

the newer techniques of field desorption,^{13,14} fission fragment induced desorption (²⁵²Cf desorption),^{18,19} and electrohydrodynamic ionization²⁰ mass spectrometries. By use of sample volatilization techniques first described by Beuhler et al.,^{2-4,21} together with adequate ion detection methods, the utility of the better established electron-impact and chemical ionization techniques for analysis of polar, unstable, "nonvolatile" compounds can be greatly extended.^{19,22-24} This is a discovery of major importance given the generally superior structural information contained in spectra produced using these relatively energetic ionization modes as compared with spectra produced using "soft" ionization methods.

Acknowledgment. We express appreciation to the M. J. Murdock Charitable Trust for a grant which supported this research.

References and Notes

- (1) Spectra of underivatized peptide amides have been reported: W. R. Anderson, Jr., W. Frick, G. D. Daves, Jr., D. F. Barofsky, I. Yamaguchi, D. Chang, K. Folkers, and S. Rosell, *Biochem. Biophys. Res. Commun.*, **78**, 372 (1977).
- (2) R. J. Beuhler, E. Flanigan, L. J. Greene, and L. Friedman, *Biochem. Biophys. Res. Commun.*, **46**, 1082 (1972).
- (3) R. J. Beuhler, E. Flanigan, L. J. Greene, and L. Friedman, *J. Am. Chem. Soc.*, **96**, 3990 (1973).
- (4) R. J. Beuhler, E. Flanigan, L. J. Greene, and L. Friedman, *Biochemistry*, **13**, 5060 (1974).
- (5) For our experiments a Consolidated Electrochemicals Corporation (Du Pont) 21-110 mass spectrometer was used.
- (6) Apparently similar results have been achieved by Ohashi et al. (M. Ohashi, K. Tsujimoto, and A. Yasuda, *Chem. Lett.*, 439 (1976)) using a technique termed "in beam" electron ionization mass spectrometry first reported by Dell and coworkers (A. Dell, D. H. Williams, H. R. Morris, G. A. Smith, J. Feeney, and G. C. K. Roberts, *J. Am. Chem. Soc.*, **97**, 2497 (1975)) who used it to obtain mass spectra of the antibiotic echinomycin.
- (7) R. Khan, *Adv. Carbohydr. Chem. Biochem.*, **33**, 235 (1976).
- (8) J. Lonngrén and S. Svensson, *Adv. Carbohydr. Chem.*, **29**, 41 (1974).
- (9) S. Hanessian, *Methods Biochem. Anal.*, **19**, 105 (1971).
- (10) T. Radford and D. C. DeJongh in "Biochemical Applications of Mass Spectrometry", G. R. Waller, Ed., Wiley-Interscience, New York, N.Y., 1972, pp 313-350.
- (11) N. K. Kochetkov and O. S. Chizhov, *Adv. Carbohydr. Chem.*, **21**, 39 (1966).
- (12) H. D. Beckey, *Int. J. Mass Spectrom. Ion Phys.*, **2**, 500 (1969).
- (13) H. D. Beckey and H. R. Schulten, *Angew. Chem., Int. Ed. Engl.*, **14**, 403 (1975).
- (14) H. D. Beckey and H. R. Schulten, *Z. Anal. Chem.*, **273**, 345 (1975).
- (15) We have used with equal success a loop of tungsten wire,¹ a rhenium ribbon, and a molybdenum photoetched mesh.
- (16) Since the initial report,¹ a complete spectrum of the heptapeptide amide *p*-Glu-Gln-Phe-Phe-D-Leu-Leu-MetNH₂ has been obtained which exhibits peptide backbone characterizing ions at *m/e* 908 (MH⁺), 760, 647, 534, 387, 240, and 112.
- (17) Using ion monitoring techniques we have already observed selected ions at such high masses.
- (18) R. D. Macfarlane and D. F. Torgerson, *Science*, **191**, 920 (1976).
- (19) O. Becker, N. Furstenan, W. Knippelberg, and F. R. Koneger, *Org. Mass Spectrom.*, **12**, 461 (1977).
- (20) D. S. Simons, B. N. Colby, and C. A. Evans, Jr., *Int. J. Mass Spectrom. Ion Phys.*, **15**, 291 (1974).
- (21) See also D. F. Barofsky and E. Barofsky, *Int. J. Mass Spectrom. Ion Phys.*, **14**, 3 (1974); J. F. Holland, B. Soltmann, and C. C. Sweeley, *Biomed. Mass Spectrom.*, **3**, 340 (1976).
- (22) M. A. Baldwin and F. W. McLafferty, *Org. Mass Spectrom.*, **7**, 1111, 1353 (1973).
- (23) D. F. Hunt, J. Shabanowitz, F. K. Botz, and D. A. Brent, *Anal. Chem.*, **49**, 1160 (1977).
- (24) B. Soltmann, C. C. Sweeley, and J. F. Holland, *Anal. Chem.*, **49**, 1164 (1977).

William R. Anderson, Jr., Willi Frick, G. Doyle Daves, Jr.*

Department of Chemistry and Biochemical Sciences
Oregon Graduate Center, Beaverton, Oregon 97005

Received December 2, 1977

Book Reviews

Anionic Surfactants. Part 1 (Surfactant Science Series. Volume 7). Edited by WARREN M. LINFIELD (Eastern Regional Research Center, USDA). Marcel Dekker, Inc., New York, N.Y. 1976. xi + 314 pp. \$35.00.

This first volume of a two-volume subseries on anionic surfactants is likely to be of most value to those interested in the chemical engineering of sulfonates and sulfates and in the chemistry associated with such processes, or to the technologist interested in the formulation of products based on these compounds.

Several chapters catalog and discuss industrial processes used to sulfonate or sulfate alkyl benzenes, monoalcohols, unsaturated fats, and lower alcohol or alkylphenol ethoxylates. Olefins, alkanes, and fatty acids will be discussed in Volume 2. Representative data on compositions and properties have been assembled. Indeed, a useful compilation of the extensive research at the Eastern Regional Research Center on anionics containing other polar functional groups comprises one chapter.

For the chemist, the chapter by Edwards represents a sound comprehensive analysis from the literature of the reaction intermediates and mechanisms involved in the sulfonation chemistry of monofunctional fatty intermediates. The sulfonation chemistry of the polyoxyethylene materials was not treated in detail and still needs clarification.

Notably absent, considering the broad title, are (1) a treatment of soaps comparable to those on sulfates and sulfonates and (2) a serious treatment of the physical chemistry of anionic surfactants.

The only real chemical problem I had with the book was a persistent misuse of the term "amphoteric". This term has historically had a clearly defined meaning. Specifically, it denotes a molecule which has the capacity to react both as an acid and a base (e.g., aluminum hydroxide or glycine). Both in the first chapter and elsewhere (e.g., pp 176, 182), it is applied to structures which are neither acidic nor basic,

e.g., a quaternary ammonio sulfonate containing a carboxylic amide link. This molecule is zwitterionic but neither acidic, basic, nor amphoteric. This mistake is noticeable elsewhere in the literature of surfactant technology as well.

Robert G. Laughlin

Miami Valley Laboratories, Procter & Gamble Company

Topics in Carbon-13 NMR Spectroscopy. Volume 2. Edited by GEORGE C. LEVY (Florida State University). Wiley-Interscience, New York, N.Y. 1976. xii + 485 pp. \$27.50.

The first half of this volume is devoted to ¹³C NMR studies of naturally occurring molecules. Separate chapters deal with ¹³C NMR probing of peptide conformation and structure (R. Deslauriers and I.C.P. Smith), a sample of ¹³C NMR studies of small naturally occurring molecules such as terpenes, alkaloids, and coumarins (E. Wenkert et al.), an inclusive, pragmatic and highly instructive discussion of ¹³C NMR biosynthetic studies (A.G. McInnes, J.A. Walter, J.L.C. Wright, and L.C. Vining), and a lucid review of ¹³C NMR work on biopolymers including proteins, nucleic acids, and polysaccharides (R.A. Komoroski, I.R. Peat, and G.C. Levy). The second half of the volume presents reviews of wider variety of subject matter in ¹³C NMR spectroscopy. An exhaustive review of the application of ¹³C NMR to the study of organometallic and transition metal complexes is given (O.A. Gansow and W.D. Vernon) and is followed by a review of ¹³C spin-relaxation theory and applications to structure determination (F.W. Wehrli). An excellent discussion of the use of the computer in Fourier-transform NMR is given (J.W. Cooper) and the last chapter is a clear and unusually readable presentation of the theory of indirect (through bond) nuclear spin-spin coupling constants with special attention being given to ¹³C-H and ¹³C-X coupling (P.D. Ellis and R. Ditchfield). All contributions are written with a general scientific readership in mind. With the exception of the chapters

dealing with naturally occurring small molecules and metal-organic compounds, which are less amenable to the approach, the reader is first presented with the theory and pertinent experimental procedures followed by illustrative examples and applications. Another general feature of the work is that each discussion is self contained and spares the reader the trouble of having to seek out other reviews in order to comprehend the discussion at hand. This is particularly evident in the biosynthesis chapter where the authors presume their readers not to be highly knowledgeable in ^{13}C FTNMR and discuss sensitivity limitations, peak assignments, and pitfalls to be avoided in the application of the technique. There is, thus, some redundancy in the volume as a whole, but it is more than compensated for by the clarity of each discussion. Nearly all the contributions are extensively documented and tables of data are abundant. For example, one table in the chapter on metal organic compounds contains chemical shift data for in excess of 300 metal-carbonyl compounds.

The development of many of the chapters is exemplified by Deslaurier's and Smith's discussion of peptide structure and conformation. At the onset the authors discuss the effect of primary structure, conformation, and pH changes on the ^{13}C chemical shifts of amino acids and peptides. The effect of these structural features on spin-lattice relaxation times (T_1) and coupling constants is then examined. This presentation is followed by systematic case by case analysis of the utilization of these NMR parameters in the study of synthetic cyclic peptides, natural cyclic peptide hormones, peptide antibiotics, and linear peptide hormones. As in other chapters the reader is constantly made aware of the strengths and the weaknesses of the method. Care is taken throughout the volume to give the prospective experimentalist an adequate understanding of the limitations of the ^{13}C NMR methodology and what equipment or instrument configuration is most profitable. Komoroski, Peat, and Levy discuss the limitations of using high-field superconducting solenoids in the study of biopolymers and the advantages of paramagnetic probes in connection with ^{13}C NMR investigations of these species. Wehrli shows how it may be necessary to take more than one ^{13}C spin-relaxation mechanism into consideration when using these data to make structural assignments of resonances. Cooper demonstrates the importance of choosing the proper digitizer work length in order to get maximum signal to noise in dilute samples or samples with strong and weak lines.

Professor Levy has recruited authors who are expert in their respective subjects, and the result is a book which is up to date, informative, illustrative, useful, and the very epitome of an excellent reference work.

Richard N. Loepky, *University of Missouri—Columbia*

Laser Spectroscopy. Edited by S. HAROCHE (Université de Paris), J. C. PEBAY-PEYROULA (Université de Grenoble), T. W. HANSCH (Stanford University), and S. E. HARRIS (Stanford University). Springer-Verlag, New York and Berlin. 1975. iii + 467 pp. \$18.50.

This book includes the proceedings of the Second International Conference on Laser Spectroscopy, held in Megeve in June of 1975. Thus a good deal of the contents has been published in more comprehensive form elsewhere. However, it does provide a good collection of articles which would otherwise take some time to obtain from scattered individual journals. There are also some speculative sections of a type which are not normally published in periodicals. These selections arise from the more informal verbal medium for which they were prepared and thus enable a reader to obtain some feel for possible new directions in which this research may turn.

Most of the articles may be classified as either involved with laser development or spectroscopic applications of laser technology. There is heavy emphasis on applications of tunable lasers, clearly reflecting the increasing importance of such lasers for spectroscopy. There are also numerous articles on multiphoton and nonlinear effects which are becoming more ubiquitous. The opening section includes papers by A. Kastler, A. Javan, J. J. Synder and J. L. Hall, V. S. Letokhov and N. Bloembergen, all of whom would have to be listed among the founders of laser spectroscopy. The remainder of the book includes a wide variety of contributions from many countries reflecting the broad interest generated by this topic. The papers are by and large well written, and understandable by anyone with a reasonable knowledge of laser technology.

It is, of course, quite encouraging to see the inclusion of papers both from the Soviet Union and the United States on the sensitive topic of isotope separation. These clearly have possible application to inexpensive generation of nuclear materials, which has traditionally been

a topic which both countries have sought to keep from the open scientific literature. Perhaps it is a measure of the relative security both countries feel in their ability to produce isotopes in sufficient quantities for weapons by other techniques, that they allow freer discussion of laser techniques. Even so, as the editors point out, this section of the book is hampered by secrecy; thus we might not in fact have a very good view of the real progress. However, the increasing number of papers published openly raises the specter of providing an inexpensive nuclear technology to numerous other countries, not to mention well-financed terrorist groups. Each new organization with nuclear capability vastly complicates efforts to avoid nuclear warfare.

It is the impulse of all scientists to struggle for free and open dissemination of scientific ideas. However, it is possible that in this case the impulse should be modified by social concerns. While I am not necessarily suggesting we censor publication, perhaps it is timely to bring the issue into the open for full discussion. Should we, in fact, encourage publication of technological data which will enable anyone who chooses to produce nuclear fuels?

John R. Lombardi, *City College, CUNY*

Treatise on Solid State Chemistry. Volume 3. Crystalline and Non-crystalline Solids. Edited by N. BRUCE HANNAY (Bell Laboratories). Plenum Press, New York, N.Y. 1976. xvi + 774 pp. \$45.00.

The title "Crystalline and Noncrystalline Solids" could be misleading to a scientist seeking a first exposure to the nebulous fields of study of the solid state. This book is intended for the advanced researcher in the field and no attempt is made to familiarize the reader with the standard subjects and terminology covered in traditional solid-state textbooks. In particular, the material covered relates to rather complex solid state structures, and one needs some knowledge of the simpler crystal structures to utilize this book.

This volume of the Treatise contains a wealth of easily readable material which is pertinent to researchers active in many areas of solid state chemistry, solid state physics, or metallurgy. The contributors to each chapter are highly qualified researchers in their respective fields. Consequently the material presented along with the numerous references allows the reader an insight into the present state of the art as well as an appreciation of the problems in some of the more active areas of research in solids. In general the nine chapters are associated with metastable phases in both crystalline and amorphous thin films, inclusion compounds, structural studies of some complex oxides, interstitial phases, inorganic amorphous solids with major emphasis being placed on the conditions for glass formation and on the structural characteristics of glasses and glass-ceramic materials; polymers are very extensively and adequately discussed from the viewpoint of the morphology, theory of growth, and chain folding in synthetic polymers with the final two chapters devoted to the study of organic molecules and the charge-transfer complexes in these low mobility crystals.

Although none of the chapters deal exclusively with superconductivity, the first two chapters should be of considerable interest to researchers investigating some of the more exotic superconducting materials.

It is my opinion that the contributors of each chapter have done a fine job of compiling up to date information on some very difficult subjects and then presenting the material in a very comprehensible manner.

B. J. Marshall, *Texas Tech University*

Structure and Bonding. Volume 26. Edited by J. D. DUNITZ ET AL. Springer-Verlag, Berlin-Heidelberg-New York. 1976. 144 pp. \$23.80.

This book is Volume 26 of the series "Structure and Bonding". At present there are 32 volumes in print. The book is divided into three sections. The first section was written by P. S. Braterman and is titled "Spectra and Bonding in Metal Carbonyls. Part B: Spectra and Their Interpretation" (Part A was published earlier in "Structure and Bonding", Volume 10, p 57 (1972), by the same author). The present section discusses vibrational spectra from the point of view of deriving electron distributions in metal carbonyls from vibrational frequencies. In line with this program, the following topics are discussed: filiation curves, incomplete energy factored force fields, Cotton-Kraihanzel and related force fields, isotopic substitution, anharmonicity, solvent and environment effects, and intensity studies. The analysis of vibrational data in terms of force constants, bond order and bond type, substituent, and orbital following effects is also discussed.

The second section of this book is by G. Blasse and is titled the Influence of Charge Transfer and Rydberg States on the Luminescence Properties of Lanthanides and Actinides. This section discusses the influence of charge-transfer and Rydberg ($f^{n-1}d$) states on the luminescence of lanthanides and actinides. The following topics are discussed thoroughly: charge-transfer and $4f^{n-1}5d$ states of lanthanides and their dependence on surroundings, influence of charge transfer and $4f^{n-1}5d$ states on emission spectra of the lanthanides, dependence of thermal quenching temperature on the charge transfer and $4f^{n-1}5d$ states of lanthanides, influence of charge transfer or $4f^{n-1}5d$ states on probability of energy transfer between two luminescent states, and luminescence of hexavalent uranium.

The third and final section has the following title: Vibrational Spectra of Oxo-, Thio-, and Selenometallates of Transition Elements in the Solid State. The authors are Achim Miller, Enrique J. Baran, and Roscoe O. Carter. This section consists of a review of the vibrational spectra of solid chalcogenometallates. The following topics are discussed: vibrational spectra of powdered, crystalline samples, single crystal Raman spectra, interpretation of Raman band intensities and widths, resonance Raman spectra, pressure and temperature influence, and sample preparation. Included are extensive tables on IR and Raman vibrational spectra of the chalcogenometallates.

Ed Mooberry, *North Carolina Agricultural and Technical State University*

Handbook of Adhesives. Second Edition. Edited by I. SKEIST (Skeist Laboratories, Inc.). Van Nostrand Reinhold Co., New York, N.Y. 1977. xviii + pp. \$39.95.

This classic handbook for the adhesive scientist and formulator has been revised by 75 specialists in adhesives and bonding technology.

The first section (Chapters 1–5) on fundamentals retains its original format and covers important topics such as markets for adhesives, theory of adhesion, roll application of adhesives, physical properties, testing, and design of adhesives.

The second section, Adhesive Materials (Chapters 6–40), is an overview of natural and synthetic raw materials used in adhesive formulations. Chemical structures, physical properties, and unique characteristics of many of the raw materials are described. New chapters on subjects such as thermoplastic rubber, vinyl acetate-ethylene copolymers, acrylic polymers, polyethylenimine, aromatic polyimides, organofunctional silane coupling agents in adhesives, anaerobic adhesives, and silicone sealants have been added. Each chapter contains an excellent balance between theoretical chemical principles and practical information.

Tables of commercial products and data, graphs of adhesive properties, and pictures of applications for adhesives make the handbook easy to read and understand. An abundance of references at the end of each chapter provides a source of additional information.

The information on adherents and bonding technology has been combined into the third section (Chapters 41–56). This section discusses where and how specific types of adhesives are used in today's markets. For example, specific information is given for bonding of plastics, textiles, and wood. Specific industries such as automotive, electrical, and construction are discussed with pictures and diagrams. New sections include Medical and Biological Adhesives and Metalization of Plastics. The section is concluded with a chapter on the mechanical handling of multicomponent adhesives which includes pictures of equipment and a chapter written as guide for designers.

In general, the handbook is a must for every person working in the adhesive industry.

Charles D. Rowe, *Daubert Chemical Company*

Aspects of Organic Photochemistry. By WILLIAM B. HORSPOOL (The University of Dundee). Academic Press Inc., London. 1976. x + 290 pp. \$20.75.

This textbook of organic photochemistry is aimed at graduate and advanced undergraduate students. The first three chapters contain background material; the following six describe the most important types of organic photochemical reactions.

The first chapter is the worst in the book, and a beginner would be well advised to skip it. Otherwise, he or she may start using concentrations in $g\ l^{-1}$ when determining molar extinction coefficients from measured optical densities, having the impression that a maximum

possible value of oscillator strength is unity, believing that the electronic states of a carbonyl group can be classified as gerade or ungerade, expecting typical lifetimes of upper excited singlet states to be $10^{-1} - 10^{-10}$ s and typical intersystem crossing rates to be 10^{-2} to $10^{-5} s^{-1}$, drawing potential energy diagrams containing large regions of geometries in which the lowest excited singlet state lies far below the lowest excited triplet, etc.

The second chapter provides a useful, brief summary of experimental aspects of preparative and, to a lesser degree, mechanistic organic photochemistry.

The third chapter describes the status of Woodward-Hoffmann rules in organic photochemistry a decade ago. An obsolete version of the butadiene-cyclobutene state correlation diagram is presented, the now classical developments due to Oosterhoff, Salem, and many others are ignored, and no indication is given to the reader as to what might be happening between the initial act of light absorption and the moment of appearance of the first ground-state product, although most of the newer material is conceptually no more difficult than that included in the chapter.

The remaining chapters expose the reader to a well-balanced survey of the most important types of organic photochemical processes. Numerous examples are provided and generous use of structural formulas makes the reading easy. I have been favorably impressed with the overall organization, as well as the selection of the topics, and I think that it is particularly fortunate that examples of preparative use of photochemistry for the synthesis of natural products are included. This main body of the book suffers from obsolescence and mistakes to a much smaller degree. Some that came to my attention are the claim that the triplet state of acenaphthylene has not been observed spectroscopically ($S_0 \rightarrow T_1$ absorption data were published in 1971), the reference to eight MOs on p 155 which should be to seven, and the obsolete description of triplet methylene as linear.

The book is provided with a good subject index. Detailed references are not given, but at the end of each chapter there is a list of pertinent review articles. This is a good idea for a textbook; once again, the references tend to be old.

Josef Michl, *University of Utah*

Physical Chemistry. An Advanced Treatise. Volume 11B. Mathematical Methods. Edited by DOUGLAS HENDERSON (IBM Research Laboratories). Academic Press, New York, N.Y. 1975. xx + 586 pp. \$47.00.

This volume of what is overall an outstanding treatise contains five chapters: Methods in Lattice Statistics by N. W. Dalton; Probability Theory and Stochastic Processes by D. A. McQuarrie; Nonequilibrium Problems-Projection Operator Techniques by James T. Hynes and J. M. Deutch; Scattering Theory by F. David Peat; and The Solution of Integral and Differential Equations by R. L. Somorjai.

Dalton's chapter on lattice statistics considers the application of graph theory including methods of lattice constant evaluation to three problems of fundamental interest: the Ising, percolation, and excluded volume problems. The article provides a very instructive description of the interrelationships between different types of exact and approximate methods including exact series expansions, random walks, conversion matrices, and especially the applications of Pfaffians. An extensive discussion of the Pfaffian solution of the planar Ising problem is included.

McQuarrie's chapter begins with a well-written, general description of basic concepts in probability theory including properties of random variables and stochastic processes. This is followed by a very clear discussion of random walks and flights, birth/death and related processes, and continuous processes described by diffusion, Langevin, Fokker-Planck, and Chandrasekhar equations.

The chapter on projection operators by Hynes and Deutch provides a "road map" to the many uses of such operators in applications to nonequilibrium statistical mechanics. Included in this useful article are applications to the theories of Brownian motion, magnetic relaxation, dilute gases, hydrodynamics, and (using higher order results) critical phenomena and generalized hydrodynamics.

Peat's chapter begins with a general (but often too brief and fragmented) introduction to scattering theory including single particle scattering, Green's functions, multichannel scattering, optical models, and analytic properties of the scattering matrix. Applications to electron-atom scattering are considered, including elastic scattering (static exchange and polarized orbital approximations, variational

methods) and inelastic scattering (close-coupling, configuration interaction, autoionization).

Somorjai's very formal article covers the basic properties of solutions to both linear and nonlinear integral and differential equations including general theories of operator equations, existence properties, and methods of solution. Although sparse in illustrating concepts by examples, the article contains a very extensive review of pertinent literature.

Overall, the chapters of this book provide several carefully written, well-documented, and often highly instructive treatments of important aspects of the mathematics of physical chemistry.

George C. Schatz, *Northwestern University*

The Chemistry of Phosphorus. By J. EMSLEY and D. HALL (University of London). John Wiley & Sons, Inc., New York, N.Y. 1976, xi + 563 pp. \$39.50.

This book is intended to cover both the inorganic and organic chemistry of phosphorus. There is a chapter on bonding, one on NMR and vibrational spectra, several on organophosphorus compounds (organized according to the coordination number of phosphorus), one on free radicals, one on transition metal complexes with phosphorus(III) ligands, one on P-N compounds, and one on P-P and P-B compounds. In addition, the first chapter is on environmental phosphorus chemistry, and the last on biophosphorus chemistry.

An advertisement claims this book, a product of collaboration between an inorganic phosphorus chemist and an organic phosphorus chemist, brings together in one volume *all* aspects of the chemistry of phosphorus, and this claim is restated in the Preface. Such a claim is a major overstatement. While the book will be valuable and interesting to an expert, its coverage would mislead a newcomer. Large portions of the subject matter of the field are omitted. For example, there is little on the chemistry of the condensed phosphates, little on industrial organophosphorus chemistry, and nothing on phosphorus complexes of the main group elements.

As for what is included, the treatment is generally uncritical, but coverage is lopsided in terms of examples chosen, space devoted to particular topics, and critical details left out. Examples of compounds and reactions are often exotic at the expense of the standard. For instance, of the phosphorus-halogen compounds surely those containing chlorine are the most important, but those of fluorine get the lion's share, presumably because of NMR. For reactions, there is no indication of the method of choice in a synthesis, or of the role of solvents, or of whether one is speaking of a ton or a milligram scale. Many pages are devoted to pseudorotation or to the mechanism of hydrolysis of phosphonium cations, but hardly any to phosphoric acid or phosphorus trichloride. Space is given to a discussion of the normal modes of vibration and to the IR and Raman selection rules, but none to such experimental questions as whether carbon tetrachloride can be used as an IR solvent for tertiary phosphorus compounds. The work of Mayo on the radical mechanism of the chlorophosphonation reaction, and of Shore on the effect of solvent polarity on the molecular state of phosphorus pentachloride, and of Meyers and Van Wazer on carbodiimide-mediated condensations of phosphates are examples of critically important details left out though the topics themselves are taken up in the book.

There are many detailed errors of fact in this book; a few examples follow. In the phase diagram of phosphorus, liquid phosphorus is shown well above the critical temperature, and black phosphorus, the thermodynamically stable form at standard conditions, is shown as existing only at high temperatures and pressures. Ring strain arguments assume planarity of five- and six-membered saturated rings. The formula of Paris Green is incorrect. A magnesium carboxylate salt is called a Grignard reagent. The energy levels of the hydrogen atom are given in incorrect order, and the meaning of "slow on the NMR time scale" is incorrect. It is stated that carbon disulfide adducts are useful for purifying phosphines; this is wrong. An inconsistent account is given of the effect of tertiary phosphorus substituents, in the sequence $>P-CH_3$, $>P-C_2H_5$, $>P-OC_2H_5$, on bond and molecular dipoles, electron-withdrawing effects, and back- π bonding in metal complexes. A semimystical theme is developed that there are two primordial sources of energy, light and O_2 . Usually no attempt is made to write reactions as balanced chemical equations, but occasionally a few numerical coefficients are thrown in at random while others are left out and elements may be created or destroyed. Elaborate efforts may be made to show the degree of hydration, e.g., in the preparation of superphosphate of lime, while ignoring it in the by-

product gypsum. It is suggested that the apophily rules for phosphorus may be applied to five-coordinate osmium, neglecting the results of structure determinations of many five-coordinate transition metal complexes.

There are a number of peculiarities of usage; for example, subgroups 3 and 4 of the Periodic Table are called T1 and T2. There is imperfect coordination between authors, or sections, in several cases. For example, back- π bonding of a lone pair on oxygen to the d orbitals of phosphorus is questionable in Chapter 2, a fundamental assumption in Chapter 4, and conveniently ignored in the discussion of that mythical intermediate, the monomeric metaphosphate ion, PO_3^- . As another example, compounds of the type $P(O)(NR_2)_3$ are discussed as solvents and ligands in one place, with no reference to their discussion as chemosterilants (spermatocides) in another. References are cited frequently, but not frequently enough. There are questions at the end of each chapter, with answers in the back. These are of very uneven quality and utility. The environmental and biophosphorus chapters really seem out of place.

This book will be a mine of interesting nuggets for the experienced phosphorus chemist and an invaluable reference work for a special topics course in phosphorus chemistry. The neophyte should first read A.D.F. Toy's book, "Phosphorus Chemistry in Everyday Living", published by the American Chemical Society

John T. Yoke, *Oregon State University*

Halonium Ions. By GEORGE A. OLAH (Case Western Reserve University). John Wiley & Sons Inc., New York, N.Y. 1975. xvi + 190 pp. \$18.50.

This monograph describes the preparation, spectral properties, and reactions of dialkyl, alicyclic, alkyl aryl, vinyl aryl, and diaryl halonium ions. The book emphasizes stable or observable halonium ions and largely omits detailed discussions of reactions in which halonium ions are postulated as intermediates. There are extensive tabulations of aliphatic halonium ions, prepared in superacid media, and many reproductions of NMR spectra from the author's own work, but coverage of the classical work on diaryl halonium ions is more limited. There are a few references to work published in 1974. Subject and author indexes are adequate.

Hans J. Reich, *University of Wisconsin—Madison*

Kinetics of Chemical and Enzyme-Catalyzed Reactions. By DENNIS PISZKIEWICZ (University of California—Irvine). Oxford University Press, New York, N.Y. 1977. xii + 235 pp. \$12.50, cloth; \$6.00, paper.

For students and scholars in the life sciences a clear, meaningful, and useful treatment kinetics is a rare but gratefully received event. Dennis Piszkiwicz has accomplished this feat with his book "Kinetics of Chemical and Enzyme-Catalyzed Reactions". I perceived the book to be divided into two sections. The first five chapters are devoted to fundamental principles of chemical kinetics and physical and enzyme chemistry, and the last two are devoted to a more complex enzyme kinetic models. In the first five chapters the author has gently, but thoroughly, introduced the reader to the mathematical principles of elementary chemical kinetics, thermodynamics of reactions, the effects of pH on reactions, and classical enzyme kinetics of uni-substrate reactions. The meaningful way in which illustrations and examples are used, usually from the scientific literature, makes the entire work exceptionally lucid and easy to read. The last two chapters deal with the enzyme kinetics of multisubstrate reactions and allosteric enzymes. These chapters are not started with the traditional complex algebraic treatment of countless kinetic models, so discouraging to the novice who needs kinetics as a tool rather than a profession. Rather they effectively and thoroughly teach the principles of deducing, by inspection, the results of experiments based on model assumptions. Unfortunately, principles of the theory and practice of fast kinetics was not treated this book. A section on this topic written in the author's effective style would have been a valuable addition to the reader.

All the chapters contain a liberal number of salient problems and the appendices contain much of the technical and operational definitions of terms and constants superfluous to the text.

"Kinetics of Chemical and Enzyme-Catalyzed Reactions" is a book of value to every student of the life sciences. It is also a book of great value to researchers in biology and chemistry with a new found need for enzyme kinetics.

Fred W. Wagner, *University of Nebraska—Lincoln*