Book Reviews

Progress in Inorganic Chemistry. Volume 37. Edited by S. J. Lippard (Massachusetts Institute of Technology). John Wiley and Sons: New York, Chichester, Brisbane, Toronto, and Singapore. 1988. v + 613 pp. $100.00. ISBN 0-471-62297-4.

This comprehensive series provides inorganic chemists with a forum for critical authoritative evaluation of advances in nearly every area of the discipline. Volume 37 continues to report recent progress with a significant selection of papers prepared by internationally recognized researchers. Articles are given which continue to present how broad inorganic chemistry is. Four papers relate to the fascinating bioinorganic discipline and three others include discussions in theoretical and structural inorganic chemistry.

Bernard Lippert describes studies aimed at a better understanding of platinum–nucleic acid interactions on a molecular level. His paper focuses primarily on studies of the chemistry of Pt electrophiles with isolated nucleobases and he shows strong evidence that DNA is a very important target of antitumor platinum coordination compounds.

Gary Brudig and Robert Crabtree present an overview of the involvement of manganese, through its coordination chemistry, in photosynthetic water oxidation. They report on the substantial progress in understanding the structure and function of manganese because of the recent identification of a multinuclear manganese-containing active site in Photosystem II. Due to this discovery, intense research in the coordination chemistry of high-valent manganese has been stimulated that may lead to useful catalysts for the redox process involving water.

Jeremy Berg reviews seven groups of proteins which have the property of containing one or more regions of amino acid sequence that appear to be capable of forming a structural domain around a coordinated metal ion. He speculates the major reason for the rapid development of this field is the tremendous increase in the rate of protein sequence determination made possible by gene cloning and DNA sequencing techniques since the discovery of zinc finger domains in 1985.

Molecular mechanics (MM) calculations have become increasingly more important in drug design or studying the matching up of bases in nucleic acids. Robert Hancock appraises the application of MM calculation to gain insight into metal ion selectivity and ligand design in order to answer the question: How does one change the architecture of a ligand to enhance its selectivity for small metal ions? This is order to better understand ion transport and recognition and the factors controlling molecular recognition.

Elmars Kranz and James Ferguson have provided the reader a discussion of the entire spectroscopy of the $[Ru(bpy)_3]^{2+}$ system. In particular, based upon their own findings, they pay attention to the evidence that bear on charge delocalization in the excited state exhibited by this complex. They also give a critical review of other major issues found in the literature regarding this structure.

Michael Natan and Mark Wrighton summarize the progress in the preparation, characterization, and uses of chemically modified microelectrodes which is made possible through recent advances in nano- and microfabrication techniques for electronics and derivation of electrode surfaces with redox-active materials. Work on molecular based devices is just beginning to achieve important function not possible with conventional electronics.

Tarlock Lobana provides a comprehensive article on the subject of tertiary phosphine and tertiary arsine chalcogenide metal complexes, which complements a 1984 review of secondary phosphine chalcogenides. He discusses a number of novel bonding, structural, and spectroscopic features. He makes it quite clear in his review that work on tertiary phosphine chalcogencides far exceeds that of the arsine analogues.

In summary, Volume 37 continues the fine tradition of providing chemists an examination of contemporary inorganic chemical research coupled with an in depth review of the literature. This compilation is valuable to those wishing a better understanding of modern inorganic chemistry.

Thomas J. Haas, *United States Coast Guard Academy*

Asbestos Engineering Management and Control. By Kenneth F. Cherry (National Institute for Environmental Communications). Lewis Publishers: Chelsea, Michigan. 1988. ix + 265 pp. $49.95. ISBN 0-87371-127-0.

Current industrial hygiene practices follow the model of "Recognition, Evaluation and Control" of hazardous materials found in the work place. Asbestos, tremolite, anthophyllite, and actinolite can cause disabling respiratory disease and various types of cancers if the fibers are inhaled, but the symptoms usually do not appear until after a latent period of more than 20 years. OSHA has established permissible exposure limits for these materials. This text is intended not only to assist in evaluating asbestos hazards in complying with regulations but, more importantly, to explore sound engineering practices to effectively and safely deal with these materials.

Professor Cherry, an international authority in all phases of environmental matters, including asbestos control, initially discusses the current uses of asbestos and asbestos-like materials. He briefly summarizes the OSHA regulations found in 29 CFR 1910 to assist the nonexpert's understanding of the rules. The strength of the book, however, lies with what I believe to be the best review of acceptable engineering controls for asbestos in print today. He provides information on establishing operations and maintenance programs, how to conduct a building survey, specifications and work practices for removal projects, and examples of cost estimating.

I found the sample specifications to be of particular value for a manager who may be faced with abatement work. This chapter allows these individuals to review specifications prepared and used by Agencies experienced in asbestos projects and then modify them to his or her particular environment. The research is done and summarized in a very convenient form. Another very good chapter describes health and safety concerns in the proper choice and use of respirators and protective clothing. The glossary, a list of asbestos substitutes and other sources of information, rounds out this fine publication.

The reader should find that this one text contains most of the background needed to address an asbestos problem as safely and economically as possible.

Thomas J. Haas, *United States Coast Guard Academy*

Sonochemistry: The Uses of Ultrasound in Chemistry. Edited by T. J. Mason (Coventry Polytechnic). Royal Society of Chemistry: Cambridge. 1990. XIII + 157 pp. £35.00. ISBN 0-85186-293-4.

This is a publication on the secrets of ultrasound, addressed primarily to experimentalists. It originated at "the first-ever residential course devoted to sonochemistry", held at Coventry Polytechnic in September 1988.

The book is divided into eleven chapters and is written by nine authors. A general introduction (Chapter 1) written by T. J. Mason tells briefly about the scope of the use of sonochemistry. The principles and factors affecting cavitation are discussed by J. P. Lorimer (Chapter 2). The ultrasound used for diagnostic purposes, such as detection of mechanical defects in metals (Chapter 3) by C. S. Gartside and M. M. Robins, may be of little interest to most chemists. However, characterization of dispersion systems discussed in this chapter is of broad technological applicability.

The discussion of the practical aspects of sonochemistry begins in the chapter on power ultrasound by J. P. Perkins (Chapter 4) and commercially available instrumentation by T. J. Mason (Chapter 5). These chapters are followed by a survey on the applications of sonochemistry in organic synthesis by R. S. Davidson (Chapter 6), and for generation of free radical leading to new reactions by J. L. Luche (Chapter 7). The ultrasound uses in the field of heterogeneous catalysis, particularly involving metals, are compiled by J. Lindley (Chapter 8), and those in polymer chemistry by J. P. Lorimer (Chapter 9). Potentials of sonochemistry for industrial applications are the subject of the following chapters by T. J. Mason (Chapter 10) and T. J. Goodwin (Chapter 11).

The book will be used primarily by practicionals rather than theoreticians. The low price of the ultrasonic bath and the versatility of the applications may attract new enthusiasts to sonochemistry. With this view in mind, the publication represents a large source of information on the instrumentation, experimental techniques, laboratory hints, and applications in all fields of chemistry and chemical engineering. These are spread through all chapters including Chapter 2 in which the theoretical principles are demonstrated through their practical applications. Thus, among much practical information, one learns about a beneficial effect of detergents for sonication in an ultrasonic bath as well as about the

corrosion of the tip of the ultrasonic horn affecting the performance of the probe.

Topics of individual chapters are covered in sufficient depth with respect to both the basic concepts and their practical applications. By comparing the format of individual chapters it becomes evident that the book is a collection of unedited lectures presented at a workshop at Coventry Polytechnique. Even notation showing the use of sonication in chemical reactions is not uniform from one chapter to another (e.g., US., four bend arrows ( ))))), or nothing). Also the number of literature quotations (from zero to a respectable list) differs from one chapter to another.

As the use of ultrasound in chemistry is increasing there is interest in publications presenting the state of the art of the discipline. This book is the third major publication on this subject that appeared within the last four years, and the reader has a choice between this and two other excellent publications, the two-part review by T. J. Mason and J. P. Lorimer (the co-authors of this book *Chem. Soc. Rev.* **1987**, *16*, 239, 275) and the monograph by K. S. Suslick, Editor (*Ultrasound, its Chemical, Physical, and Biological Effects*; VCH: Weinheim, 1988).

Vaclav Horak, *Georgetown University*

Treatise on Analytical Chemistry. Part I. Theory and Practice. Volume 11. Second Edition. Edited by I. M. Kolthoff (University of Minnesota), J. D. Winefordner (University of Florida), and M. M. Bursey (University of North Carolina, Chapel Hill). John Wiley and Sons: New York. 1989. xvii + 311 pp. $75.00. ISBN 0-471-50938-8.

Five major topics (chapters) are presented in this volume, which are loosely related by the use of some type of mass spectrometric analysis. The balance is appealing because several aspects and applications of mass spectrometry are described. This includes the commonly known mass spectral analysis, ion/molecule chemistry, elemental analysis, atmospheric analysis, and even surface analysis.

Despite the title Mass Spectrometry of Organic and Biological Compounds, Chapter 1 is actually a general overview of mass spectrometry with discussions on ion formation, mass analysis, and detection. A brief historical perspective as well as the basic principles, theory, and a large section on application is also present. The title is somewhat misleading if one expects to read about the application of mass spectrometry to large organic and biological compounds. In particular, there is no discussion on the mass spectrometry of biopolymers such as peptides, nucleutides, and saccharides. In addition, many of the techniques which are at the forefront of bioorganic mass spectrometry such as fast atom bombardment, laser desorption, plasma desorption, etc. are only briefly mentioned. One can, however, appreciate the scope of such a review and there are already several books on these topics. However, this chapter is still useful for the brief overview of mass spectrometry that it provides.

The second chapter deals specifically with Fourier transform–ion cyclotron resonance mass spectrometry (or Fourier transform mass spectrometry). There is often confusion between the two names but they refer to the same group of instruments. However, the development of the Fourier transform for use in the ICR has made it become more of an analytical instrument. The chapter explains the method of FTICR very well. Illustrations of ion motion helps the reader obtain a feeling for the actual analysis. Demonstrations of the versatility of the method for chemical studies in ion–molecule chemistry are numerous and very recent. However, demonstrations of the FTICR as an analytical technique are relatively few.

Chapter 3 deals with spark source mass spectrometry. This technique is useful for obtaining elemental information particularly for inorganic analysis. The principles as well as the experimental aspects are well-discussed. The discussion of individual commercial instruments is useful. There is also a section on applications which, although short, covers a wide area.

Chapter 4 on plasma chromatography seems out of place. This chapter is only 15 pages and is focused on a specific instrument by a specific manufacturer. It reads more like a condensed instrumentation manual.

A method for the analysis of solid surfaces using low-energy ion-scattering spectroscopy is discussed in the final chapter. A practical overview provides both qualitative and quantitative aspects of the methods and a separate section on applications covers both its use in surface analysis as well as obtaining bulk (depth) concentration profiles.

In general, this book is useful for those who are not in the field and would like a fast reference for any of the topics in this book. Care has been taken in all the contributions to present an even-handed review with enough experimental and instrumental techniques as well as actual applications. The book is well suited for those who wish to incorporate any of these topics in a course or those who simply wish to be more familiar with them. It may not, however, be extremely useful for those already in the respective fields.

Carlito B. Lebrilla, *University of California*

The Chemistry of the Metal–Carbon Bond. Volume 5. Edited by Frank R. Hartley (Cranfield Institute of Technology, Cranfield, England). Series Editor, Saul Patai. John Wiley & Sons: New York. 1990. xv + 590 pp. $275.00. ISBN 0-472-91556-4.

The five-volume series on *The Chemistry of the Metal Carbon–Bond* claims to cover the chemistry of the metal–carbon bond as a whole, with emphasis on the carbon end. The preceding four volumes covered the structure and thermochemistry of the organometallic compounds, the preparation of organometallic compounds, and the analysis and spectroscopic characterization of organometallic compounds (Volume 1); cleavage of the metal–carbon bond, insertions into metal–carbon bonds, nucleophilic and electrophilic attack of metal–carbon bonds, oxidative addition and reductive elimination, and structure and bonding of main group organometallic compounds (Volume 2); and the use of organometallic compounds to create carbon–carbon, carbon–hydrogen, and other carbon–element bonds (Volumes 3 and 4).

Volume 5 claims to cover the use of organometallic compounds in organic and biological synthesis. The topics included seem to have been chosen without much critical consideration of the volume title, but the stronger and more relevant contributions compensate for the inclusion of the less important ones. Part I of Volume 5 includes chapters on three disparate techniques, The Application of Sonochemistry in the Formation and Reactions of Metal–Carbon Bonds by D. Bremner (Chapter 1), The Photochemistry of Organometallic Compounds by C. Long (Chapter 2), and Phase-Transfer Catalysis in Organometallic Chemistry by J.-F. Petrignani (Chapter 3). The three chapters are loosely joined together in Part I under the heading of Synthetic Techniques. Each of these chapters is short and concentrates on descriptive aspects of the indicated subjects under review. They serve as interesting highlights to the use of the three different techniques in organometallic chemistry but are in no way comprehensive. Of the three topics covered in Part I, photochemistry can be considered a technique of broad applicability, while sonochemistry and phase-transfer catalysis could be categorized as less general. The latter two techniques, while interesting, are currently restricted to use in an "Edisonian" fashion in organic synthesis with organometallic compounds.

Synthetic Reactions, the title given to Part II of Volume 5, includes chapters on Enantioselective Synthesis With Optically Active Transition Metal Catalysts by H. Brunner (Chapter 4), Organometallic Oxidation Catalysts by G. Speier (Chapter 5), and Olefin Metathesis by W. J. Feast and V. C. Gibson (Chapter 6). The chapter on enantioselective synthesis by Brunner is limited to catalytic reactions with optically active transition-metal complexes applied in substoichiometric amounts. The author has restricted coverage to procedures for established reaction types giving high chemical and optical yields. Given this restriction, the reader is presented with a nice overview of the more important enantioselective metal-catalyzed processes discovered and developed during the last 20 years. Additional references are presented for those interested in a more detailed analysis of the area. The next chapter, Organometallic Oxidation Catalysts, although thorough in its development, is somewhat out of place in a book on the chemistry of the metal–carbon bond. A good portion of the chapter covers oxidation systems that do not entail the formation of a metal–carbon bond. Olefin Metathesis, Chapter 6, surveys the more prominent aspects of an important industrial process, but one that has seen little use, until recently, by chemists interested in organic synthesis. The development of metathesis-based ring-opening polymerization is an example of a recent use of the metathesis reaction in a specialized area of organic synthesis.

Part 3, Synthetic Reagents, begins with Chapter 7, The Use of Transition-Metal Clusters in Organic Synthesis by G. Süss-Fink and F. Neumann. This is a strange topic for inclusion in a section on synthetic reagents, since there are few reactions of *general* use in organic synthesis that rely on metal clusters. The Pauson–Khand cyclocarbonylation of alkynes and alkenes is one of the few important examples that come to mind. One can find numerous cases of esoteric transformations mediated by metal clusters, but it is difficult to categorize these as "synthetic reagents". There also are processes where metal clusters function as precatalysts, but the actual catalytic intermediate is a monomeric moiety generated under the reaction conditions. Chapters 7 and 8 represent two of the better contributions to Volume 5 of The Chemistry of the Metal–Carbon Bond. G. A. Molander's offering, Lanthanide Reagents in Organic Synthesis (Chapter 8) is thorough, comprehensive, and scholarly. In addition to the inclusion of an introduction to the general properties of the lanthanides, sections on organocerium, -ytterbium, and -samarium reagents describe the known chemistry of these species in detail. There is an additional chapter on lanthanide salts as Lewis acid catalysts for carbon–carbon bond forming reactions and a final section on less highly developed applications of lanthanides to organic synthesis. I found Chapter 9 on The Use of Organoantimony and Organobismuth Compounds in Organic Synthesis by L. D. Freedman and G. O. Doak to be informative and interesting. Although organoantimony and -bismuth

compounds have found comparatively little use in organic synthesis, recent work suggests that there may be a wealth of synthetically useful processes moderated by these species. In some ways, it would have been interesting to see the organic chemistry of lead compared with that of bismuth, since there are similar reaction trends shown by organic compounds of both elements.

Part 4, Biological Synthesis, is the final section of the book. Chapter 10, Biological And Environmental Methylation of Metals by P. J. Craig, is a short review of the processes by which inorganic elements are methylated by biological systems, and hence brought into the environment with increased lipophilicity and volatility. This chapter takes a critical and balanced look at the important issue of introduction of heavy metals into the environment by way of methylation. Chapter 11, Bioorganotin Compounds by K. Molloy, ranks on par with the Molander chapter described above. The author has successfully fulfilled his stated goal of reviewing the state of knowledge in the area of triorganotin compounds, those organotin compounds with biocidal applications. Molloy has chosen to focus his review on the toxicity of organotin compounds, the interaction of organotin compounds with biological receptors, and industrial applications of biocidally active organotin compounds. The reader interested in laboratory-scale synthetic aspects of triorganotin compounds is directed to other reviews. I found this chapter to be very informative and thorough in its presentation.

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Chemistry of Tin. Edited by P. G. Harrison (University of Nottingham). Blackie: Glasgow and London. Chapman and Hall: New York. 1989. 461 pp. $120.00. ISBN 0-216-92496-00.

In this fairly compact volume, authorities on tin chemistry review the current (ca. 1987) state of knowledge ranging from the element—history, occurrence, and properties—to industrial uses of tin chemicals. Significant emphasis is given to the inorganic chemistry of tin. Chapters by Harrison on general compounds of tin, J. D. Donaldson and S. M. Grimes on the inorganic chemistry of tin, and F. Glocking on tin–metal bonding provide a good survey of this area. Organostannane chemistry is covered in three chapters entitled formation and cleavage of the tin–carbon bond by J. L. Wardell, organometallic compounds of tetravalent tin by K. C. Molloy, and organometallic compounds of bivalent tin by P. D. Lickiss. One chapter each is devoted to tin spectroscopy (Harrison), the biochemistry of tin (M. J. Selwyn), tin oxide surface chemistry (Harrison), and industrial uses of tin compounds (C. J. Evans). Last, but not least, two chapters, radical chemistry of tin by A. G. Davies and the use of organotin compounds in organic synthesis by Wardell, focus on synthetic applications of organotin compounds.

The A–Z coverage tends to be balanced and well-referenced. Thus, this book would serve as an excellent starting point for someone who is thinking about entering the field or who wants to answer some specific question about tin chemistry. As might be expected from a multiple author work, there is some overlap in material, but it is not excessive. The chapters of greatest interest to me were those dealing with synthetic applications. Though covering many of the highlights in this rapidly expanding field, they are not nearly as detailed as the recent monograph by Pereyre, Quintard, and Rahm (Butterworths, 1987). I also found the chapters on biological chemistry and industrial applications quite interesting and informative on practical matters such as toxicity of various organotin compounds and everyday uses of tin compounds.

I was somewhat bothered by errors in structural formulas in my cursory reading of chapters on synthetic applications and on formation and cleavage of the tin–carbon bond. I also found the lack of parentheses in complex line formulas confusing. For example, $R_3SnCH(OH)R^1 \rightarrow R_3SnCH(Br)R^1$ appears as $R_3SnCR^1HOH \rightarrow R_3SnCR^1HBr$. We would deduct points for such usage on our sophomore exams.

In summary, the book offers an excellent general survey of tin chemistry. It belongs in every serious chemistry library. However, it is not a "must have" acquisition for the personal library of individuals involved in synthetic chemistry.

James A. Marshall, *The University of South Carolina*

Physical Chemistry from Ostwald to Pauling—The Making of a Science in America. By John W. Servos (Amherst College). Princeton University Press: Princeton. 1990. xxiv + 402 pp (alkaline paper). $49.95. ISBN 0-691-08566-8.

This book is a well-referenced, historical account of how and why the scientific discipline of physical chemistry took root, grew, and flourished in America in the decades around the turn of the twentieth century. The author, a historian of science, begins with Ostwald, van't Hoff, Arrhenius, and Nernst and their studies of solutions and thermodynamics. The story of their American students and the research groups they founded in the States is then taken through the early years of the quantum revolution, the emergence of chemical physics, and Pauling's ideas about chemical affinity. To accomplish this, the author focuses on the research schools developed by Arthur A. Noyes at MIT and Caltech, by G. N. Lewis in Berkeley, and by Wilder D. Bancroft at Cornell.

The Science developed by the protagonists is described in a readable fashion, although portions of the nomenclature are, appropriately, somewhat dated. A minus has been substituted for the equal sign in the Bragg equation on page 273.

The author uses correspondence and unpublished biographical manuscripts to bring his famous cast of characters to life. The book is fascinating and, once opened, difficult to put down.

"Yet physical chemistry was not always dowdy..." we are told on page xv. Virtually every physical chemist will want to read on, not only to find out why physical chemistry has turned dowdy, but to learn about the early trials of the *Journal of Physical Chemistry* and the founding of the *Journal of Chemical Physics*, the rise and fall of the Research Laboratory of Physical Chemistry at MIT, and the infusion of physical chemistry into the U.S. Geological Survey and the Geophysical Laboratory of the Carnegie Institution.

Increasingly we are told that our introductory chemistry courses should be exemplars of liberal arts instruction, concentrating on the history and philosophy of the science as well as on the what and how. General chemistry teachers are urged to read this volume carefully, along with Jammer's *Conceptual Development of Quantum Mechanics*. Here is to be found the real, blood and guts story of the development of so many physical chemistry concepts now described in such a prosaic, if oversimplified, fashion in our beginning courses.

Edward K. Mellon, *Florida State University*

Principles of Chemical Sensors. By Jiri Janata (University of Utah). Plenum Press: New York and London. 1989. xi + 317 pp. $39.50. ISBN 0-306-43183-1.

This text, published as part of a continuing series of volumes on Modern Analytical Chemistry edited by David Hercules, comprehensively treats the principles of the various classes of chemical sensors that have seen rapid development and increased application in the last couple of decades. Janata draws the important distinction between information acquisition systems that utilize sensors and the sensors themselves and concentrates his discussion on the events involved in the generation of a chemically selective sensor response. The material presented is a blend of topics from the several disciplines that are frequently involved in sensor development such as chemistry, chemical engineering, and semiconductor and solid-state physics.

The book consists of five chapters and five appendices. Each chapter has its own glossary of symbols and list of references. The first chapter deals with various general aspects of chemical sensors including the thermodynamics and kinetics of simple bimolecular reactions, the effects of mass transport on sensor response, sensor selectivity, enzyme and immunochemical reactions, and protein immobilization techniques. The next two chapters on thermal and mass sensors focus on pyro- and piezoelectric devices. Excellent descriptions of the origins and properties of pyro- and piezoelectric effects are given but only brief mention is made of the application of these devices. The fourth chapter, comprising the major portion of the book, deals with electrochemical sensors with sections on potentiometric, amperometric, and conductometric sensors. The section on potentiometric sensors is the most detailed and thorough of the entire book. It starts with a discussion of the various interfaces that comprise the electrochemical cell and the potentials that arise at those interfaces. Specific sensor designs described include ion selective and liquid membrane electrodes, coated wire electrodes, ion sensitive field effect transistors, enzyme based devices, and gas sensors. In the discussion of FETs and work function sensors, a considerable amount of effort is spent on the fundamental properties and functions of semiconductor devices. The section on amperometric sensors emphasizes enzyme, chemically modified, and gas electrodes. The final section of the electrochemistry chapter deals with conductometric sensors based on chemiresistors and semiconducting oxides. The fifth chapter is on optical sensors and starts with an introduction on the interaction of light with matter and a survey of spectroscopic methods. The basics of optical fibers and waveguides, reflection and refraction, and the resulting evanescent field at the fiber surface are presented. Optrodes for use as gas sensors and biosensors are briefly described.

According to the preface, Janata intends this to be a textbook for use at the senior undergraduate or graduate level, in addition to serving as a reference for workers in the field of chemical sensors. The book would be effective for either purpose, providing a discussion of fundamentals and references to the original literature for more specialized topics. The text, however, suffers from a somewhat uneven treatment of the material, with some sections written at the freshman level and others assuming the reader has an extensive background in certain topics. This book would probably be most effective as a course text when used in conjunction with an applications oriented supplemental reading list.

Adrian C. Michael, *University of Pittsburgh*