

Additions and Corrections

Determination of the Zero-Field Splitting Constant for Proton NMR Chemical Shift Analysis in Metaquomoglobin. The Dipolar Shift as a Structural Probe [*J. Am. Chem. Soc.* **1993**, *115*, 9754–9762]. YUNG-HSIANG KAO AND JULIETTE T. J. LECOMTE

Page 9758: In Table 1, the fourth entry for Ile-101 should be HG2 and not HB2.

The observed chemical shifts of HD1 and HD2 of Leu-2 were inadvertently interchanged from the correct assignments (Cocco, M. J.; Kao, Y.-H.; Phillips, A. T.; Lecomte, J. T. J. *Biochemistry* **1992**, *31*, 6481–6491). This adjustment renders the deviation between calculated and observed values for Leu-2 HD2 insignificant. The entry in Table 1 and all other references to Leu-2 as a deviating residue should be deleted.

Page 9762: Arg-62 should be replaced with Lys-62.

Updated supplementary material is available from the authors.

Book Reviews *

Structure and Bonding. Volume 79. Complexes, Clusters and Crystal Chemistry. By M. J. Clark, J. B. Goodenough, J. A. Ibers, C. K. Jorgenson, and D. M. P. Mingos. Springer-Verlag: Berlin and Heidelberg. 1992. viii + 388 pp. \$198.00. ISBN 0-387-55095-X.

This volume contains six independent articles covering a wide range of topics which are collected under the general heading of Complexes, Clusters and Crystal Chemistry. The price of the volume is high, but this seems, unfortunately, to be the way for this type of collective work.

The first survey by Mingos *et al.*, entitled "Moments of inertia in cluster and coordination compounds", is a review detailing how moments of inertia can be used to study geometric and bonding problems in the title compounds. An introductory section considers general and simple geometries (cube, icosahedron, bipyramids, prism, antiprism). The review is instructive both to the reader to whom the topic is new and to those already initiated in the theory. It is well written and exemplified.

The Drillon *et al.* review, "Progress in polymetallic exchange-coupled systems; some examples in inorganic chemistry", opens with sections dealing with the theory of exchange-coupling and models available for understanding exchange phenomena. The main thrust of the article (understandably) is a survey of systems exhibiting exchange-coupling, *e.g.* perovskites, trirutile compounds, CsV₂O₅, copper(II) phosphates, RuF₅, and Ba₂CaCuFe₂F₁₄.

The electrochemistry of metal carbonyl cluster compounds is an area that has needed overviewing, and this is supplied by Zanella in the article entitled "Stereochemical aspects associated with redox behavior of heterometal carbonyl clusters". Zanella has clearly presented the chemistry, grouping compounds according to nuclearity and framework geometry. With 201 references, this article should make invaluable reading for the majority of transition metal cluster chemists. The chapter is profusely illustrated with structural figures and cyclic voltammograms.

"Electronic structure and bonding in actinyl ions" by Denning (135 references) has developed from a series of lectures. An informative introduction to this article sets out the properties of actinyl ions and defines the aims of the article. Discussions of electronic structure are addressed from both experimental and theoretical standpoints and are followed by a more chemically biased section in which the MO₂²⁺ unit is again the focus of attention.

In an article entitled "A new approach to structural description of complex polyhedra containing polychalcogenide anions", Evian *et al.* attempt to develop a scheme by which many of the well-known polychalcogenide clusters are rationalized. Unfortunately, the chosen structural nomenclature does not, at first glance, lend itself to easy interpretation and its general utility is not immediately apparent. The approach is based on relatively subtle differences in solid state structural parameters and has a relatively small data set (27 references, latest being 1987).

The final article considers the "Crystal chemistry of inorganic nitrides" (Brese *et al.*) and is, as the authors state, a systematic review of the topic. It provides a straightforward and well illustrated and referenced (377 references) account and is accompanied by tabulated structural data.

The review should provide a vital source of information for solid state and molecular cluster chemists.

Catherine E. Housecroft, *University of Cambridge*

Food Phytochemicals for Cancer Prevention I. Fruits and Vegetables. ACS Symposium Series 546. II. Teas, Spices, and Herbs. ACS Symposium Series 547. Edited by Mou-Tuan Huang (Rutgers), Toshihiko Osawa (Nagoya University), Chi-Tang Ho (Rutgers), and Robert T. Rosen (Rutgers). American Chemical Society: Washington, DC. 1994. I: xii + 428 pp; \$99.95; ISBN 0-8412-2768-3. II: xii + 370 pp; \$89.95; ISBN 0-8412-2769-1.

This book was developed from a symposium sponsored by the Division of Agricultural and Food Chemistry at the 204th National Meeting of the American Chemical Society held on 23–28 August 1992 in Washington, DC. In Part I, after a preface by the editors, there are 34 chapters organized under the following headings: Perspectives; Sulfur-Containing Phytochemicals in Garlic and Onions; Limonoids and Phthalides; Phytochemicals from Fruits and Vegetables; Phytochemicals in Soybeans; and Micronutrients. There are author, affiliation, and subject indexes. In Part II, after a preface by the editors, there are 35 chapters organized under the following headings: Perspectives; Phytochemicals from Tea; Antioxidants; Phytochemicals in Tumeric and Ginger; Lignans; Licorice, Ginseng, and Other Medicinal Plants. There are author, affiliation, and subject indexes.

Polymers for Electronic and Photonic Applications. By C. P. Wong. Academic Press: New York. 1993. xiv + 662 pp. \$93.50. ISBN 0-12-762540-2.

This book is divided into 15 chapters. The first chapter, by J. M. Shaw, offers an overview that focuses relatively heavily on polymers for integrated circuit processing (resists, planarization, and packaging), with a lighter treatment lean to active materials such as conductive and electro-optical polymers. The composition of this chapter represents to some extent the overall disposition of the book. Subsequent general chapters deal with microlithography (Reichmanis), dielectrics (two chapters: Monk and Soane; and Wight and Ors) and encapsulation (Wong). Specific polymers are discussed in chapters on polyimides (Satou and Makino), polyimidesiloxanes (Lee), and epoxy resins (Bauer). General thermoplastics (Funer and James) appear as a separate chapter. At this point, the focus of the book expands to include active materials: piezo and pyroelectrics (Davis); second- (Boyd) and third-order nonlinear optics (Kuzyk); optical interconnects and waveguides; and LB polymer film oligothiophene based structures (Rubner). A final chapter briefly discusses mechanical properties (Robinson).

For novices, the strength of this book lies in the material dealing with integrated circuit processing and technology. There is enough material and enough overlap of ideas and concepts between authors for the reader to develop a relatively informed picture of this domain of polymer

*Unsigned book reviews are by the Book Review Editor.

technology. The "active" polymer science aspects of the book do not meld to make as well a defined picture of what is going on within those fields. In some cases (e.g. Robinson), the author was clearly given insufficient space to develop anything but a relatively cursory treatment. Readers will experience some dissatisfaction with this part of the book if they already aren't reasonably well informed on general solid state and optical physics and also don't possess general knowledge of research in those fields. For instance, Kuzyk's article is well written and informative, though parts will be an intellectual challenge to nonexperts. This leaves the book effectively attempting to fulfill two missions, one the coalescence of information on IC technology and the other to provide a selection of current research accounts in the active polymer fields. The varying way the authors have addressed themselves to their tasks has meant some overlap of these two goals, though one wonders whether the authors wrote either reviews or accounts of their own volition or were instructed as such.

All of the above comments should necessarily be interpreted as descriptive rather than critical, since one volume dealing with such a broad subject area is an incongruity with the magnitude of the task. This book would be of value to polymer scientists within the electronics and optical materials field if the \$93.50 list price doesn't scare anyone away. Most of the chapters are generously referenced. The chapters on IC related technology are easy and interesting reading. Most of the active polymer chapters are good introductions to their fields but only hint at the research breadth of their fields' "big pictures", so that the reader will be forced to branch to other sources for real understanding.

Carl W. Dirk, *University of Texas at El Paso*

Naturally Occurring Benzodiazepines. Structure, Distribution and Function. Edited by Ivan Izquierdo (University Federal do Rio Grande do Sul, Brazil) and Jorge Medina (University of Buenos Aires, Argentina). Ellis Horwood Limited: New York. 1993. viii + 134 pp. \$57.00. ISBN 0-13-015488-1.

This book describes the discovery, characterization, and biosynthetic origins of endogenous, benzodiazepine-receptor ligands that are present in the brain, including the two benzodiazepine drugs *N*-desmethyldiazepam and diazepam. In addition, the potential role of these endogenous ligands in memory regulation and in neurological disorders is explored. The editors, Ivan Izquierdo and Jorge Medina, contributed six of the nine chapters, with the remaining three chapters being contributed by other leading researchers in the field. The authors provide a comprehensive list of up-to-date literature references, including those published as recently as 1992. Within each of the chapters, considerable experimental data is provided to support the tenets of the authors.

In the first chapter Angel Luis de Blas provides a very brief but clear overview of the mode of action of the commonly used benzodiazepine therapeutic agents in addition to a more detailed chronology of the discovery of endogenous, benzodiazepine-receptor ligands. In the second chapter Medina and Alejandro C. Paladini provide an overview of benzodiazepine-receptor ligands that occur in nature. This issue is of considerable relevance because several of these ligands were previously thought to be only synthetic in origin. In the third chapter Medina and Paladini provide a cohesive overview of research aimed at determining the origin of the benzodiazepine-receptor ligands in the brain, including both benzodiazepines and other small-molecule ligands of unidentified structure. Although the origins of the ligands are still highly speculative, evidence is presented that the benzodiazepines either are of alimentary origin or are biosynthesized by enteric flora, while the non-benzodiazepine ligands may be produced by a neuronal or glial biosynthetic pathway.

Chapters 4-8 focus on the potential roles of the endogenous, benzodiazepine-receptor ligands both in memory regulation and in neurological disorders. Considering that research on memory is in its infancy, it is not too surprising that the conclusions and implications presented in these chapters are highly speculative as well as subjective. In chapter 4 Ivan Izquierdo provides a very brief overview of neurotransmitter systems involved in memory with a particular emphasis on the role of GABA_A receptors (the benzodiazepine receptor is located in the extracellular domain of the GABA_A receptor complex). Izquierdo in Chapter 5 and C. Da Cunha, C. Wolfman, Izquierdo, and Medina in Chapter 6 provide an overview of research that has probed the effect of benzodiazepine-receptor ligands on memory regulation. In Chapter 7 Anthony S. Basile provides a very clear summary of the role of benzodiazepine-receptor ligands in the pathogenesis of hepatic encephalopathy. In particular, Basile provides experimental evidence which implicates elevated levels of endogenous *N*-desmethyldiazepam and diazepam in the pathogenesis of the disease. In Chapter 8 Jeffrey D. Rothstein and Alessandro Guidotti also discuss the role of benzodiazepine-receptor ligands in the pathogenesis of hepatic encephalopathy. In contrast to the results reported by Basile, their research suggests that two non-

benzodiazepine ligands, endozepine 2 and 4, are the key ligands in the pathogenesis of the disease. In the final chapter the editors reiterate many questions about the endogenous benzodiazepine-receptor ligands which still need to be explored.

Jonathan Ellman, *University of California, Berkeley*

Heterocyclic Compounds. Volume 51. Aza-Crown Macrocycles. By Jerald S. Bradshaw, Krzysztof E. Krakowiak, and Reed M. Izatt (Brigham Young University). An Interscience Publication of John Wiley and Sons, Inc.: New York. 1993. x + 886 pp. \$225.00. ISBN 0-471-52485-9.

The authors state in their preface that a *Chemical Reviews* article written in 1989 made them aware of the wealth of chemistry available in the azamacrocycle field and resulted in the present compilation. No more explanation for the existence of this book than that is required. The azacrowns are an extremely important class of synthetic macrocycles, and both the variety of their structures and the imagination with which they are designed and prepared are burgeoning. Moreover, compilations of structures are both difficult and tedious to develop. Our own volume on macrocycle syntheses, appearing in 1982, was less than half the size of the present one and covered all crowns then known as well as a large number of podands. The azamacrocycles chapter was barely 70 pages in that volume compared to the present volume, which devotes the better part of a thousand pages to this subject. The sheer volume of information contained in this book speaks clearly for the importance of the monograph.

The book is divided into thirteen chapters. Of these, the latter nine (V-XIII) are largely tabular but also include specific syntheses and representative synthetic approaches to the compounds tabulated. The earlier chapters are as follows: (I) Aza-crown macrocycles: an overview; (II) Preparation of starting materials; (III) General synthetic methods for the polyaza-crown macrocycles; and (IV) Common methods for the formation of polyazamacrocyclic rings. These first chapters are particularly useful in that they show what sorts of starting materials and synthetic schemes have been applied in the preparation of this diverse class of compounds. Such comments (p 40) as the following are included: "This method of preparing diamino ethers is probably not a general one. It is likely that the reaction of 1,5-dichloro-3-oxapentane with ammonia would give morpholine [*sic*] not the desired 1,5-diamino-3-oxapentane...." These are valuable to one less familiar either with the area on the particular compound type because it teaches potential pitfalls as well as probable successes. My experience suggests that it is the former that is usually harder to learn about.

In all, the authors are to be commended on bringing to the field an important reference work. It is, so far as I could tell, a thorough compilation of the literature and includes principles, examples, and critical judgment as well as tabular information. This volume will be important to all those working in or approaching the azacrown field.

George W. Gokel, *Washington University School of Medicine*

Thiophene and its Derivatives. Part 5. The Chemistry of Heterocyclic Compounds. Volume 44. Edited by S. Gronowitz (University of Lund). John Wiley and Sons, Interscience: New York. 1992. xiv + 918 pp. \$320.00. ISBN 0-471-52944-3.

This volume of the invaluable Weissberger/Taylor series of heterocyclic compounds forms the fifth part of a comprehensive review of thiophene chemistry. The set is appropriately edited by Salo Gronowitz, who also, together with Anna-Britta Hornfeldt, is the author of the first of the three chapters dealing with the chemistry of vinylthiophenes and thienylacetylenes. Both the synthesis and the chemistry of these very important thiophene derivatives are thoroughly reviewed. The 1020 references, many of them from very recent years, attest to the activity in this area of thiophene chemistry. A valuable aspect of this volume is the fact that many of the references throughout are from the patent literature.

The second chapter entitled Organometallic Derivatives of Thiophene was written by Torbjorn Frejd. It covers the synthesis and chemistry of the thienyllithium and -magnesium compounds. Metalation, directed metalation, transmetalation, and metal halogen exchange and the reactions of the so-derived thienyllithium derivatives are covered extensively. A very significant section of this chapter deals with the ring-opening reactions of 3-thienyllithium compounds, leading to mercaptoacetylenes, a sequence discovered and extensively investigated by S. Gronowitz and his colleagues in Lund. In addition, this chapter contains a valuable section on the metalation of thienocyclopentadienes and dithienocyclopentadienes.

The third chapter, written by Rolf Hakonsson, deals with the synthesis, reactions, and physical properties of bithienyls, polythienyls, and related compounds. This chapter summarizes the chemistry of this significant

class of thiophenes. The review is timely and up to date. Most of the 368 references are from the recent literature.

Altogether, the three chapters of this volume contain a wealth of information and are invaluable not only for the active researcher in thiophene chemistry but also for many organic chemists with diverse interests. It certainly is a pleasure to browse through the well illustrated volume.

With this large amount of material reviewed and presented, it is not surprising that some duplication was unavoidable in some tables. Furthermore, a number of errors have been overlooked, in some cases simple typographical errors while others are the result of so-called "Graphic Chemistry" ("ChemDraw Chemistry"). These errors do not decrease the tremendous value of this volume, following the high standards for which the Weissberger series is known.

Klaus G. Grohmann, Hunter College, CUNY

Computing for Scientists and Engineers. A Workbook of Analysis, Numerics, and Applications. By William J. Thompson (University of North Carolina). John Wiley and Sons: 1992. xiv + 444 pp. \$54.95. ISBN 0-471-54718-2.

This workbook is designed for a class or self-study of numerical methods commonly used by scientists and engineers rather than a recipe book of programs. It provides discussions of the basic mathematics of a topic, followed by a presentation of the various methods that can be used including estimates of the errors inherent in the method. The reader is expected to work through the exercises and to use his or her own software for the programs demonstrating the materials discussed. The programs do not include graphics, putting the emphasis on numerical solutions and not on data presentation. Also, a diskette of programs is not included.

The author has chosen to use C instead of FORTRAN, for which he argues unconvincingly; however, the result makes the book a useful guide to the FORTRAN or PASCAL literate who wishes to learn C for numerical computations. An appendix relates C to FORTRAN and PASCAL, although handling multidimensional arrays is not considered.

Topics that are covered include complex algebra, power series, numerical differentiation and integration, curve fitting (which was especially useful), discrete and integral Fourier transforms, and differential equation solving. Because only one-variable differential equations are treated, the reader does not get information on solving systems of equations. Linear algebra is not covered at all, which makes this book of less use to the chemist who uses numerical packages for quantum calculations and would like to understand them.

This book is not a guide to sophisticated numerical packages currently available for the chemist nor a book on programming per se. It is not even a complete guide to the basics of numerical methods; however, chemists who want to review or improve their knowledge of calculus will find it useful. Also, the chemist who uses canned programs and wants to understand the limitations of the methods employed will find this book useful.

John Pojman, University of Southern Mississippi

Topics in Fluorescence Spectroscopy. Volume 2. Principles. Edited by Joseph R. Lakowicz (University of Maryland School of Medicine). Plenum Press: New York and London. 1991. xv + 432 pp. \$79.50. ISBN 0-306-43875-5.

This book is the second in a series intended to be an ongoing attempt to summarize the current state of fluorescence spectroscopy. This particular volume, which has a publication date of 1991, is concerned with several fundamental concepts associated with the measurement and interpretation of steady-state and time-resolved fluorescence. Although in many of the chapters in this book an attempt is made to introduce the relevant formalism from first principles, in general, the book assumes some familiarity with modern applications of fluorescence spectroscopy. In Chapters 1-3 the various authors describe many theoretical and practical examples of fluorescence anisotropy, fluorescence quenching, and resonant energy transfer. These contributions are very readable with theoretical concepts and practical examples provided. These particular chapters should serve as very useful starting points for researchers interested in exactly what type of structural and dynamic information may be obtained from these techniques. A drawback in these, and other, chapters is the fact that a significant delay obviously occurred from the time that these chapters were written and the date of publication. This delay is, perhaps, of more serious concern for the contributions of Chapters 4 and 5, which describe detailed methods of numerical analysis of fluorescence data, and of Chapter 7, in which the use of fiber optics in fluorescence spectroscopy is discussed. Chapters 6 and 8 describe somewhat more specialized measurements of fluorescent

polarization from oriented systems and inhomogeneous broadening of dye molecules in solution. It should be noted that this volume is almost exclusively concerned with the applications of fluorescence measurements to biochemical systems, although the theoretical framework that is presented will be useful to any researcher in this field. In summary, this book will be a valuable addition to the library of molecular luminescence spectroscopists and especially to those involved in studies of the structure and dynamics of luminescent biomolecules.

James P. Riehl, Michigan Technological University

Silk Polymers. Materials Science and Biotechnology. ACS Symposium Series 544. Edited by David Kaplan (Natick Research, Development, and Engineering Center, U.S. Army), W. Wade Adams (Wright Laboratory), Barry Farmer (University of Virginia), and Christopher Viney (University of Washington). American Chemical Society: Washington, DC. 1994. xii + 370 pp. \$94.95. ISBN 0-8412-2743-8.

This book was developed from the Workshop on Silks: Biology, Structure, Properties, and Genetics sponsored by the Division of Polymer Chemistry, Inc., held 28-29 January 1993 in Charlottesville, Virginia. After a preface by the editors, there are 29 chapters organized under the following headings: Biology, Genetics, and Synthesis; Characterization, Properties, and Modeling; and Processing and Applications. There are also author, affiliation, and subject indexes.

Polymers for Microelectronics: Resists and Dielectrics. ACS Symposium Series 537. Edited by Larry F. Thompson (AT&T Bell Laboratories), C. Grant Willson (The University of Texas at Austin), and Seiichi Tagawa (Osaka University). American Chemical Society: Washington, DC. 1994. xii + 572 pp. \$119.95. ISBN 0-8412-2721-7.

This book was developed from the symposium sponsored by the Division of Polymeric Materials—Science and Engineering, Inc., of the American Chemical Society and the Society of Polymer Science, Japan, at the 203rd National Meeting of the American Chemical Society held in San Francisco on 5-10 April 1992. After a preface by the editors, there are 39 chapters organized under the following headings: Chemically Amplified Resists; Top-Surface Imaging and Dry Development Resists; Electron-Beam, X-ray, and Photoresists; and Polyimides and Dielectric Polymers. There are author, affiliation, and subject indexes.

Sensors. A Comprehensive Survey. Volumes 2 and 3. Chemical and Biochemical Sensors. Parts 1 and 2. Edited by W. Göpel (Tübingen University), T. A. Jones, M. Kleitz (LIE-NSEEG), J. Lundstrom (Linköping University), and T. Seiyama (Tokuyama Soda Co.). VCH: Weinheim and New York. 1991. xvii + 1231. \$285.00 each. Vol. 2, ISBN 3-527-26768-9 (VCH: Weinheim); Vol. 3, ISBN 0-89573-674-8 (VCH: New York).

Sensor technology has grown in importance in the last twenty years. The advent of increasing environmental concerns, the drive to improve productivity with the use of more automation, improved health care, etc. have led to a major increase in sensor research. The editors of this survey and their contributors have provided an important service by compiling in these two volumes an encyclopedia of biochemical and chemical sensors.

The two volumes on chemical and biochemical sensors, reviewed here, are Volumes 2 and 3 of a seven-volume survey on sensors. To quote the editors of the survey, "The aim of 'Sensors' is to give a survey of the latest state of technology and to prepare the ground for a future systematics of sensor research and technology." Volume 1 of the seven-volume survey covers general aspects and fundamentals; Volumes 2 and 3, the subject of this review, cover chemical and biochemical sensors. The other four volumes in the series will deal with physical sensors: thermal, magnetic, optical, and mechanical.

The two volumes on chemical and biochemical sensors, Volumes 2 and 3 of the survey, contain 26 chapters prepared by 44 contributors. While the editors did a fine job of organizing these two volumes, as you can expect with so many contributors, the writing is uneven and there is much repetition. It appears that the contributors did not read chapters other than their own. Among the better chapters are Chapter 6, Multicomponent Analysis in Chemical Sensing, and Chapters 12 and 18 dealing with optochemical sensors.

The volumes *Chemical and Biochemical Sensors*, as described in the preface, "are intended to foster the future developments and applications of sensors and at the same time serve as a useful reference work." Sensors

are defined, in the first sentence in the first chapter, simply as "(miniaturized) devices which convert a chemical state into an electrical signal."

The subject is treated in two volumes. The first volume of *Chemical and Biochemical Sensors* deals with general and theoretical aspects. It provides definitions, the physical and physical chemistry bases of sensors, and a description of the various sensor types. It surveys conventional electrochemical sensors—using both liquid- and solid-state electrolytes, field effect sensors, calorimetric sensors, optochemical sensors, and mass-sensitive sensors.

Part 2 places more emphasis on the practical aspects and the applications of chemical and biochemical sensors. It tries to cover all chemical and biochemical sensors including biosensors, gas sensors, environmental sensors, humidity sensors, clinical diagnostic sensors, high-temperature sensors in glass melts, etc.

Some of the chapters are out of place in a treatise of this sort. For example, the chapters on Chemical Sensors and Instrumentation in Analytical Chemistry add nothing that is not covered in other chapters, and the chapters on Humidity Control and Calibration of Gas Sensors could easily have been omitted.

The volumes are organized in a way that leads to a lot of repetition. There are chapters on Specific Features of Biosensors, Biosensors for Monitoring Pesticides in Water, Sensors in Biotechnology, and Chemical Sensors in Clinical Diagnostics. The material in these chapters could easily have been incorporated into one chapter, avoiding a lot of unnecessary repetition.

This is a large and complex subject, and even the over 1200 pages devoted to this subject cannot provide a complete review. However these volumes are a good first reference. It provides a starting place and leads the reader to other sources of information. The chapters are well referenced; however, the references are predominantly to the European literature. I was left with a feeling that the American literature was not adequately represented.

These volumes are far from perfect. There are many highs and lows depending on the authors and their expertise, and there are many typographical errors. It is not an easy book to read because of awkward sentence structure and an over use of jargon. Some of the sentence structure and the words appear to be literal translations from languages other than English, and the diagrams are difficult to understand. Some subjects such as the Nernst equation are treated in great detail while a more advanced subject such as the Butler-Volmer equation receives very little explanation. An important plus, though, is the treatment of cluster analysis, neural networks, and multidimensional analysis.

Keep in mind that any book is several years behind the state of the art. In rapidly changing fields such as biosensors, optical probes, and field effect devices, the material can be out dated or omit important advances. Some of the sensors are now commercially available while others have proven to be impractical. Important subjects such as microelectrodes, new methods of improving enzyme-modified sensors, and solid-state pH electrodes are treated only superficially. These volumes are difficult to read and are poorly edited; the illustrations are hard to interpret; the references are predominantly European and cover at best only up to 1989; the index is not very thorough, and there is no author index. (The editors promise to provide a cumulative index in the last volume of the survey.)

Despite its faults, these volumes can serve as a convenient reference to the various types of sensors available to the analytical chemist. The editors did an excellent job of outlining the structure of the chapters. They provide a good insight into the fundamental principles and the applications.

Herbert P. Silverman, *Consultant*

Molecular Orbital Calculations Using Chemical Graph Theory. By Jerry R. Dias (University of Missouri). Springer-Verlag: New York. 1993. xi + 113 pp. \$89.00. ISBN 0-387-56134-x.

This short monograph is intended for advanced undergraduates, beginning graduate students, and practicing chemists. It is meant to be

an update, with some modern examples such as organometallic systems, C60, etc., of the classical HMO treatises by Roberts, Streitwieser, Salem, and others.

Chapter 1 treats small conjugated polyenes. Chapter 2 discusses the concept of decomposition of molecules with n -fold symmetry. Chapters 3 and 4 deal with heterocyclic and organometallic molecules and large conjugated polyenes, respectively. A brief appendix lists a BASIC program for finding the real roots of a monic polynomial. It employs a functional group-like approach to extract useful chemical information from polyene molecular structures without computer intensive calculations. It is concisely and well written.

The basic premise of Dias' approach to HMO is that Huckel orbital energies and nodal patterns may be figured out quicker and more easily using graph theory rather than the more common group theory (i.e. symmetry) that has been around longer and is more familiar to many organic chemists. This is arguable and clearly doubtful, or at least the author, in this brief treatment, did not make his case sufficiently clear and convincing to induce practicing chemists to want to learn a new math tool (graph theory).

Unfortunately, the exorbitant price precludes purchasing by students as well as most individual chemists and even many libraries. Publishers who insist on such extravagant pricing, particularly in the face of modern computer printing techniques (including graphics and structures) ipso facto ensure their own failure.

Peter J. Stang, *The University of Utah*

Reflections on Symmetry in Chemistry ... and Elsewhere. By Edgar Heilbronner and Jack D. Dunitz. Verlag Helvetica Chimica Acta and VCH: Basel and Weinheim. 1993. iv + 154 pp. \$39.50. ISBN 1-56081-254-0.

This is an excellently written, beautifully illustrated (by Ruth Pfalzberger), and elegantly produced folio. The first part of the book deals with symmetry in art (including examples from the well-known M. C. Escher and the less well-known Koloman Moser), alchemy, games, mathematics, physics, and everyday life. Even the difficult concept of averaged symmetry (as in cyclohexane, whose symmetry in the chair conformation is D_{3d} , whereas the averaged symmetry of the rapidly interconverting molecule is D_{6h} , i.e., that of a planar hexagon) is illustrated—with a round vase with a flower on one side. In the light of day the symmetry of such a vase is σ , but in the dark or to a blind person's touch or if rapidly spun on a turntable, it is $C_{\infty v}$.

The second and major part of the book deals with chemistry, with molecules and their models, with chirality, with crystals (Dunitz's specialty), and with quantum chemistry (Heilbronner's specialty). Although the facts and ideas in this section will be familiar to most chemists, the illustrations and explanations are often illuminating and sometimes challenging and thought-provoking. For example, can an 8×8 chessboard with two squares at opposite ends of a diagonal removed by completely covered with 2×1 domino pieces? Once the squares on the board are colored alternately black and white (as they are on a real chessboard), the problem can be solved readily on the basis of extended symmetry principles.

The book is written for the educated layman; however, it may not make easy reading unless the reader has some general background in, or at least flair for, mathematical, physical, and perhaps even chemical concepts. In the words of the authors, "[It is] hard to steer a secure course between the Scylla of irresponsible superficiality and the Charybdis of unintelligible jargon." In this reviewer's opinion, they have succeeded quite well in steering such a course; the book is certainly not superficial.

I recommend this stimulating book especially for juniors and seniors in high school and freshmen in college who have shown some interest in and aptitude for science. However, and especially given its very reasonable price, the book is also recommended for the personal library of any chemist, both for the sheer pleasure of its esthetic appeal and for its carefully thought-through and frequently challenging approach.

Ernest L. Eliel, *University of North Carolina at Chapel Hill*