is recorded in the present." Also implied is that we might live in a "participatory universe" in which "no phenomenon is a phenomenon until . . . it is an observed phenomenon." Most of the other contributions are of a highly technical nature, concerning quantum logics, orthomodular structures, C*-algebras, and the like.

S. M. Blinder, *University of Michigan*

Quantum Chemistry. By J. P. LOWE (Pennsylvania State University). Academic Press, New York. 1978. xvi + 599 pp. \$49.50.

This is a textbook on quantum chemistry for graduate students and advanced undergraduates. The Schrödinger equation and the requisite principles of quantum mechanics are developed along standard lines, but the writing is distinguished by clarity and style. The focus of the book is on ground-state molecular-orbital theories. Full chapters are devoted to the simple Hückel method, the extended Hückel method, and SCF-LCAO-MO methods. Detailed derivation is given of the basic SCF equations, partly in an appendix. The variational method and its matrix formulation, perturbation theory, and group theory are covered in individual chapters, with emphasis quite appropriately on chemical applications rather than mathematical rigor. A concluding chapter deals with qualitative molecular orbital theories, featuring Walsh diagrams and the Woodward-Hoffmann principles. Some 90 pages of appendices include mathematical supplements to the text, a listing of Hückel MO's, computer programs, and group-theoretical tables. Each of the 14 chapters contains a selection of problems and references. Readers of Lowe's book should acquire an excellent appreciation of the present status of both ab initio and semiempirical quantum chemistry. Only its rather steep price might deter the book's adoption as a course text. (Recently, however, a paperback student edition has appeared costing \$19.50.)

S. M. Blinder, *University of Michigan*

Affinity Chromatography. Journal of Chromatography Library. Volume 12. By J. TURKOVA (Prague). Elsevier Scientific Publishing Co., Amsterdam. 1978. ix + 405 pp. \$69.75.

The uniquely specific complexes which form between many biologically important substances have in recent years provided the basis for a wide variety of analytical and preparative techniques useful for diagnostic medicine as well as fundamental research. This new monograph on affinity chromatography is an exhaustive treatment of one of the more important of these techniques. Historical per-

spective, theoretical background, laboratory practice, and existing applications are presented in an organized and lucid manner. The text will be very useful to both experts and newcomers to this important experimental technique. A very useful feature is the extensive tabulation of applications of affinity chromatography to the isolation of biologically active products including antibodies, antigens and haptens, cells and organelles, cofactors, enzymes, glycoproteins, proteins, and nucleic acids, etc. Some attention is also given to hydrophobic chromatography and immobilized enzymes, topics not inclusive to the title of this excellent effort.

Peter T. Kissinger, *Purdue University*

Cyclodextrin Chemistry. Reactivity and Structure Concepts in Organic Chemistry. Volume 6. By M. L. BENDER and M. KOMIYAMA (Northwestern University). Springer-Verlag, Berlin. 1978. x + 96 pp. \$22.00.

Cyclodextrins are fascinating substances which make very good enzyme models. But they are much more than just that: they can make simple organic reactions quite stereospecific, they stabilize free radicals, and they even improve the efficacy of cockroach poison! In this small book these and other aspects of the chemistry of cyclodextrins are reviewed by one of the leading investigators in the field.

Myron Bender wrote another review of cyclodextrin chemistry some six years ago [*Advances in Catalysis*, **23**, 209 (1973)]. This book is a much expanded and completely rewritten version of that review; it has, for example, three times the number of references, which attests to the very rapid recent growth of interest in this subject. Although the emphasis in this book is on catalysis by cyclodextrins through inclusion of substrates into their central cavities, and what can be learned from this about catalysis by enzymes, there are sections on the properties and structure of cyclodextrins as well as a thoughtful analysis of the forces that bind substrate and catalyst together.

I enjoyed reading this book. I am sure that chemists working with cyclodextrins will find it a valuable reference work and that others who read it will discover that it contains some very interesting chemistry.

A. J. Kresge, *University of Toronto, Scarborough College*

Applications of Polymer Spectroscopy. Edited by E. G. BRAME, JR. (E.I. du Pont de Nemours & Co.). Academic Press, Inc., New York. 1978. xiv + 289 pp. \$29.50.

This book is based on the papers presented at the American Chemical Society meeting in San Francisco in 1977; however, as the editor states, it contains new and updated material in addition to that presented at the meeting. The collection of 16 papers deals with three important areas of application of spectroscopy for structural studies: NMR, IR, and mass spectroscopy. The first group of seven papers contains coverage of the use of carbon-13, proton and fluorine-19 NMR for determination of polymer structure including studies of cis-trans and 1,2-1,4 isomerism, determination of copolymer composition and comonomer sequence distribution, end-group analysis, determination of the degree of branching, and studies of conformational transitions in amorphous and semicrystalline polymers, as well

as application of NMR spectroscopy to follow oxidation of diene polymers. The group of papers related to IR spectroscopy gives a survey of application of Fourier Transform IR for studies of optically dense materials (e.g., polymers filled with carbon black), reflection-absorption IR for investigations of polymeric films on metal surfaces, and dynamic IR for studies of molecular mechanics of polymer deformation. Papers dealing with mass spectroscopy are devoted to studies of mechanical and thermal degradation of polymers. Examples of application of Raman spectroscopy, ESR, and chemiluminescence method for structural studies are also treated in the book. Although, this volume is not a general and exhaustive survey of the field, the collection of presented papers indicates the new trends in application of various spectroscopic techniques for structural studies and should be highly recommended for all interested in this field.

P. Kubisa, O. Vogl, *University of Massachusetts*

Environmental Analysis. Edited by G. W. EWING (Seton Hall University). Academic Press, Inc., New York, 1977. xvi + 344 pp. \$18.50.

This book is a collection of the papers presented at the Third Annual Meeting of the Federation of Analytical Chemistry and Spectroscopy Societies on November 15–18, 1976. A number of papers were devoted to reviews of the state of the art with respect to specific environmental analytical techniques, while others represented the results of applying such techniques to particular situations. The 23 chapters are grouped together (more or less) by topical categories. Techniques discussed include: anodic stripping voltammetry, tunable lasers, remote sensing, flame resonance spectrometry, infrared spectroscopy, microcomputer-controlled single beam spectrometry, inductively coupled argon plasma optical emission spectroscopy, and laser Raman spectroscopy. A variety of conventional techniques are covered as well.

The book presents some interesting and potentially useful techniques. However, the title is rather misleading as it relates to present-day state of the art in environmental analysis. The use of mass spectrometry (alone or coupled to a GC or LC) seems to have been completely ignored at this conference, as has FT-IR (long or short path). Another omission is the growing use of high performance liquid chromatography.

William C. Kuryla, *Union Carbide Corporation*

International Conference on Computers and Optimization in Analytical Chemistry, Amsterdam, April 5–7, 1978. Edited by J. T. CLERC (Universität Bern). Special Issue of *Analytica Chimica Acta—Computer Techniques and Optimization*, Vol. 103, No. 4. Elsevier Scientific Publishing Co., Amsterdam, 1978. 227 pp. \$36.50.

The proceedings of this excellent conference have been published in journal form as a special issue of *Analytica Chimica Acta*. The contributions consist of 20 papers divided roughly into recognizable groups: data retrieval and search systems, newer computerized instrumentation and data analysis systems, microprocessor applications, and chemometric techniques.

The collection covers the following topics: problems in spectroscopic data retrieval systems; a new laboratory search system for mass spectra; design and application of low-cost IR data systems; numerical taxonomy applied to IR spectra; applications of computerized dispersive IR solution spectroscopy; theory of error for target factor analysis; chemical substructure coding; computerized Kalousek polarography; microcomputer systems for potentiometric stripping analysis, viscometry, atomic absorption spectrometry, and photometric analysis; the super-modified simplex method; four levels of pattern recognition; monitoring of water quality by autocorrelation analysis; small laboratory computer networks; an automated chemical synthesis system; discussion of a significance test for inductive/mesomeric effects; and laboratory automation for pharmaceutical quality control.

Persons interested in obtaining copies of this special issue are encouraged to order directly from Elsevier rather than their bookseller.

Russell D. Larsen, *University of Michigan*

Inorganic and Organometallic Photochemistry. *Advances in Chemistry Series No. 168.* Edited by MARK S. WRIGHTON (Massachusetts Institute of Technology). American Chemical Society, Washington, D.C. 1978. vii + 231 pp. \$30.00.

Here is another slim but excellent volume in the popular *Advances in Chemistry Series*. Papers presented in a symposium at the Fall 1977

ACS meeting in Chicago review the most recent developments in the photochemistry of inorganic coordination compounds and organometallic compounds. The authors, editor, and publishers are to be congratulated for producing the book in just over a year.

Four of the dozen articles concern the intricacies of polypyridyl complexes with Ru(II), its periodic table neighbors, and Cr(III); their photochemistry, and electron and energy transfer reactions, from the laboratories of Sutin, Whitten, Watts, and Hoffman. Gray and colleagues explore isocyanide complexes as well as their bridged polynuclear Rh(I) species. Ford describes some of the rich photochemistry of Ru(II) ammine complexes. Alway and Barnett have studied the photochemistry of ligand loss and of isomerization of iron cyclopentadienyl complexes.

The other papers are largely concerned with olefin reactions sensitized by organometallics or catalyzed by photoproduced catalysts. Geoffroy and Epstein describe photoreactions of cobalt carbonyls in a hydrogen atmosphere; George, Busby, and Iske discuss their work on a new class of stable Mo alkylazenido complexes formed by irradiation of Mo-N₂ species and alkyl iodides. Kutal extends his studies on norbornadiene isomerization using Cu(I) and Ir(III) sensitizers from the standpoint of energy storage, while Salomon pursues similar work with emphasis on mechanism. Finally the Editor and his colleagues demonstrate photocatalysis of alkene isomerization and silylation by iron group carbonyls.

Gerald B. Porter, *University of British Columbia*

Energy and the Atmosphere. A Physical-Chemical Approach. By IAN M. CAMPBELL (University of Leeds). John Wiley & Sons, Ltd., London, 1977. ix + 398 pp. \$35.95.

This book covers two interrelated topics—the energy balance and chemistry of the atmosphere. It is written at the level of the advanced undergraduate or beginning graduate student and could be used as a text in a course on the atmosphere at this level.

The first six chapters deal with energy balances starting with a comparison of the planetary atmospheres in Chapter 1. Chapters 2 and 3 describe the energy balances in the earth's atmosphere including discussions of the partition of energy into reflection, scattering and absorption, and how the energy input determines the atmosphere temperature profile.

Chapters 4–6 deal with energy on the earth's surface. These include discussions of the photosynthetic origin of fuels, combustion, and the realization of energy. The last topic includes a description of the operation of engines, their thermodynamics, and their efficiencies. There is a large section devoted to fuel cells.

Chapter 7 gives an overall review of the global chemical cycles for hydrogen, carbon, oxygen, nitrogen, and sulfur. The detailed chemistry starts in Chapter 8 which discusses polluted tropospheric chemistry. However, a good deal of this chapter discusses fundamental photochemical problems such as selection rules in photoabsorption and primary photochemical processes. The electronic state term symbols are introduced arbitrarily, and this may be the weakest part of the book. Then follows an overview and the important chemical reactions in the polluted troposphere. The detailed mechanisms of reactions and all the side cycles are not covered in depth, and this is probably wise for this level book.

Chapter 9 deals with the upper atmosphere. It includes a discussion of photodissociation coefficients of atmospheric gases. Emphasis is given to the stratospheric ozone problem and the biological effects of ultraviolet radiation. The chemistry of the airglow is also covered quite nicely. The ionosphere is discussed somewhat briefly in Chapter 10, which is only eight pages.

All in all this is a good book which adequately covers the subject at the level intended. It is well and clearly written and should serve as a useful first introduction to the physics and chemistry of the atmosphere.

Julian Hecklen, *The Pennsylvania State University*

High Resolution NMR Spectroscopy in Solids (NMR, Basic Principles and Progress). Volume 11. Edited by P. DIEHL, E. FLUCK, and R. KOSFELD. By M. MEHRING (Universität Dortmund). Springer-Verlag, Berlin-Heidelberg-New York, 1976. xi + 246 pp. \$27.90.

High-resolution NMR spectroscopy has won an important place as a tool for the study of liquids by researchers in the chemical sciences for three decades. In contrast to high-resolution NMR in liquids, where the resolution is limited only by the homogeneity of the applied magnetic field, the problem is very complex in high-resolution studies

of solids. The unwanted dipolar broadening needs to be eliminated in solids to reveal hidden chemical shifts and exchange coupling interactions in them. The technique to achieve this, called high-resolution NMR in solids, requiring complex multiple rf pulses, is a newer and very powerful technique whose experimental and theoretical development started with the pioneering efforts of John Waugh and his co-workers. Peter Masfield, among others, has contributed significantly to this sophisticated new approach, which has resulted in a wealth of new information in solids. It should be equally valuable in the study of semisolids. The present monograph by M. Mehring is the first comprehensive review of the subject.

Mehring begins his book with an introduction of some of the main approaches used for high resolution NMR studies in solids along with some typical results. The second chapter has a condensed discussion of the nuclear spin Hamiltonian describing spin interactions in solids in tensorial form. It also includes a discussion of the molecular re-orientation and sample rotation method. The next chapter, "Multiple-Pulse NMR Experiments", is the heart of the book. It contains a brief review of the classic pulse sequences, including Carr-Purcell sequence and phase-altered sequence (PAS). This is followed by the basic and most used WAHUA four-pulse sequence and MERV eight-pulse sequence, which give rise to the vanishing dipolar and quadrupolar Hamiltonian. An excellent feature of this chapter, as well as the rest of the book, is the inclusion of a number of schematic representations of models, experiments, pulse sequences, rotations and different frames of reference. Chapter Four is a detailed discussion of double-resonance experiments, including cross polarization and spin-decoupling dynamics. Chapter Five reviews magnetic shielding tensors and their current status. The spin-lattice relaxation in multiple pulse experiments is discussed in the final chapter.

The monograph should be extremely helpful to those who are well grounded in basic NMR, and wish to learn about the theory, technique, and important applications of high resolution NMR in solids. The author's comment in his preface about some familiarity with books by A. Abragam and M. Goldman as a prerequisite for this text should be taken seriously. It would be difficult reading without an adequate background.

The monograph is clear, thorough, and rigorous in treatment. Liberal use of well-conceived models, sketches, and diagrams greatly facilitates the understanding of the material. Also, there are excellent reference lists for each chapter containing those of greatest importance to a newcomer to the field. Typographical errors are few for a first edition. Mehring is to be commended for producing an excellent and much needed complete text on the subject. Along with the recent book by Ulrich Haeblerlin, it brings the reader to the exciting frontiers of high-resolution NMR in solids.

Prem P. Mahendroo, *Texas Christian University*

Haemostasis: Biochemistry, Physiology, and Pathology. Edited by D. OGSTON and B. BENNETT (University of Aberdeen). Wiley-Interscience, New York. 1977. ix + 529 pp. \$39.00.

The editors of this book had as their goal to produce a "comprehensive and up-to-date account of the biochemistry, physiology and pathology of the haemostatic mechanism and its individual components." For the most part they have admirably accomplished their purposes. By enlisting the aid of expert and well-known workers in this very diverse field, they have produced a single volume which goes a long way to summarizing the important observations and concepts relating to haemostasis.

O. D. Ratnoff reviews blood clotting mechanisms, Y. Nemerson summarized tissue pathways of coagulation, and in separate chapters, R. F. Doolittle and L. Lorand cover the conversion of fibrinogen to stabilized fibrin. The role of platelets in coagulation is reviewed by P. N. Walsh.

About one-third of the space is devoted to various pathological aspects of hemostasis, including both genetic and nongenetic conditions. Some attention is given to the interactions of various chemical species, including heparin and various antibodies, with the components of the hemostatic system.

The book very adequately serves the role of a complete and concise historical review of the field. Each chapter is clearly written and documents the information with numerous literature citations (between 50 and 730 references per chapter). The manuscripts were apparently finished in 1975, since very few references appear after that date. Except for this one limitation, this book is a handy and easily used guide to the complex field of haemostasis.

Jerome S. Schultz, *University of Michigan*

Catalysis in Organic Syntheses 1977. By GERARD V. SMITH (Southern Illinois University). Academic Press, New York. 1977. vii + 295 pp. \$15.00.

"Catalysis in Organic Syntheses 1977" contains 15 reports presented at the Sixth Conference on Catalysis in Organic Syntheses. As implied by the title, the scope of the book is rather broad, while that of the individual articles is somewhat narrow, although not necessarily uninteresting. Although a full one-third of the book describes work done at Southern Illinois University, the other chapters are derived evenly from both industrial and other academic sources.

The book describes both mechanistic and synthetic studies which rely on catalysis both homogeneous and heterogeneous in nature and has a decided applied orientation as a whole. The book is divided into three parts. The first, on hydrogenation, contains two reports on polymer-anchored homogeneous catalyst systems and two reports of heterogeneous catalysis using rhodium and palladium. The second section, entitled "special topics", contains three chapters which describe catalysis by molecular sieves, alumina supported metal oxide catalysts, and the oxidation of propylene. The last and largest section on "unusual catalysis" contains several chapters on nontransition metal catalysis including that of triphase catalysis and a lengthy chapter on chlorination with carbon tetrachloride/potassium hydroxide mixtures. Included also in this section are interesting reports of metal catalysts intercalated into silicate layers, polymer-anchored hydroformylation catalysts, and palladium-catalyzed vinyl substitution reactions. Lastly, this section contains articles which do not discuss catalytic reactions per se, but however are of potential relevance to catalysis; these chapters describe the transition-metal activation of dienes and a new synthesis of boron aluminum hydride reducing agents.

One refreshing aspect of this book is that it presents an illustration of the variety of catalysis in organic chemistry including homogeneous and heterogeneous catalysis with both transition metal and nonmetal reagents from both an applied and fundamental perspective. Nonetheless, the brevity and lack of depth of the individual articles limits the long-term usefulness of the book for private use.

Thomas B. Rauchfuss, *University of Illinois*

Principles of Industrial Chemistry. By CHRIS A. CLAUSEN III and GUY MATTSON (Florida Technological University). John Wiley & Sons, Inc., New York. 1978. xiv + 412 pp. \$18.95.

This text might better be titled "Some Chemical Engineering Principles for Chemists". Dealing exclusively with process development, the heavy emphasis is placed on material and energy accounting, chemical transport, heat transfer, reactor design, separation processes, and instrumented control systems. Process improvement and development are the lowest risk elements of the industrial investment dollar, and every dollar saved in process appears on the profit bottom line. But product development, returning only about 10% after taxes on the sales dollar, is essential for survival and growth in the competitive environment of chemical industry. Product development is only briefly covered in the one chapter on research and development appearing late in the book. Missing, too, are the very important project control techniques used by industrial management, such as PERT or CPM, and the importance of such R&D tools as experimental design and statistical analysis is mitigated by lack of emphasis (Chapter 10—Further Considerations).

Most chemists, as the authors agree, are hired initially into R&D positions. This text may provide a rather lopsided view of what their employers expect from them. However, the concepts discussed are important ones and the career success probabilities of the novice industrial chemist might be considerably enhanced by an understanding of them. Energy balance, for example, is of growing importance in industrial processing and has, in the past, too often been ignored by the chemist. Perhaps the authors are prescient in their concentration on process development: In today's harsh regulatory environment and in view of energy costs and uncertainties, it would appear that high-risk product development is losing in the battle for investment capital.

The text is intended for a senior or graduate level course in industrial chemistry, and such would serve well to provide a better understanding of basic engineering concepts. The value of this book to the recent chemistry graduate just starting his industrial career may be somewhat less and would depend on his assignments and objectives. Chapters are well referenced and most are followed by a problem section. Unfortunately, the answers to these problems are nowhere in the book.

Lewis B. Weisfeld, *Container Corporation of America*