Figure 1 shows the photocurrent vs. output voltage for the CdTe-based cell employing a Te^{2-}/Te_2^{2-} electrolyte for irradiation with a known power at 633 nm. At low intensity, the short-circuit current (0.0 V output) corresponds to a quantum efficiency for electron flow $\cong 0.6$, and the maximum power output (current × output voltage) occurs at ~0.45 V. The maximum overall optical to electrical energy conversion that we have measured is 10.7% at 633 nm, and from wavelength response data we calculate efficiencies of 14 and 7% at 800 and 400 nm, respectively, at the same light intensity. As shown in Figure 1, the efficiency suffers at higher intensities as we found with CdS- and CdSe-based cells, but the main finding here is that good open-circuit voltages, respectable efficiencies at high incident intensity, excellent wavelength response, and good stability all obtain in the Te^{2-}/Te_2^{2-} electrolyte.

Acknowledgment. We thank the National Aeronautics and Space Administration for support of this work.

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(9) For emphasis, we note that spectral changes upon photoelectrochemical generation of Te_2^{2-} are identical with those for the conventional electrochemical generation. Additionally, the current efficiency in each case is the same.
(10) Fannie and John Hertz Fellow.
(11) Fellow of the Alfred P. Sloan Foundation, 1974–1976, and recipient of a Dreyfus Teacher–Scholar Grant, 1975–1980.

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Book Reviews

Atomic Absorption and Fluorescence Spectroscopy. By G. F. KIRKBRIGHT (Imperial College, London) and M. SARGENT (Shell Research, Ltd., Cheshire). Academic Press, New York and London. 1974. 808 pp. $50.00.

This book attempts to give comprehensive coverage to the theory and techniques of atomic absorption spectroscopy (AAS) and atomic fluorescence spectroscopy (AFS). Considering the tremendous difficulties of such an undertaking, especially when the techniques are still undergoing rapid development, the authors have been very successful. The material is organized in the generally accepted format with an introductory chapter, three chapters of theory, six chapters on instrumentation, two chapters on techniques, one chapter on interferences, and one long chapter on applications data.

The theory is presented with sufficient detail to prevent its being misleading but at the same time is not so comprehensive as to discourage beginning students. The instrumentation is discussed in terms of individual components (sources, flames, etc.) with the emphasis being on properties and characteristics rather than theory of operation. In this way the authors make it easy for readers to make comparisons and evaluations of various types of comonents that are available. Considerations such as optimization of parameters, sensitivity, precision and accuracy, and sample pretreatment are very adequately discussed in a chapter on techniques. A second techniques chapter includes some discussion of other nonroutine operations such as indirect analysis, isotope analysis, and laser-excited AFS. A long (176 pp) chapter on applications data should be very helpful to the new or occasional user of AAS or AFS. Important numerical data and analytical conditions along with key references are summarized for each metal that can be determined directly.

The major shortcomings of this book result almost exclusively from the still rapid pace of development in the techniques and instrumentation of AAS and AFS. Important recent developments not included are the use of vidicon and array detectors for simultaneous multielement analysis, new nonflame atomization devices, and applications of on-line computers in automating optimization of instrument parameters. Despite these shortcomings the book is of high quality and far more comprehensive than any of its current competitors and as such should become a well-known and well-used standard reference volume for AAS and AFS.

Larry G. Hargis, *University of New Orleans*

Treatise on Analytical Chemistry. Part I. Theory and Practice. Volume 11. Edited by I. M. KOLTHOFF and PHILIP J. ELVING. John Wiley & Sons, Inc., New York, N.Y. 1975. xxiii + 697 pp. $39.50.

The "Treatise on Analytical Chemistry" is a comprehensive account in three parts: I. Theory and Practice; II. Analytical Chemistry of Inorganic and Organic Compounds; and III. Analytical Chemistry in Industry. This volume, the 11th in Part I, consists of Chapters 108 through 119 of theory and practice. These chapters have been written at a level and thoroughness consistent with those that have appeared earlier in this highly significant collection. They add to this continually expanding source of reference background material for analytical chemists. Unfortunately, it is difficult to use as a reference source because of its very size and the organizational problems presented by a series consisting of hundreds of chapters appearing over a period of years. This is not to suggest that the editors could have done more than they have in an organizational sense.

This volume consists of Chapters 108, General Laboratory Apparatus, by F. Hecht; 109, General Laboratory Operations and Techniques, by W. Prodinger and F. Hect; 110, Safety in the Analytical Laboratory, by R. F. Stalzer, J. R. Martin, and W. E. Railing; 111, Qualitative and Quantitative Chemical Analysis, by James I. Watters; 112, Qualitative Analysis: Scope and Limitations, by Richard B. Hahn; 113, Gravimetric Analysis, by Charles L. Rulfs; 114, Titrimetric Analysis: Introduction, by James I. Watters; 115, Titrimetry: Acid-Base Titration in Aqueous Solution, by John Beukenkamp and William Rieman III; 116, Titrimetry; Acid-Base Titration in Nonaqueous Solvents, by C. A. Steuli; 117, Titrimetry: Complexation Titration, by Axel Johansson and Erkki Wanninen; 118, Titrimetry: Precipitation Titration, by I. M. Kolthoff; 119, Titrimetry: Oxidation-Reduction Titration, by James A. Goldman.

Some of these chapters treat topics that were the subject of earlier

chapters but add new information and perspective and give a more up-to-date point of view. The chapter on precipitation titrations is exceedingly brief and mainly refers the reader to about six earlier chapters dealing with the precipitation phenomenon and adds little that is new. The complexation chapter demonstrates by numerous examples the extension of logarithmic diagrams to this area of analytical chemistry. The chapters on apparatus and techniques are thorough. When the first edition is completed, it is hoped the editors will compile an overall index.

This volume, like the earlier ones, is recommended to analytical chemists everywhere.

W. E. Harris, *University of Alberta*

Organic Chemistry. By RONALD F. BROWN (University of Southern California). Wadsworth, Belmont, Calif. 1975. 1008 pp.

As stated in the preface, the author adds ". . . yet another textbook to the many excellent texts now available for use in the first year course in organic chemistry . . .". This new book is of high quality and very adequately covers the range of topics necessary for such a text. In addition to the book, a detailed solution manual is available along with an optional supplementary paperback which presents additional material especially geared toward the motivated student seeking more information. This latter book is very helpful, in my opinion, especially the section dealing with the chemical literature, a topic whch is sadly neglected in most texts.

Overall, I would rate the total package as very good, but there are two important points which need discussion. First, from my own reading and from the opinions of a few selected student volunteers, I feel that, although the authors' style is certainly good, the level of the discussion is pitched a little too high for the majority of students likely to take organic chemistry, namely biology majors, chemical engineers, pre meds, and various health-related majors. I was particularly disturbed by Chapter 6 (stereochemistry), which required very careful reading on my part to comprehend even the basic concepts. The incorporation of bioorganic material is comprehensive and excellent. I was particularly impressed at the extensive and well-done coverage of such topics as heterocyclics, terpenes, and steroids, each of which was given an entire chapter. Also, the inclusion of short guest essays by prominent chemists represents an interesting and worthwhile addition. All in all, I believe the level and coverage of the text and supplementary material are best suited for an advanced or honors group of chemistry and/or biochemistry majors.

The second point which bothered me about the text was the decision to present a relatively large number of organic reactions early in the book (Chapters 2 and 3) before the concepts of structure and bonding are presented. In my opinion, this approach tends to separate the concepts of and the connection between reactions and mechanism. For instance, nucleophilic substitution is presented in Chapter 2, but without any real explanation concerning the inversion of configuration, kinetics, and other aspects necessary to understand substitution reactions; these omissions are necessary since stereochemistry is not introduced until Chapter 6, rates in Chapter 8, and a thorough discussion of bonding in Chapter 5. In my opinion, this may lead to confusion and lack of understanding for many students. It may appear that this reviewer places undue emphasis on the first few chapters, but it has been my experience that it is precisely at the beginning of organic chemistry that a great opportunity exists for capturing and motivating the interest of students toward the science.

The text seems relatively free of serious error; I noted that the NMR spectra on pp 40 and 42 of the supplement are interchanged.

R. O. Hutchins, *Drexel University*

Solvent Effects on Chemical Phenomena. Volume 1. By EDWARD S. AMIS and JAMES F. HINTON. Academic Press, New York and London. 1973. x + 474 pp. $32.50.

This book starts off with three fairly short, general chapters on the nature of solvation and methods of evaluating the degree, nature, and strength of solvation. Over half of the book is then contained in Chapter 5, "Solvent Effects on Rates and Mechanism". The subject is enormous, and the authors have surveyed a corrspondingly large literature; a total of 1375 references are given. In places the choice of subject matter seems a little odd. There are sections on the Hammett equation and the Brønsted catalysis law, but very little discussion of solubilities. A second volume, mostly devoted to electrochemical phenomena, is planned.

Many of the observations described in the section on rates and mechanisms are necessarily very short. Generally, the discussion seems to reflect the views of the original authors. Where Amis and Hinton introduce their own views, they seem to favor electrostatic theories involving such properties as the dielectric constant over theories based on more detailed structural considerations, although some of the latter are reported.

This book will be most helpful in providing an entry into the large literature of this field.

Maurice Kreevoy, *University of Minnesota*

Electrochemistry of Molten and Solid Electrolytes. Volume 9. Edited by S. F. PAL' GUEV (Institute of Electrochemistry, Urals Branch of the Academy of Sciences of the USSR). Consultants Bureau, New York, N.Y. 1972. vi + 105 pp. $20.00.

This book is the ninth volume in a continuing series of collections of papers on the electrochemistry of molten salts and solid electrolytes. The editor has subtitled this volume "Thermodynamics of Salt and Oxide Systems". I find that this subtitle is misleading because only three of the eighteen papers have a significant relationship to the discipline of thermodynamics. A large majority of the papers deal with physical properties such as surface tension, density, viscosity and structure, and electrical properties such as electroconductivity and ion mobility.

The Russian edition of this book was published in 1969. Even at that time, more than 60% of the references listed were over five years old and about 33% were over ten years old. The translation from the Russian is well done and the papers are quite readable. The references to the non-Russian literature appear to be more frequent than in previous volumes.

Most researchers in the molten salt and solid electrolyte fields will find this book to be a useful source of pertinent information. The articles are written in a scholarly manner and include abundant graphical and tabular data. Researchers just getting into the molten salt field will find the discussions on the definition and evaluation of transport numbers in ionic media useful for developing background information. However, the disinterested observer who wishes to assess recent progress in the area of molten salts and solid electrolytes will probably be disappointed in the lack of timeliness of the material presented.

Roger N. Kust, *Kennecott Copper Corporation*

The Kinetics of the Oxidation-Reduction Reactions of Uranium, Neptunium, Plutonium and Americium in Aqueous Solutions. By T. W. NEWTON (Los Alamos Scientific Laboratory). ERDA Technical Information Center, Oak Ridge, Tenn. 1975. viii + 132 pp. $5.45.

This book is largely a compendium of results obtained from kinetic studies on redox reactions of the lighter actinides. A very brief review of the basic concepts of redox kinetics is followed by detailed examination of a number of specific systems. Effects such as self-radiolysis and ionic strength dependence are also considered. Nearly one-third of the book consists of tabular presentation of data. Discussion of relationships between the various systems examined, or between the actinides and redox reactions in general, is minimal. Consequently, while the data available here should be useful to researchers active in this particular field, this book probably would not be of general interest.

Jay A. Labinger, *University of Notre Dame*

Computer-Aided Experimentation: Interfacing to Minicomputers. By JULES FINKEL (Weizmann Institute of Science). John Wiley & Sons, Inc., New York, N.Y. 1975. xviii + 422 pp. $24.95.

This book is intended to present the basic knowledge required for using minicomputers in experimentation. The reader is assumed to have no background in electrical engineering, computer science, or mathematics. Throughout the book the emphasis is on giving the reader a familiarity with terminology and device operation.

The first major topic following the introduction is analog signal processing. In Chapter 2 the author describes the characteristics of analog signals and their transmission. The next chapter describes amplifiers and includes an elementary discussion of input impedance, gain, and frequency response. The presentation is very qualitative and descriptive, but contains no theory or mathematical derivations which might be helpful to the reader in specific applications. Chapter 4 contains a broad coverage of analog to digital conversion techniques. In addition to an explanation of the operation of A-D and D-A converters, it describes analog multiplexers and sample and hold devices.

A very simple, but clear, presentation is given concerning the importance of choosing the appropriate sampling rate.

Chapters 5–7 are concerned with various aspects of the collection, recording, and transmission of analog information. The material is generally clear, but serves only to illustrate the operation of an idealized system.

The remaining chapters (8–19) are concerned with computers and the associated hardware for getting information into and out of a machine. This material begins with an elementary treatment of digital logic. Following this is a lengthy discussion (100 pp.) of computer peripheral devices and hardware for providing digital inputs and outputs. A particularly well-written section of the book describes typical input/output instructions of a computer and illustrates their use with simple programming techniques. Input/output transfers using interrupt control and direct memory access are also explained.

In Chapter 15 on remote computing this reviewer found two errors. The first, on page 314, is the statement: "Full duplex lines are always four wires", which ignores the common use of frequency multiplexing to share a single telephone pair for full duplex operation. The second concerns the often confusing term, baud, which the author states, "is defined as 1 bit per second". A baud corresponds to 1 bit per second only if two-level signaling is used.

Chapters 17 and 18 give an overview of the hardware and software components and system structure of common minicomputers. This material is potentially quite valuable to the beginning computer user and thus probably belongs toward the beginning of the book rather than the end. An interfacing standard, CAMAC, which has been used by researchers in nuclear laboratories is described in Chapter 19. The author fails to mention that CAMAC is an acronym for Computer Automated Measurement and Control.

In summary this book is an easy to read, elementary introduction to data acquisition and minicomputers. It provides the individual having no previous background in electronics or computers the necessary familiarity with current technology to study more advanced material. The author attempts in Chapter 20 to aid the reader in this endeavor by listing sources of additional information. It is unfortunate that although he included a great number of commercial sources, no other books or publications of a more advanced nature in the area of computers are listed.

Robert A. Meyer, *Clarkson College*

Handbook of Biochemistry and Molecular Biology: Nucleic Acids. Volume 1. Third Edition. Edited by G. D. FASMAN (Brandeis University). CRC Press, Cleveland, Ohio. 1975. xi + 637 pp. $49.95.

"Buy this handbook" would be sound advice to all biochemistry, biophysics, chemistry, and general science research libraries. Although it is expensive, most research laboratories using nucleic acids will also want a copy of this comprehensive and useful reference book. It will serve nucleic acid chemists the way that the "CRC Handbook of Chemistry and Physics" serves all students and chemists.

Surprisingly, the first (1968) and second (1970) editions of this handbook have not been reviewed for *the Journal of the American Chemical Society* or for *Science*. Many of us who used the second edition have purchased our own copy, because it is an enormous (1600 pp) source of data on amino acids and proteins, carbohydrates, lipids and steroids, pyrimidine and purine derivatives, nucleic acids, genetics and biology, and basic data on research chemicals. The third edition will subdivide this material into four sections, each consisting of one to three volumes of tabular and graphic material.

The Nucleic Acids section, Volume 1, contains a unit (62 pp) on the most current IUPAC-IUB rules for nomenclature and abbreviation of nucleotide derivatives, organic stereoisomers, pyrimidine photoproducts, and labeled compounds.

The second unit (480 pp) on purines, pyrimidines, nucleotides, and oligonucleotides represents a doubling of the amount of material from the second edition on physical and spectral properties. In addition to data on structure, molecular weight, melting point, optical rotation, pK values, and UV absorbancy at 3 pH's, there are tables and graphs showing CD, ORD, PMR, Raman, and IR spectral values. In addition to common nucleotides, coverage has been updated and extended to the properties and natural distribution of modified nucleosides, antibiotics, 2′-O-methylated oligonucleotides, alkylated derivatives, and other human urinary metabolites. Particularly useful are the remarks by Hall and Dunn on the natural occurrence and detection of modified nucleosides in RNA (including Yt, now called wyosine).

The third unit (75 pp) on nucleic acids and polynucleotides represents a threefold expansion of the data on the structural organization, buoyant density, melting temperature, and base composition of viral DNA's, viral RNA's, and synthetic polynucleotides. New UV, CD, ORD, and IR spectral data on polynucleotides are also included. Unfortunately, most of the viral DNA tables are reprinted directly from the second edition, so that information obtained since 1970 is not included [no mention is made, for example, of glucosylated hydroxymethylcytosine in bacteriophage G DNA, putresinylthymine in phage ϕW-14 DNA, or dihydroxypentyluracil in phage SP15 DNA].

Volume 1 concludes with an 11-page index. Nucleic Acids, Volume 11, is expected to expand the 231 pages from the second edition to 672 pages in covering the occurrence, sequence, biology, genetics, and enzymology of cellular nucleic acids.

Volume 1 is a unique book, containing a huge amount of current information, some of it unpublished or difficult to find in the literature. The distinguished editor, advisory board, and contributors are all to be congratulated for updating and expanding this attractive, readable, and very useful compendium on nucleosides and nucleic acids.

Alan R. Price, *University of Michigan*

Infrared Spectra of Surface Compounds (Translation from Russian). By A. V. KISELEV and V. I. LYGIN (M. V. Lomonosov, State University of Moscow and Institute of Physical Chemistry, USSR Academy of Sciences). John Wiley & Sons, New York, N.Y. 1975. xi + 384 pp. $37.50.

In their monograph, the authors have attempted to cover the work done in the field of infrared spectroscopy as it can be applied to the study of surface chemistry and surface adsorption. The book includes chapters that cover the interpretation of infrared spectra, experimental techniques, the molecular-statistical theory of adsorption, and several chapters dealing with specific surfaces. The surfaces included in these chapters are silicas, alumina gels, aluminosilica gels, and zeolites. Much of the work discussed in these chapters is used to manifest the catalytic properties of the surfaces covered. Also included are references to ultraviolet spectroscopy when this information serves to make their points clear. The authors conclude with a chapter that covers the trends and prospects for future development of infrared spectroscopy as it can be applied to studies of chemistry at solid surfaces.

This reader found that the chapter on the interpretation of infrared spectra does not add anything substantive to the book. As most chapters in the same vein, it is somewhere between the reader who knows nothing and the one who is an expert. One of the main purposes of a monograph of this type is to serve as a review of the literature in the field—indeed this is the main reason the authors cite for taking on the task of writing this book. The book, however, was published in Russian in 1972 and the references in the book are comprehensive only through 1969.

On the whole the book is very well written. Throughout, the authors attempt to discuss fundamental adsorption and surface processes and illustrate these with experimental facts. The authors are very skillful in illustrating the interpretation of infrared spectra as applied to surface studies. The advantages of infrared spectroscopy for these studies are carefully weighed against its disadvantages, and this thread, as it runs throughout the monograph, puts the work in perspective. This book is recommended to anyone working in the fields of adsorption, catalysis, and gas or liquid chromatography.

Thomas M. Niemczyk, *The University of New Mexico*

Progress in Surface and Membrane Science. Volume 9. Edited by D. A. CADENHEAD (SUNY, Buffalo), J. F. DANIELLI (SUNY, Amherst), and M. D. ROSENBERG (University of Minnesota, St. Paul). Academic Press, New York, N.Y. 1975. xi + 316 pp. $33.00.

Volume 9 of this well-known series consists of five articles covering a wide range of topics in surface and membrane science. M. M. Dubinin (USSR Academy of Sciences) writes on "Physical Adsorption of Gases and Vapors in Micropores"; T. B. Grimley (University of Liverpool) on "Chemisorption Theory"; K. C. Campbell and S. J. Thomson (University of Glasgow) on "Radioisotopes in Studies of Chemisorption and Catalysis"; L. Ter-Minassian-Saraga (Centre National de la Recherche Scientifique and Université René Descartes) on "Interactions of Ions with Monolayers"; and S. Razin (Hebrew University) on "The Mycoplasma Membrane".

The article by Dubinin largely covers the work of the author and his colleagues in the USSR and includes a discussion and defense of his "theory of volume filling of micropores". Grimley reviews the quantum-mechanical theories of chemisorption, while Campbell and

Thomson review the application of radioisotope techniques to the study of topics such as surface area determination, film growth, surface diffusion, surface heterogeneity, the kinetics and mechanisms of catalyzed surface reactions, and catalyst poisoning.

The last two articles are concerned with membranes. Ter-Minassian-Saraga briefly discusses the interaction of inorganic ions with both biological membranes and membrane bilayer model systems. The bulk of the article is concerned with interactions of ions with monolayers, including discussions of specific effects. In the last article, Razin discusses the isolation, characterization, and the lipid and protein composition of the mycoplasma membranes.

This volume should be a valuable addition to any chemical library.

R. Pecora, *Stanford University*

Adhesion Science and Technology (Polymer Science and Technology. Volume 9B). Edited by LIENG-HUANG LEE (Xerox Corp.). Plenum Press, New York, N.Y. 1975. xiii + 441 pp. $37.50.

In the second volume of this two-volume series, there is a continuation of most of the papers presented at the American Chemical Society Symposium on Science and Technology of Adhesion in April 1975 at Philadelphia and in August 1975 at Chicago with discussion of the papers by meeting attendees.

Adhesion of organic coatings is one of the most practical problems in the coatings industry today. Both academic and industrial chemists who are working in the coatings field will be interested in these current papers.

The contents of the book is divided into four sections. The first section includes marketing information and growth trends for textile, anaerobic cure, cyano acrylate, epoxy, urethane, and hot melt adhesives. The second section discusses the theory of adhesive joint performance in structural adhesives. In the third section, the papers discuss trends in adhesive research. This information spans a large range of topics and is more fundamental in its approach. In the last section, the new trends in polymers, printing plates and processes for lithography are discussed.

This section contains many papers that are of practical value to the ink chemist. The new trend toward waterless lithography (Driography) is given a good treatment.

Charles D. Rowe, *Daubert Chemical Company*

Physics and Chemistry of Surfaces. By JACQUES OUDAR (University of Paris). Blackie Publishers, London. 1975. xi + 130 pp. £6.55.

This book presents a brief survey of the absorption studies of surfaces at the gas–solid interface and the techniques which are presently used for these studies. The book is divided into two sections: the chemisorption of gases on metals and the oxidation of metals. Although this division may seem arbitrary to some investigators in the field, the author maintains this division because of the techniques of study which are employed.

The book is aimed at the undergraduate student in chemistry or physics and gives the student a broad perspective of the field. To scientists in the field the book may appear to present the material in a superficial way; however, the book is well written and could very well inspire the undergraduate student to expand his or her knowledge of the physics and chemistry of surfaces. The student can draw upon the well-selected bibliography located at the end of the book and subdivided into topics covered in the text. References are not cited throughout the text.

James M. Schlegel, *Rutgers University*

The Study of Enzyme Mechanisms. By E. ZEFFREN (Proctor and Gamble Co.) and P. L. HALL (Virginia Polytechnic Institute and State University). John Wiley & Sons, Inc., New York, N.Y. 1973. xi + 284 pp. $14.95.

This book is divided into two parts. Part one consists of an introduction and chapters devoted to the purification of enzymes, chemical modification of enzymes, kinetics (three chapters), mechanisms for catalysis, and organic coenzymes. Part two contains four chapters, the first of which deals with hydrolytic enzymes wherein mechanisms of action for chymotrypsin, carboxypeptidase, and lysozyme are discussed. Approximately 20% of the text is contained in this chapter. Enzymically catalyzed oxidations and fructose 1,6-diphosphate aldolase are treated in the two following chapters. The final chapter contains a discussion of allosterism, which deals with properties of regulatory enzymes, the model of Monod, Wyman, and Changeux, and its application to aspartate transcarbamylase. The book also contains an appendix which summarizes schemes for the classification of enzymes.

In my opinion, the depth of coverage of this book is not sufficient to make it suitable as the primary text for a semester course devoted to the mechanism of action of enzymes. The chapter on purification of enzymes contains no more detail than many basic biochemistry texts. Furthermore, it is difficult to see how a beginning student could appreciate a discussion given in this chapter of the purification of asparaginase, since it precedes any definition of specific activity or unit of enzyme activity. The chapters dealing with enzyme kinetics contain nicely presented derivations for the simple two-step pathway, the three-step acyl-enzyme pathway, as well as derivations for the effect of various kinds of inhibitors on steady-state parameters. Equations for the effect of pH on steady-state kinetic parameters are also given. These chapters, however, have a few serious shortcomings. In the equations describing the pH dependencies of k_{cat} and K_m, the pH-independent values are incorrectly defined as the values observed for these parameters at the pH optimum. The section dealing with inhibitors is almost entirely devoted to algebraic derivations and contains little reference to what types of interactions could lead to the different types of inhibition for which equations were derived.

The chapter dealing with mechanisms for coenzymes would have been more useful if the stereochemical requirements for these reactions were discussed in greater detail. In addition, the chapter on allosterism should contain a comparison of the model of Wyman et al. with that of Koshland et al. Finally some of the assertions made by the authors which were generally thought to be correct at the time this book was written have since been shown to be wrong. For example, the authors state in several places that transimination reactions between amino acids and a pyridoxal phosphate Schiff base should be faster than reaction between amino acids and the aldehydic group of pyridoxal phosphate. Recent studies, however, show that amino acids react faster with the aldehydic group of pyridoxal phosphate than with the imine linkage of a pyridoxal phosphate Schiff base. In spite of these shortcomings, individuals with a need for a very concise treatment of mechanisms of action for enzymes may find this book useful.

Jules A. Shafer, *University of Michigan*

Phase Transitions and Critical Phenomena. Volume 3. Series Expansions for Lattice Models. Edited by C. DOMB (Kings College, University of London) and M. S. GREEN (Temple University). Academic Press, London. 1974. xviii + 694 pp. $46.50.

This is the third volume of a highly specialized, open-ended series of reference works on the characterization of phase transitions and critical phenomena. In this book series expansion techniques are introduced, discussed, and evaluated by some of the prominent researchers who have been largely responsible for developing the methods they describe. The level of presentation is uniformly high, and the contributors provide good insight into the capabilities and limitations of the expansion techniques while including detailed descriptions of specific applications.

Series expansion methods for exploring critical behavior have provided much of the significant information available on three-dimensional models incorporating realistic interactions between the microscopic constituents of the system. Although the correlation between series behavior and critical phenomena is in general not mathematically rigorous, the results predicted by experienced investigators consistently have been verified in cases where exact methods can be used. With this level of confidence, series coefficients have yielded valuable information in cases too complex for other techniques.

The first three chapters of this volume are concerned with generating appropriate series expansions for physically interesting models. Included in this section is a full chapter on computer techniques for evaluating lattice constants. This is most welcome since the use of computers is almost essential for many major calculations. The remaining six chapters are devoted to the use of series coefficients to determine critical behavior of thermodynamic functions both from a general point of view and for specific models. One chapter each is devoted to the Heisenberg, Ising, D-vector or Universal Hamiltonian, X-Y, and Ferroelectric models.

Each chapter stands as a complete treatment and is intended to provide enough information to allow the reader to pursue the calculations. Because of this there is considerable redundancy particularly in introducing graph theory and some of the approximations which

are essential mathematical tools in the field. Much of the writing of this material predated the recent application of the renormalization group to these problems, but this is the only major deficiency noted. A future volume which will be dedicated to this topic, however, is planned.

In sum, this contribution represents a scholarly work of primary interest to mathematical physicists and a limited number of chemists. As a standard reference it should be a part of departmental library holdings.

Leonard D. Spicer, *University of Utah*

Mechanisms of Elimination Reactions. By W. H. SAUNDERS, JR. (University of Rochester) and A. F. COCKERILL (Lilly Research Centre). John Wiley & Sons, Inc., New York, N.Y. 1973. ix + 641 pp. $19.95.

The text covers in critical detail the mechanism of E1, E2, pyrolytic, and various other miscellaneous elimination reactions. While the book concentrates on β eliminations to afford alkenes, one chapter deals with β eliminations giving alkynes and multiple bonds containing heteroatoms, and a second on photochemical and homolytic eliminations. The discussions on the orientation effects, effects of structure, and the effect of variables on stereochemistry in 1,2-eliminations is very extensive and well presented. The discussion of the various mechanistic proposals and criteria regarding elimination reactions is well developed and of special interest to workers unfamiliar with the intimate details in this area of chemistry.

The text is well written and appears to be relatively free of typographical errors, although occasionally the bonds drawn in cyclohexane systems are somewhat askew. While the tone of the book is largely a mechanistic discussion of elimination reactions, the extensive references and attention to detail as concern stereochemistry and orientation should make the book of value to synthetic workers utilizing elimination processes. Furthermore, the text should be a valuable reference work for instructors in advanced undergraduate or graduate courses where elimination reactions are presented and discussed.

John S. Swenton, *The Ohio State University*

Silicate Science. Volume VI. Silicate Structures and Dispersoid Systems. By WILHELM EITEL (Institute for Silicate Research). Academic Press, New York, N.Y. 1975. xviii + 819 pp. $59.50.

This book presents a revision and modernization of Volume I in this series. It is divided into sections: (A) silicate crystal structures; (B) clay minerals; and (C) silicate dispersoids. The 1960–1970 literature is reviewed in considerable detail with emphasis upon crystallography and crystal chemistry, although a number of spectroscopic articles are also described. There is no general discussion of significant trends within the field. The paragraphs, keyed to individual articles, are numbered consecutively and organized to some extent by topic, but no other effort at organization is made.

J. Tossell, *University of Maryland*

Photoplasticity. By J. JAVORNICKÝ (Institute of Theoretical and Applied Mechanics, Prague). Elsevier Scientific Publishing Co., New York, N.Y. 1974. xvi + 280 pp. $34.65.

The text is divided into four sections. The first, approximately 70 pages, begins with basic definitions and develops the theory of inelastic deformation of materials starting with a mathematical formulation of rheological relationships and viscoelastic deformations continuing through to the relationship between theory and experiment and modeling of the problems. The bulk of the text, 185 pages, is a comprehensive review of photoplasticity (a branch of photoelasticity) of model amorphous materials and model polycrystalline materials. The final section deals with the use of photoelastic coatings as birefringent media applied to the surface of the body studied. The text contains 442 references numbered continuously, and has a subject index, author index, and a list of symbols.

According to the publishers the book was written to serve two functions. One function is a comprehensive review of the modern literature concerned with the stress and strain of structural materials. The second objective is to act as a reference book for experimentalists in the area of plasticity. Since the thrust of the text is specifically aimed at engineers, the material content of the book will have extremely limited applicability to the readers of the *Journal of the American Chemical Society.*

Walter H. Waddell, *Carnegie-Mellon University*

Complex Carbohydrates. By NATHAN SHARON (The Weizmann Institute of Science). Addison-Wesley Publishing Co., Reading, Mass. 1975. xix + 466 pp. $21.50, cloth; $12.50, paper.

The 30-page Introduction also serves as an overview of the entire field. It should be required reading for all students in an elementary course, especially those who are using a biochemistry text which, in Professor Sharon's words, "relegate carbohydrates to a secondary place."

The large section on general glycoproteins occupies almost one-half of the book, and includes sections on isolation and purification, identification of the monosaccharides, sequencing and nature of attachment of monosaccharides, the nature of attachment to the protein, biosynthesis of the polysaccharide fraction, and the functions of the whole molecule. Two fairly short chapters on the blood group substances are followed by others on the mucopolysaccharides, the lipopolysaccharides, and the mureins or peptidoglycans. While this is not a book for those interested in cellulose, starch, or plant gums, there is an amazing amount of information in what is really a short text.

It is not, however, the amount of material, but rather the whole form of the book which makes it so good. These are Professor Sharon's Lecture Notes for a course. He is a bona fide authority in the field, seems to enjoy his work, and has a unique ability to convey his enthusiasm to the reader. The fact that the entire work was written by one author also gives it a continuity which is often missing in "edited by" books. A comment on the cover states that the book is highly comprehensible. This is true; it is not only comprehensible, but also enjoyable reading.

Another comment on the cover states that it is not necessarily comprehensive. This is also true. There are monographs and reviews on selected topics which are more comprehensive, but Professor Sharon's book is an excellent, readable introduction to those topics which he has chosen.

C. Edwin Weill, *Rutgers University*

Statistical Mechanics and Its Chemical Applications. By M. H. EVERDELL (University of Aston in Birmingham). Academic Press, London. 1975. xxii + 305 pp. $22.75.

The author intends this book as an introductory text aimed primarily at undergraduates. The treatment is essentially limited to systems of independent particles (ideal gases and Einstein solids), although two chapters on adsorption and one on solutions are also included. The author gives the student a feel for the second law with combinatorial examples in Chapters 1 and 2, and by developing the statistical mechanics of ideal gases from the microcanonical ensemble in Chapters 4–7. This route, although more tedious than that by other ensembles, does give the beginning student a firm feel for the way in which the law of large numbers operates in statistical mechanics. The treatment of the calculation of equilibrium constants for ideal gases—one of the most important accomplishments of statistical mechanics for a physical chemistry course—is particularly well done with numerous examples and ample discussion. The treatment of the third law contains the common error in elementary texts of hanging the argument on the degeneracy of the ground state rather than on the *density* of states near $E = E_0$. The treatment of the canonical and grand canonical ensembles in Chapters 8 and 12 is satisfactory, although the discussion of minimum free energy is vaguely worded. It is unfortunate, however, that the author fails to give the derivations of the ideal gas results in this ensemble. They are merely quoted without any attempt at justification, thus forcing the student to follow the microcanonical route if he wants to understand the results.

The book is marred by several serious flaws. The treatment of atomic crystals in Chapters 3 and 8 is quite unsatisfactory. The author conducts the entire discussion without introducing the concept of a normal mode of vibration. This results in such misleading statements as "In the Debye theory the atoms (sic) are assumed to have a range of vibrational frequencies . . .". The omission of a discussion of normal modes is particularly unfortunate since they must be discussed eventually in any case in dealing with vibrations in polyatomic molecules in Chapter 5. The treatment of vapor pressure of solids in Chapter 9 contains a major conceptual error involving electronic degeneracies which is compounded by an example in which the error occurs explicitly.

A second serious flaw is the strong impression which the author gives (explicitly stated on p 198) that statistical mechanics is incapable of dealing precisely with anything but independent particles. Such a statement ignores the accomplishments of the last thirty years in the

exact solution of numerous models of systems of interacting particles in two dimensions, and in the systematic treatment of interacting systems in three dimensions by exact series expansions, integral equations, molecular dynamics, and Monte Carlo techniques and perturbation theories. Such a position is particularly indefensible when the author devotes two chapters to a lattice model of adsorption and one to a lattice model of solutions without mention of Onsager's exact solution of the two-dimensional interacting lattice gas or of the revolution in modern ideas of phase transitions brought about by the studies of these models in three dimensions by series expansions.

While the author does treat absolute entropies and equilibrium constants of ideal gases, many of the topics of most interest to chemists are omitted. Not treated are the Mayer expansion for nonideal gases, or its extension to solutions, the Debye–Hückel theory of electrolytes, polymers, correlation functions, or statistical mechanical theories of reaction rates. The author remarks in the introduction that he fails to include the virial expansion because "*I fail to follow a method that appears to depend on the expansion of an expression* $\ln(1+x)$ *where* x *is very much greater than unity. The fault is undoubtedly mine. Those who are untroubled by such an objection are referred . . .*". While he is correct on observing that such presentations are merely heuristic, fully rigorous proofs are readily available. It is unfortunate to use a tone which suggests that only those untroubled by lack of rigor should proceed further.

Despite the numerous flaws in this book, which I believe are too serious to allow its recommendation as a text in present form, I believe that it could be revised, without great difficulty, to be a satisfactory introductory text, and that such a revised edition of this book would be a worth-while contribution to the teaching of physical chemistry.

John C. Wheeler, *University of California, San Diego*

Chemistry and Physics of Carbon. Volume 12. Edited by PHILIP L. WALKER, JR., and PETER A. THROWER (Pennsylvania State University). Marcel Dekker, Inc., New York, N.Y. 1975. 232 pp. $29.50.

This volume of the series, which was initiated in 1965 and is "concerned with recent advances in carbon research and development and with comprehensive reviews of past achievements in important areas of carbon", contains Chapters 50 through 53. As might be expected with a work of this magnitude, some of the treatment begins to become more specialized than in many earlier chapters. For this reason, this volume is probably of less general interest than some of the earlier volumes but unquestionably conforms to the stated purpose of the series.

The first chapter, "Interactions of Potassium and Sodium with Carbons", treats a subject, carbon intercalation, discussed from other aspects in Volumes 5 and 10. The subject of sodium–carbon interaction is of practical interest in aluminum smelting where swelling of carbon cathodes due to sodium attack is a problem. The second chapter, "Ortho-/Parahydrogen Conversion and Hydrogen-Deuterium Equilibration over Carbon Surfaces", covers its subject in an elegant manner but in such detail that probably only a reader with a special interest in the subject will maintain this interest through the 65 pages of text and detailed tables and figures. Much of the third chapter, "Thermoelectric and Thermomagnetic Effects in Graphite", is a theoretical, mathematical treatment of the subject probably of limited utility to most readers, but the early sections and summary are of more general interest. The final chapter, "Grafting of Macromolecules onto Carbon Blacks", discusses in a very readable manner a subject of considerable practical importance in the rubber industry.

David Belitskus, *Aluminum Company of America*

The Design of Organic Syntheses. By STEPHEN TURNER (Reckitt and Colman). Elsevier, Amsterdam. 1976. xii + 228 pp. $22.95.

The "art" as well as the more prosaic aspects of organic synthesis represent increasingly popular subjects for books. Most recent volumes on this subject employ a picture-book format with a terse style not unlike that found in journal communications. It is therefore a pleasant surprise to find in the present brief volume a lively, readable, occasionally philosophical exposition of current trends in organic synthesis. The book is written from the vantage point of an industrially employed organic chemist who is a recent graduate of the Woodward–Corey school of synthesis. I found to be particularly enlightening the commentary on differences in approaches and biases in academic and industrial synthesis which runs as a thread through the book. Among the other topics included in the book are a brief historical survey of organic synthesis, comments on the "ideal synthesis", strategies for the design of complex syntheses, the use of stereochemical control elements and the evaluation of alternative approaches including points to consider if pilot-scale synthesis is contemplated. Not unexpectedly there is among the illustrative examples a heavy dose of vitamin B_{12} and prostaglandin syntheses (one whole chapter in the latter case).

For those with an interest in organic synthesis, I highly recommend this book.

Eric Block, *University of Missouri—St. Louis*

Practical Scanning Electron Microscopy (Electron and Ion Microprobe Analysis). Edited by JOSEPH I. GOLDSTEIN (Lehigh University) and HARVEY YAKOWITZ (U.S. National Bureau of Standards). Plenum Press, New York and London. 1975. xvii + 582 pp. $49.50.

This is an excellent book which can be highly recommended to anyone seriously interested in scanning electron microscopy or electron microprobe analysis. The first six chapters cover electron optics, electron-specimen interactions, image formation and contrast, specimen preparation, and typical applications in scanning electron microscopy. The next seven chapters give a uniquely authoritative and up-to-date coverage of electron microprobe analysis, including a very thorough development of the theory of data correction procedures; discussions of the latest methods for handling data from both crystal spectrometers and Si(Li) solid-state detectors; and descriptions of specimen preparation techniques and procedures for analysis of metallurgical, mineralogical, and biological materials, thin films, and fine particles. The final chapter gives a concise survey of ion microprobe mass analysis.

Six authors were involved in writing this book. Since all are at the forefront of their respective fields, the treatment of all topics is authoritative and up to date. The editing has been especially effective, so that the presentation shows very good continuity in all respects throughout. It is perhaps unfortunate that the title, as it is given in most advertising literature, tends to emphasize scanning electron microscopy more than microprobe analysis. Several other books give competitive treatments of scanning electron microscopy whereas there is none that I am aware of that equals this in the treatment of electron microprobe analysis. I would prefer "Scanning Electron Microscopy and Microbeam Analysis" as a title.

W. C. Bigelow, *The University of Michigan*

Vitamin C: Recent Aspects of its Physiological and Technological Importance. Edited by G. G. BIRCH and K. J. PARKER. Halsted Press/John Wiley & Sons, Inc., New York, N.Y. 1974. xx + 259 pp. $32.50.

Although this volume reflects an understandable desire on the part of its sponsors to promote broader uses and increased consumption of vitamin C, the book nevertheless contains a wealth of important and interesting research data about vitamin C or ascorbic acid. Consisting of 15 papers and discussions with 62 tables and 47 figures contributed by 22 active researchers in the field, it represents the proceedings of "an industry-university co-operation Symposium organised under the auspices of the National College of Food Technology, University of Reading, [held] on 2nd and 3rd April, 1974."

The papers provide a valuable résumé of present thinking and knowledge about a wide range of topics, including the history of vitamin C (I. M. Sharman), methods of analysis (J. R. Cooke), technical uses in the food industry (H. Kläui), quality improvement in fruit juice and vegetable processing (G. G. Birch, B. M. Bointon, E. J. Rolfe, and J. D. Selman), nutritional interactions with heavy metals (R. E. Hughes), inhibition of nitrosamine formation (C. L. Walters), effects in food canning and freezing (J. D. Henshall), applications in meat products (M. D. Ranken), use in soft drinks and fruit juices (D. M. Gresswell), value in breadmaking (B. H. Thewlis), progress in metabolic studies (D. Hornig), role in microsomal cytochromes (E. Degkwitz and Hj. Staudinger), effects on lipid metabolism and atherosclerosis (E. Ginter), problems in tissue metabolism, over-saturation, desaturation, and compensation (C. W. M. Wilson), and advances in the molecular biology of vitamin C (S. Lewin).

Despite this wide coverage, the book conveys a fairly unified view of the role and value of vitamin C in modern food technology and human nutrition. It also presents a good account of evidence in support of a generally increased dietary intake of ascorbic acid. In this latter connection there is of course much current interest and controversy over the use of vitamin C for the prevention and treatment of the

common cold and other disorders. Body utilization of ascorbic acid is greatly increased during colds and stress and leads to significant reduction in plasma and leucocyte levels. What is still not clear, even according to the most recent findings [e.g., those of C. W. M. Wilson, M. Greene, and H. S. Loh, *J. Clin. Pharmacol.*, **16**, 19 (1976)], is the extent to which supplementary vitamin C averts or alleviates colds and their symptoms. Results vary from investigator to investigator—some showing considerable benefit, others not. There is evidence to suggest a marked difference in response among individuals and between males and females, but much more work remains to be done to find out why.

In summary, this is a useful book that covers many interesting facets of vitamin C, but it is by no means a complete guide to the vast literature of the subject. For example, there is no mention of the now well-established role of ascorbic acid in countering toxic effects of excessive fluoride ingestion, especially in primates, although its role in diminishing adverse effects of heavy metals and other toxic agents is reviewed. Thus this is a welcome book in that it directs attention to many significant findings about vitamin C that are not altogether well known. However, it obviously cannot, at this stage, provide final answers to the many problems that remain to be resolved.

Albert W. Burgstahler, *The University of Kansas, Lawrence*

Energy Transformation in Biological Systems. Edited by SIR ANDREW HUXLEY (University College London). Associated Scientific Publishers, Amsterdam. 1975. x + 416 pp. $29.25.

The book is a collection of papers presented at a symposium held July 2nd to 4th, 1974, and published as Volume 31 of the Ciba Foundation Symposium Series. The meeting was held to celebrate the 75th birthday of Dr. Fritz Lipmann, a man whom many workers in the field consider to be the father of bioenergetics.

As stated by the organizer of the symposium, Sir Andrew Huxley, the objective of the meeting was to promote cross-fertilization between related disciplines in the field of bioenergetics. In my opinion, the book succeeds admirably in this objective. The topics covered, with the number of chapters on each topic in parentheses, are as follows: muscle and other contractile systems (4), transport processes (4), excitable membranes (2), ATP as the currency of energy in the cell (2), metabolic regulation (2), photosynthesis (2), oxidative phosphorylation (1), bioluminescence (1), and phosphotransferases (1). Since this is a symposium volume, the topics included may have been limited to some extent by the availability of participants. Although the book contains good coverage of the field, some important subjects are omitted or receive only cursory treatment. These include bacterial respiratory chains, photosynthesis in procaryotes, and the Ca^{2+}-dependent ATPase of sarcoplasmic reticulum.

The articles vary both in quality, from good to excellent, and in scope, from short historical reviews (such as Lipmann's introductory chapter) to in-depth reports of current research. Although numerous theories are discussed in the different areas of bioenergetics, the common underlying themes found throughout the book are the Conformational Coupling Theory of Dr. Paul Boyer and the Chemiosmotic Theory of Dr. Peter Mitchell. Both theories were originally proposed to explain the mechanism of oxidative phosphorylation, but each finds additional support in studies of other energy-transducing systems. The Conformational Coupling Theory has many advocates among those presenting papers on muscle contraction. This is understandable when one recognizes that this theory emphasizes the importance of interconversion of mechanical energy and chemical energy, which is precisely the function of muscle. On the other hand, the Chemiosmotic Theory receives its most enthusiastic support from those reporting on membrane transport systems. Again this is understandable, since the main emphasis of the Chemiosmotic Theory is the interconversion of electrochemical-gradient energy and chemical energy. Perhaps the most prophetic comment in the book is made by Drs. Gutfreund and Trentham, who point out that the two theories are not mutually exclusive and that the final solution to energy coupling mechanisms may include features of both theories.

The organizers of the book obviously took great care to enhance its value to the beginning graduate student as well as the established investigator. The excellent reference lists that follow each chapter include titles, and a subject index is provided at the end of the book. Also, there is a general discussion of unsolved problems in bioenergetics, in which several interesting ideas for future research are offered.

Aside from the papers themselves, the most valuable feature of the book is the specific discussion section which follows each chapter. At times these sections are humorous, entertaining, or off the point, but they are consistently informative. The participants often ask the same basic question that is on the mind of the reader, and it is gratifying to have an answer directly from the author. The provocative discussions of the Chemiosmotic Theory following the Henderson-Kornberg paper and of the Conformational Coupling Theory following the McClare paper make one wish he or she had been in attendance.

Richard L. Cross
Upstate Medical Center, State University of New York—Syracuse

Dynamic Light Scattering with Applications to Chemistry, Biology and Physics. By BRUCE J. BERNE (Columbia University) and ROBERT PECORA (Stanford University). John Wiley & Sons, Inc., New York, N.Y. 1976. vii + 376 pp. $24.95.

With such an ambitious title and so few pages of text, one may well wonder what was left out. Fortunately, this book meets its stated goal, providing a "comprehensive introduction to the principles underlying laser light scattering". The discussion is limited to Rayleigh scattering with only brief mention of Raman scattering and no mention of developments due to picosecond techniques, nonlinear effects, or scattering from solids, liquid crystals, or membranes.

There are fifteen chapters, including an introductory historical sketch. The following two chapters present excellent introductory accounts of the theory of fluctuations and time-correlation functions and the classical theory of light scattering, respectively. Classical theory is used almost exclusively throughout the book. The fourth chapter describes experimental techniques in some detail and should be particularly useful to students new to the laboratory methods of light scattering. Interestingly, the light source, which is a laser, receives no technical mention in this chapter. The practical nature of this chapter, and of many sections throughout the book, makes this omission surprising.

The remaining chapters cover individual topics as varied as the motility of microorganisms, collision-induced light scattering by gases, fluctuations in chemically reacting systems, cooperative effects, hydrodynamic effects, and scattering from macromolecules. In each chapter, the theory is presented in a concise way, with details left to footnotes, to an excellent collection of chapter appendicies, or to original literature references.

This book should be a valuable introduction to anyone interested in the theory or practice of light scattering, whether student or active worker in the field, because of the variety of topics covered and the care with which the authors have organized the material.

John Winn, *University of California, Berkeley*

Thorium: Preparation and Properties. By J. F. SMITH, O. N. CARLSON, D. T. PETERSON, and T. E. SCOTT (Iowa State University). Iowa State University Press, Ames, Iowa. 1975. viii + 385 pp. $9.95.

The book is divided ito seven chapters concentrating on the preparation, purification, fabrication, as well as the mechanical and physical properties of the element thorium. Additionally, there is extensive discussion of the alloying behavior of the element. The volume is indexed and references appear at the end of each chapter.

Current interest in the element thorium stems from the following facts: (a) thorium reacts with neutrons to yield an impotant fissionable isotope of uranium, (b) thorium is about three times more abundant than uranium, and (c) the element is potentially useful in light-water breeder reactors. The literature contains a large number of reports of the extraction, purification, and properties of thorium. The importance of this information from the energy source viewpoint is obvious. Early difficulties in obtaining ultrapure thorium and reproducible data on the properties of its alloys have prompted Smith et al. to compile and summarize the existing literature on the subject from a wide variety of sources, some of which were accessible only with great difficulty.

One of the prominent attractions of the treatise is the candor with which the authors critically evaluate divergent experimental results. Despite the relatively small size of the book, an enormous quantity of data is cogently presented and analyzed. To this reviewer's knowledge, no comparable comprehensive review of the subject is available; therefore, the book is highly recommended reading and will serve as a practical reference tool to nuclear scientists, metallurgists, and nuclear engineers working in the energy field.

M. Zeldin, *Polytechnic Institute of New York*