

kcal mol⁻¹ and $\Delta H^* = 1.3 \pm 1.0$ kcal mol⁻¹, should be considered as lower limits inasmuch as the value assumed for oxygen trapping of **S** represents the upper limit of diffusion control.¹³

In conclusion, we rationalize our observations in terms of a metastable singlet 1,3-biradical intermediate **S** which is accom-

modated in a potential energy trough of several kcal mol⁻¹. At room temperature, ISC of the singlet biradical **S** is inefficient but is mediated through diffusional encounters with oxygen in aerated solution. At 77 K, spontaneous ISC of **S** (formed by direct photolysis of **1**) to **T** is predominant.

(13) A direct addition of ³O₂ to **2** would of course also follow a rate law of the form given by eq 1 and thus obviate the necessity to postulate trapping of **S**, but the high value of the rate constant would be quite unprecedented, and its consistency with the ring-flip kinetics would represent an amazing coincidence.

(14) Osborne, A. D.; Porter, G. *Proc. R. Soc. (London)* **1965**, *A284*, 9.

(15) (a) *Handbook of Chemistry and Physics*; Weast, R. C., Ed.; CRC Press: Boca Raton, 1987; p F-38. (b) Keller, R. NASA-CR-1425 (1969).

Book Reviews*

Basic Solid State Chemistry. By Anthony R. West (University of Aberdeen). John Wiley and Sons: New York. 1984, 1988. x + 415 pp. \$32.95. ISBN 0471-91798-2.

The explosive growth in the discipline of materials science is substantially chemistry-driven and underscores the importance of including solid-state chemistry in the chemistry curriculum. Conventional treatments of this topic in physical and inorganic textbooks have often of necessity been superficial, reflecting the many competing subjects to be covered. As the undergraduate and graduate curricula evolve, however, solid-state chemistry is likely to assume a larger role in existing courses and to acquire status as a separate course. *Basic Solid State Chemistry* is an early entry in this potential market.

Much of this text by West appeared earlier under the title, *Solid State Chemistry and its Applications* and was reviewed previously in this journal (Honig, J. M. *J. Am. Chem. Soc.*, **1985**, *107*, 4806). West has condensed his 1984 work into a more pedagogically useful form.

The organization of the text begins with an extensive (roughly 60 pages) survey of crystal structures, including descriptions of Miller indices, *d*-spacings, close-packed structures, and other common structures. A second chapter of roughly equal length explores bonding in solids. Much of this section is standard inorganic text material, with representative topics including ionic radii, thermochemical calculations, and an introduction to band theory. Experimental techniques follow, with the third chapter covering crystallography and diffraction techniques and the fourth chapter surveying microscopy, spectroscopy, and thermal analysis. Chapter 5 provides an extensive discussion of crystal defects, nonstoichiometry, and solid solutions. Chapter 6 covers the phase diagrams of solids. The final two chapters are devoted to descriptions of electrical, magnetic, and optical properties. Concluding the text are supplemental reading lists; four appendices; a set of basic, chapter-keyed study questions (without answers); and an extensive index.

Overall, the text presents a good, nonmathematical survey of solid-state chemistry. Strengths include the chapters on crystal structures, crystallography and diffraction techniques, crystal defects, and phase diagrams. The numerous illustrations drawn from the literature include recent developments in high-temperature superconductivity and conducting polymers.

A weakness of the text is its uneven subject treatment. While it is admittedly difficult to cover everything, synthetic methods are largely ignored, despite the importance of preparative conditions in determining the physical properties of solids. Similarly, band theory, various spectroscopic techniques, and some descriptions of physical properties comprising the last two chapters are treated in a disappointingly cursory fashion. There are also some nonlinearities in topic sequence that may frustrate the reader: band gaps, for example, are used to interpret salt ionicities before their significance has been discussed.

From a student's perspective (having polled several), the book is clearly written and generally well organized. The style is a bit dry; a livelier presentation might be more effective in engaging an initially disinterested student.

Its deficiencies notwithstanding, *Basic Solid State Chemistry* can certainly be recommended as supplementary reading for a course that

includes solid-state chemistry among its subjects. For a course exclusively devoted to this area, it can serve as a primary text for some topics but needs to be augmented for others.

Arthur B. Ellis, *University of Wisconsin—Madison*

The Flavonoids: Advances in Research since 1980. By J. B. Harborne (University of Reading). Chapman and Hall: London and New York. 1988. xiv + 621 pp. \$247.50. ISBN 0-412-28770-6.

Nineteen experts contributed the 16 chapters of the third volume of the *Flavonoids* series, which reviews the progress achieved from 1980 to 1985. It is, however, more than a mere description of the work done recently. The volume includes checklists of all known structures, a plant species index, and frequent references to the two previous publications in the series. It is indeed a source of information about all aspects of flavonoids.

The first 10 chapters are related to the various classes of flavonoids: anthocyanins, flavans and proanthocyanidins, C-glycosidylflavonoids, biflavonoids, isoflavonoids, neoflavonoids, flavones and flavonols, flavones and flavonolglycosides, minor flavonoids, and miscellaneous flavonoids. The critical review deals with the multiple aspects of the investigations in each class, isolation, analytical procedures, synthesis, distribution, biochemistry, and biological activities to mention only a few of them.

Chapter 11 provides an account of the biosynthesis, with emphasis on pathways to precursors, individual steps of flavonoid classes and modifications, and regulation of enzyme activities. Four chapters are then related to the distribution and evolution of flavonoids in lower plants, in gymnosperms, in the dicotyledons, and in the monocotyledons.

The 16th and last chapter deals with flavonoids and flower color.

This book will prove a valuable tool for scientists interested in botany and in the chemistry and biochemistry of plants. Specialists will appreciate the thorough covering of the field and the wealth of information contained in the numerous, neatly presented tables. The multidisciplinary approach provides a fascinating source of research ideas in the broad field of biotechnologies. This volume is a constant reminder that, in the study of nature and natural products, multidisciplinaryity is highly rewarding.

Henri Favre, *Université de Montréal*

Introduction to Quasicrystals. Aperiodicity and Order. Volume 1. Edited by Marko V. Jaric (Texas A&M University). Academic Press: San Diego. 1988. x + 285 pp. \$49.50. ISBN 0-12-040601-2.

One must take a special perspective toward this book since it represents an entirely new subject area that began with Schechtman, Blech, Gratias, and Cahn reporting in 1984 the existence of a structure generally held to be impossible to form. The newness of the area that has resulted should strongly temper the expectations one holds for the book. Understandably, about three-fourths of the book presents the results of phenomenological studies and descriptive information on icosahedral quasicrystals. The discussion of the subject is necessarily limited in its scope since, at best, there are only threads of understanding and certainly no comprehensive intellectual fabric. This dilemma can be appreciated by comparing the Preface to the actual contents of the book. The Preface correctly recognizes the importance of findings in Chaos and the attractiveness of discovering if new temporal and spatial senses of order are related in ways that are not commonly understood. However, no further

*Unsigned book reviews are by the Book Review Editor.

comment on this could be found in the text itself. Nonetheless, the mere inkling that new intellectual territory of remarkable significance is just in front of us is exciting news and has already motivated a considerable body of research.

Because this area is definitely in a growth mode, the book will be useful for researchers in related areas and as an introduction to new students. The forthcoming developments in the area of aperiodicity and order in structures will be of considerable interest to the solid-state materials community.

John F. Fellers, *The University of Tennessee*

Electrochemistry III. Topics in Current Chemistry 148. Edited by E. Steckhan (Universität Bonn). Springer-Verlag: New York and Berlin. 1988. x + 202 pp. \$83.50. ISBN 0-387-19180-1.

Modern electrochemistry has many dimensions. It has connections to areas as disparate as organic and inorganic synthesis, surface science, design of chemical semiconductors and molecular electronic devices, biochemistry, and chemical analysis. No one individual is likely to be able to stay abreast of developments in all of these areas. For this reason, the decision of the publishers of *Topics in Current Chemistry* to devote several recent volumes (142, 143, and 148) to a number of new areas of electrochemistry comes as a welcome development. The series editor, Eberhard Steckhan, is a respected leader in electroorganic synthesis. Not surprisingly, these volumes, especially vols. 142 and 148, have a strong organic emphasis. Volume 148 includes reviews of the following topics: organic electrosyntheses in industry, organic electroreductions at very negative potentials, syntheses of alkaloids using an electrochemical reaction as a key step, and electrochemical methods in the transformation of β -lactam antibiotics and terpenoids. The articles are written by authorities in their respective fields. These volumes are highly recommended to all graduate chemistry libraries. Individuals involved in organic electrosynthesis will no doubt wish to obtain volumes 142 and 148 for their personal library.

A. J. Fry, *Wesleyan University*

Computational Quantum Chemistry. By Alan Hinchliffe (University of Manchester). John Wiley & Sons: New York. 1988. xi + 112 pp. \$34.95. ISBN 0-471-91716-8.

Within the past few years computational quantum chemistry has become recognized as a useful predictive tool. It is now used in industrial laboratories as well as by quantum chemists in universities.

This little book is intended to encourage the use of the available software packages by analytical and synthetic chemists. In particular it is aimed at senior undergraduate and graduate students. It is a concise encyclopedia of practically useful quantum chemistry based upon well-established computational techniques.

The book summarizes the concepts and mathematics of Schrödinger wave mechanics (as applied to chemistry) in 26 pages, the emphasis being on Hartree-Fock self-consistent field theory for electronic wave functions of atoms and molecules. Chapters 3-5 (37 pages) discuss the computation of molecular electronic energies including open-shell states, the importance of basis set, and the calculation of correlation energy where appropriate.

The book continues with force fields for nuclear motion and the calculation of electric and magnetic moments and polarizabilities. The final chapter relates the results of the calculations to chemical concepts: orbitals, charge density, and bond properties.

The strength of the book is its careful assessment of the accuracy and applicability of the various computational techniques, with due consideration of the cost (in computer time) of the computations. Thus, the reader is made aware of what is possible and where caution should be exercised in accepting the results. The author illustrates his judicious discussion with well-chosen examples, tables of results, and figures.

The book will be useful to quantum chemists as a compendium of concepts and formulas, and for chemists generally it provides an essential introduction to the use of computational quantum chemistry in applications. Its concise size (the whole book can be read in just a few hours) should make it accessible to otherwise busy people, and thus encourage the application of computational quantum chemistry to real chemical problems.

Geoffrey Hunter, *York University*

Handbook on the Physics and Chemistry of Rare Earths. Volume 11. Two-Hundred-Year Impact of Rare Earths on Science. Edited by Karl A. Gschneidner, Jr. (Iowa State University) and LeRoy Eyring (Arizona State University). Elsevier: Amsterdam and New York. 1988. xiii + 594 pp. \$184.25. ISBN 0-444-87080-6.

This volume celebrates the two-hundred-year anniversary of the discovery of the rare-earth elements and documents in an excellent fashion

the many subsequent contributions that the rare-earth elements have made to science and technology. The prologue and seven chapters provide an excellent, if at times very specialized, overview of the development of the field. It is not a book for an introduction to the rare earths, but for the professional chemist working in the field or interested in its detailed development, this book will provide many rewards. The prologue, by H. J. Svec, provides a delightful biography of F. H. Spedding, the "father" of so much of the field over the past 50 years. The detailed history of the discovery and separation of the rare-earth elements is presented in a chapter by F. Szabadváry. B. R. Judd provides a detailed survey of atomic theory and optical spectroscopy as it applies to the rare earths. C. K. Jørgensen brings his special brand of wit and wisdom to an insightful discussion of the influence that the rare-earth elements have had on our understanding of chemistry and chemical periodic classification. Two chapters by J. J. Rhyne and B. Bleaney provide a detailed discussion of the magnetic properties of the rare earth elements. The very important physical metallurgy of the rare-earth elements is presented in a chapter by K. A. Gschneidner, Jr. and A. H. Daane. Finally S. R. Taylor and S. M. McLennan cover the importance of the rare earths in geochemistry and cosmochemistry.

Most of the writing in this book is excellent and makes this book a fine way to spend many cold winter evenings delving into the rewarding field of rare-earth research, a field which is now 200 years old.

Gary J. Long, *University of Missouri—Rolla*

Volumes of Proceedings

Food and Packaging Interactions. Edited by J. H. Hotchkiss. American Chemical Society: Washington, DC. 1988. xi + 305 pp. \$64.95. ISBN 0-8412-1465-4.

This volume contains 21 typescript papers derived from a symposium held at the American Chemical Society National Meeting in Denver in 1987. The first paper is an overview of the whole field, and some other papers are reviews of narrower sections of the subject. Migration of components of packaging materials into the contained food is a general theme; it affects flavors and aromas as well as having the potential for toxicity. Synthetic polymers and plasticizers are prominent in the papers. Other papers are concerned with deterioration, sterilization, and shelf-life. The final paper is concerned with future prospects for food packaging.

Risk Assessment of Chemicals in the Environment. Edited by M. L. Richardson (The Royal Society of Chemistry). The Royal Society of Chemistry: London. 1988. iii + 579 pp. £59.50. ISBN 0-85186-118-0.

This book is drawn mostly from the proceedings of the third European Conference on Chemistry and the Environment, held in July 1988, with some additional contributions by authors who did not attend the conference. The book is divided into four sections: an overview of risk assessment, applications of toxicology to risk assessment, incidental emissions, and intentional emissions.

In the overview section, contributors discuss assessment protocols and their liabilities. Each contributor examines a different aspect of risk assessment. Among the contributions are a systems approach to the control and prevention of chemical disasters, a global approach, U.S. policy, and a comparison between assessment and acceptance of risk. All contributors employ an array of chemical examples. These examples vary in focus, from lead in the environment to large-scale production methods.

The second section, the relationship of toxicology to risk assessment, deals mostly with cancer. Five of the eight chapters involve cancer in some way. Of special interest to chemists outside of environmental chemistry is a chapter on solvent exposure. Two new approaches to risk assessment are proposed also: a physiologically based pharmacokinetic approach and an alternative to LD₅₀ studies.

The incidental emissions section contains contributions on acid rain, the river Danube, and a number of modeling techniques, primarily of interest to environmental chemists and not as applicable to other areas of chemistry.

The intentional emissions section deals with a range of topics. There are large overview chapters. One such chapter examines trends in risk assessment. Also contained in this section are studies of risk assessment applied to more specific areas, such as pesticides in the aquatic environment.

The volume also contains concluding remarks by the editor and a good index, which may be employed to find specific compounds in the lectures.

Chemistry and Processing of Sugarbeet and Sugarcane. Edited by M. A. Clarke and M. A. Godshall (Sugar Processing Research, Inc.). Elsevier: Amsterdam and New York. 1988. xii + 406 pp. \$136.75. ISBN 0-444-43020-2.

This book is a compilation of papers presented at the Symposium on the Chemistry and Processing of Sugarbeet in Denver, in 1987, and at the Symposium on the Chemistry and Processing of Sugarcane in New Orleans, in 1987. The editors have selected authors who are experts in the field. The book is comprised of 23 chapters describing the current state of technology in sugarbeet and sugarcane manufacturing. In addition, it includes the future possibilities in sugar production systems and products. Each chapter contains numerous references.

The text is divided into two sections: beet and cane. Chapters 1–10 discuss the chemistry and processing of sugarbeet, while chapters 11–23 focus on the chemistry and processing of sugarcane. Each section begins with an overview of the crop and the production systems and serves as a framework for the papers that follow. Several chapters, such as those devoted to sucrose chemistry (16, 18, 23) are relevant to both sugarcane and sugarbeet.

The book is intended for workers in sugarcane and sugarbeet factories and refiners as well as companies involved in the sugar industry. It might also be used as a text for a training course in sugar processing technology. The index is adequate, but could be expanded.

Ultrastructure Processing of Advanced Ceramics. Edited by John D. Mackenzie (University of California) and Donald R. Ulrich (Air Force Office of Scientific Research). John Wiley and Sons: New York and Chichester. 1988. xxxi + 1014 pp. \$95.00. ISBN 0-471-62416-0.

This book is a collection of research by 213 scientists presented at the Third International Conference on Ultrastructure Processing of Ceramics, Glasses, and Composites held in San Diego in 1987. The editors have compiled these proceedings into 82 chapters, allocated to six main topics (one of which is Miscellaneous Topics).

Each chapter is essentially a paper that was presented at the conference by a research group. The chapters have been edited to give a sense of congruity in the book, but they are still essentially reports of original research, consisting of introduction, experimental procedures, results and discussion, summary or conclusion, acknowledgments, and references.

The short index does not fully express the breadth or depth of coverage in the book that is conveyed by the table of contents or the nature of the chapters. This book is appropriate for materials scientists who need a comprehensive treatment of the more recent advances in ultrastructure processing.

Books on Biological and Clinical Subjects

Progress in Clinical Biochemistry and Medicine. Volume 4. By E. Debus et al. Springer-Verlag: New York and Berlin. 1987. 146 pp. \$59.30. ISBN 0-387-16955-5.

This book is the fourth in a series concerning recent progress in clinical biochemistry and medicine. The book contains four nonrelated chapters: (1) Immune response control, endocrine factors and the clinical significance of such regulations; (2) Malaria, a brief background and its vaccination with both sporozoite and merozoite vaccines; (3) Controlled drug delivery, delivery systems and physiochemical distribution; (4) Enzyme immunoassays, types, applications and principles, components, and performance characteristics. This book compiles the findings of a great number of researchers and contains many facts. However, the book does not contain as many pages of information as it appears to, due to the fact that the publisher used an unorthodox page numbering method (the text begins on page 9). An author index of Volumes 1–4 is included.

Chemical and Physical Behavior of Human Hair, Second Edition. By C. R. Robbins. Springer-Verlag: New York and Berlin. 1988. xiii + 305 pp. \$62.50. ISBN 0-387-96660-9.

This book provides a detailed, scientific presentation of the current knowledge on human hair. Sections on the cosmetic behavior of hair and the biological and chemical basis of some hair-growth abnormalities are included.

The biological processes involved in normal hair growth are presented first, including anatomy of the scalp and hair, followed by a general discussion of the pathology of various forms of abnormal hair growth. The chemical composition of hair is presented next, including a discussion of peptide analysis of hair and fractionation. The chemical basis of common hair treatments, including bleaching, reduction, shampooing, dyeing, and treatment with polymers is then presented. Advantages and disadvantages of each are discussed in detail, as well as the problems and health hazards each may pose. The book concludes with a discussion of some physical properties and characteristics of hair, including deformations due to elastic and tensile forces, torsion and fiber rigidity, static charge, and hair body, among others.

This book is a concise and thorough reference for hair researchers, textile researchers, cosmetic chemists, and forensic scientists.

Books on Applied Subjects

Beer Analysis. Vol. 7 of Modern Methods of Plant Analysis, New Series. Edited by H. F. Linskens (Erlangen) and J. F. Jackson (University of Adelaide). Springer-Verlag: Berlin and New York. 1988. ix + 304 pp. \$150.30. ISBN 0-387-18308-6.

This 15-chapter volume is a reference of value to scientists in the beer manufacturing industry. It contains up-to-date methods of analysis for every step in the manufacturing process of beer. Special attention is given to make them detailed and complete. The topics include germination tests; analysis for specific proteins; quantitative methods for determination of impurity levels; genetic analysis of ingredients such as malt, barley, hops, and several types of yeast; and a chapter covering German beer-purity laws. Each chapter includes a list of references. This volume also contains an unusually thorough index, which contains such intriguing entries as "sandwich ELISA".

Adulteration of Fruit Juice Beverages. Edited by Steven Nagy et al. Marcel Dekker: New York and Basel. 1988. xvi + 564 pp. \$163.00. ISBN 0-8247-7912-6.

This book is intended to be a comprehensive analysis of the problem of fruit juice adulteration. It evaluates the authenticity of 24 fruit juices, diluted beverages, and fruit wines, and it also describes many instrumental techniques used in the verification process.

It is divided into six chapters, each written by a different author, which deal with subjects ranging from ways to detect adulteration to the established criteria used in America, Germany, Australia, the Netherlands, Spain, and Israel for authenticating fruit juices. Each chapter contains numerous useful tables and graphs. The methods described include analysis for chemical markers (amino acids, flavanones, trace metals), isotope ratio determination, spectroscopy, etc.

The volume is readable and informative, and has an excellent index.

Pharmaceutical Dosage Forms. Volume 1. By Herbert A. Lieberman et al. Marcel Dekker: New York and Basel. 1988. 472 pp. \$89.50. ISBN 0-8247-7817-0.

Pharmaceutical Dosage Forms is a 5-volume series covering theory and practice. Three of the volumes are devoted to tablets, and two volumes cover parenteral medications. This volume, *Disperse Systems*, describes injectables, suppositories, aerosols, emulsions, pastes, and suspensions. There are chapters on the theory of suspensions, emulsions, and colloids, and on the principles of surface activity, rheology, and potential-energy barriers to coalescence. The series as a whole gives a detailed coverage of the principle and theory of, as well as practical information on, techniques currently in use. The series is suitable for use as text books or as a desk reference for practicing pharmaceutical chemists.

Chemical Reactions in Plastics Processing. By Klaus Kircher. Hanser: Munich and New York. 1987. x + 214 pp. \$45.00. ISBN 0-19-520730-0.

This 12-chapter volume is a collection of material on plastics processing. The first five chapters cover the general topics of polymer processing such as its industrial importance, applicability, and heat release and volume contraction during synthesis.

The remaining chapters go over the areas of polycondensations in polymer processing; production of parts using a polyaddition reaction; cross-linking of polyethylene, ethylenic unsaturated, and other polymers; and the degradation of polymers during processing. These chapters include sections explaining the basic chemistry of the reaction and sections covering finer aspects involved with the specific process, such as favorable reaction conditions and reaction accelerators or inhibitors. Most chapters are referenced. In addition to the 44 figures and 51 tables, a three-page subject index in the back of the book helps to make it a useful reference text in an industrial setting, despite its lack of information regarding specific equipment suitable for the chemical processes covered.

Practical Statistics for the Physical Sciences. By Larry L. Havlicek and Ronald D. Crain. American Chemical Society: Washington, DC. 1988. xvi + 489 pp. \$59.95. ISBN 0-8412-1453-0.

This book provides a comprehensive, up-to-date introduction to statistical procedures. Emphasis is placed on concepts and applications rather than derivations and computations. It begins with the treatment of basic statistical concepts and data, then it works through tendency, variability, regression, probability, hypothesis testing, factor design, latin square design, and hierarchical design. To illustrate each statistical procedure, this book makes use of numerous practical examples that would be found in a science-related field.

This book is intended for those wishing to learn how to draw conclusions based on well-planned statistical research. It provides an understanding of basic principles and statistical reasoning while serving also as a reference for the selection and application of appropriate statistical analysis.