In summary PicturePerfect can be rated as an adequate though not outstanding business graphics program. It lacks a number of the features and flexibility of some of the top end competition, like Harvard Graphics. For scientific graphing it comes up short in several areas, most notably in the lack of ability to do any curve smoothing in line graphs or to perform even the simplest statistical analysis of data.

G. Barrie Kitto, *The University of Texas at Austin*

Diagraph. Version 4.0. Computer Support Corporation: 15926 Midway Road, Dallas, Texas 75224. List Price $395.00.

At heart, Diagraph is a very large clip-art library, with the ability to size images, stretch and rotate them, and fill them with a variety of shading patterns. These images can then be combined with other images from the library and with text. As with any such library, the utility of the program depends upon the number of images available and their suitability for the task at hand.

The program comes with a library of more than 2000 well-drawn images and symbols, and more than 3000 others, including maps, are available in optional library packages at prices ranging from $59.00 to $129.00. Thirteen type faces are provided and twice that number are available as options at a cost of $25.00 each. The symbols range from a vast array of graphic aids such as arrows (more than 250 different kinds), banners, boxes, and word balloons to signs and icons such as road signs and transportation symbols as well as pictorial representations including trees, buildings, clouds, and perspective composition aids. The program is designed to run on IBM PC/XT/AT and compatible systems. It operates most conveniently on a hard disk and a math coprocessor enhances the speed of the program considerably.

Diagraph operates under a common shell-management system with PicturePerfect and suffers from the same antiquated copy protection system. The program comes on 9 diskettes and occupies about 2 megabytes of space on a hard disk. Like PicturePerfect, the menus and submenus as well as most editing functions are accessed through the function keys. Sizing and other manipulations of images would be greatly enhanced if mouse support was provided. Any text included in an overall chart has to be attached to a image or icon and this occasionally causes problems, since when an image is deleted from a chart any associated text is also eliminated.

Diagraph supports an exceptionally wide range of printers, plotters, and film recorders. Output on dot-matrix or laser printers is more than adequate, but multicolor printing with a plotter or conversion to high resolution slides really shows the capabilities of the program to its best advantage. Diagraph is an object-oriented program, rather than a raster-based paint program. This has a multitude of advantages for precision work. File sizes are small and high resolution is maintained over a very wide range of image size and when objects are rotated and/or sized in a nonproportional manner. Moreover, the resolution of the final image is independent of screen resolution and is limited only by the hardcopy output device. Image editing is also greatly simplified compared to raster-based programs. Unfortunately, cutting and pasting of images into other programs, such as PicturePerfect, is not available—except in the Windows version of Diagraph.

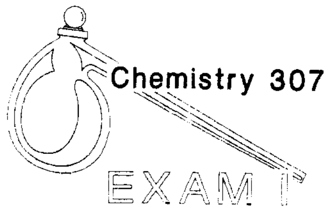

Figure 1.

Using Diagraph, it is a snap to create report covers and announcements since the images and text can readily be scaled from $^1/_8$ in. to several feet. The author has found the program very useful for generating posters, exam covers and transparencies for use in class (see Figure 1).

The Achilles' heel of Diagraph is that it does not offer users any abilities to create images from scratch. While the library has a very large range of images, one is often left frustrated by an inability to find exactly what one needs. One can modify the library images and text faces in size and shape almost endlessly, but this is not the same as having free-form capabilities. Custom made libraries and logos are offered as a service by Computer Support Corporation, but for most users the cost and time delay would be prohibitive. If the program offered the drawing capabilities of packages such as Lotus' Freelance Plus or Micrografx Designer, the combination with a large symbol and icon library would be a winner. Illustration of chemical structures in any desired size range is just one of the examples that comes to mind.

In short, Diagraph offers an exceptionally large graphics library, but it is emasculated to a considerable degree by the lack of drawing facilities.

G. Barrie Kitto, *The University of Texas at Austin*

Book Reviews

Color Chemistry: Syntheses, Properties, and Applications of Organic Dyes and Pigments. By Heinrich Zollinger (Swiss Federal Institute of Technology). VCH Publishers: New York. vii + 367 pp. $110.00. ISBN 0-89573-421-4.

This is a timely, incisive, and user-friendly book on preparation and uses, both conventional and modern, of organic dyestuffs. It is expressly intended for organic chemists who may view color chemistry as a closed topic, color chemists who may not be aware of new trends and new technological uses of dyes, and physical chemists confused by the vastness of the field. The reviewer falls in the third class, and found himself with six pages of closed-spaced notes on topics and references for immediate examination upon completing the review process.

The first ten chapters deal with the major classes of dyes, their synthesis by ecologically favorable methods, and the modern view of their unique features. Two central chapters on dyes and pigments (microcrystalline materials) describe dyeing, dye aggregation, and the physical states of pigments from the view of modern physical chemistry. Three chapters focus on the dynamic behavior of dyes and, implicitly, on the transition to active dyes which DO something in high technology. These active aspects include photosensitized reactions, photochromism, harvesting of solar energy by dye systems, dye lasers, and modern image-forming systems. The book closes with a chapter on biomedical staining and a short chapter on ecological topics. The user-friendly quality of this book is enhanced by its compactness and disciplined quality. It is in no way a historical or classical view of the dyestuff industry, and the 21 pages of references focus on key review articles and on intellectual transition papers of whatever age. All the right review references are there!

This book is, of course, a labor of love for the author. Inevitably one of the high points is the chaper on azo dyes, coming as it does from his own continuing research interest. One can regret the compact format, which prevented all but a brief account of the author's own work on the use of zinc-complexed azo dyes as long wavelength sensitizers for ZnO electrophotographic materials and seems to have prohibited any discussion of the use of nigrosines and other ionic dyes as charge-control agents in electrophotographic toners. Also missing is an account of use of dyes in photodynamic therapy, in which some diseased or malignant tissue is selectively stained with a sensitizing dye to facilitate laser removal of the material. Comments have been made on the very low efficiency of solar photogalvanic systems and on the low efficiency (to date) of the two-dye water-electrolyzing systems such as $Ru(bpy)_3$ and dimethylviologen. An omission especially significant to this reviewer is the topic of solid state solar photovoltaic cells employing organic dyes as the active components. Major projects on organic photovoltaics have been conducted in at least three major industrial laboratories, and efficiencies have been obtained which mark the best of the organic photovoltaics as potential competitors to amorphous silicon (Loutfy, Morel, Chamberlain, Tang). From the standpoint of a very conservative dyestuffs industry, the missing ingredient for the 21st century is a large volume, high technology application of photoactive dyes of this sort.

Among many candid and incisive comments is a remark about vat dyes: "It seems that this area of research for textile applications is saturated." In context this remark is to be contrasted with an earlier discussion of new and ecologically acceptable syntheses for azo dyes, work carried forward in Japanese and German laboratories but not on the North American scene. Here one could almost think that the industrial managers, so conscious as they have been of this year's "bottom line" alone and lacking the vision of a world market, had seen this remark and applied it indiscriminately to the entire dye industry. In the New York/New Jersey area alone, the last fifteen years have seen two of four large facilities for dye chemistry closed, one curtailed, and one sold off. This has had an obvious economic impact and with it the insidious secondary impact that numerous chemical intermediates have quietly vanished from American chemical catalogs. For anyone attempting to carry out research programs under these circumstances or even hoping to reverse this downward trend, Prof. Zollinger's book will be a valuable resource.

George R. Bird, *Rutgers, The State University of New Jersey*

Comb-Shaped Polymers and Liquid Crystals. Edited by N. A. Platé and V. P. Shibaev (Moscow State University). Plenum Press: New York and London. 1987. xi + 415 pp. $95.00. ISBN 0-306-42723-0.

The authors had originally published a monograph under the same title in 1980 (in Russian, Khimya, Moscow). The current edition provides a translation by S. L. Schnur (edited by J. M. G. Cowie) combined with a substantial revision. Chapters dealing with the rapidly changing field of side-chain polymer liquid crystals have been rewritten and the references updated through 1984. To my knowledge, the book was *written* by N. A. Platé and V. P. Shibaev, and not edited by them as indicated on the cover.

In comb-shaped polymers, side chains whose length is significantly greater than their own cross section are attached to a conventional flexible backbone, typically one side chain per monomer unit. While such macromolecules retain the properties inherent to the structure of the backbone, they are primarily characterized by strong *intra*molecular interaction between side groups. This leads to crystallization in atactic polymers, optical anisotropy, and gel formation in solution, and it may lead to formation of thermotropic liquid crystals if suitable mesogens are incorporated into the side group. When the mesogens are decoupled from the backbone by means of a flexible "spacer" moiety, the system combines the viscoelastic properties of a polymer with the electro- or magnetooptic properties of conventional liquid crystals.

The authors have substantially contributed to this field of research, building on pioneering studies by the Russian school (for example, the work of V. N. Tsetkov et al. on intramolecular order in solutions of comb-shaped polymers). Their writing is clear and thorough. In short, the book provides a masterful review of a most timely topic.

Rita Blumstein, *University of Lowell*

An Introduction to Statistical Thermodynamics. By Terrell L. Hill (National Institutes of Health). Dover Publications, Inc.: New York. 1986. xv + 508 pp. $10.95 (paper). ISBN 0-486-65242-4.

This is a reprint of Dr. Hill's classic introductory text. While statistical mechanics has evolved significantly in the past quarter century, the fundamentals remain unaltered. As value for money, this book cannot be surpassed. Its treatment of ensemble theory and the thermodynamic correspondence, and of independent particle statistics (both quantum and classical) and their application (ideal gases, simple crystals, gas-phase reaction, and simple polymers) is straightforward and clear. It is obviously dated in its treatment of the statistical mechanics of dense gases and fluids and it does not discuss nonequilibrium phenomena. Topics such as density functional theory, theory of liquids, kinetic theory of gases, Brownian motion, and time correlation functions are all discussed in newer texts. However, even here, the discussions of lattice statistics, imperfect gases, distribution functions, and Debye–Hückel theory will provide a useful first exposure for students. There is a wide selection of valuable problems. This is a book that should be in the library of every teacher of statistical mechanics (if it is not already there) and one that can still be used profitably by students in their first serious attempt at learning the subject.

Peter C. Jordan, *Brandeis University*

Principles of Nuclear Magnetic Resonance in One and Two Dimensions. By Richard R. Ernst, Geoffrey Bodenhausen, and Alexander Wokaun (Federal Institute of Technology, Zurich). Clarendon Press, University Press: Oxford. 1987. xxiv + 610 pp. $98.00. ISBN 0-19-855629-2.

This monograph is a comprehensive account of the principles of one- and two-dimensional high-resolution Fourier transform NMR spectroscopy. The development of the topic is framed in the language of density operators, and the presentation is detailed, logical, clear, and complete. After two chapters outlining the mathematical formalisms used in discussing the dynamics of nuclear spins systems, there are chapters introducing and discussing one-dimensional FT spectroscopy, the concept of multi-quantum transitions, two-dimensional FT spectroscopy, the myriad ways of parameter separation in two dimensiona, coherence transfer, and dynamic processes, including relaxation and chemical exchange. A final chapter deals with methods of NMR imaging. The studious reader of the entire book will be thoroughly prepared to understand all 2-D high-resolution work as it is currently done. The emphasis is on theory and methodology. There is not an extensive review of applications, though illustrative examples abound.

This book must be on the shelf of anyone who intends to engage in modern high-resolution NMR spectroscopy. Not everyone will have the prerequisite knowledge of the mathematical tools (for example, how to evaluate $\exp(-i\mathcal{H}t)$, where $\mathcal{H}$ is a matrix) necessary to understand immediately the treatment; for them it will be necessary to refer back to more elementary texts. However, the level, completeness, and clarity in this book will make it an indispensable reference for serious practitioners of NMR. The state of the NMR art is moving extremely rapidly, and in the time since the appearance of the book, new and important concepts have emerged (the literature covered in the book is mainly prior to 1985). I hope that the book will be revised and updated from time to time.

Aksel A. Bothner-By, *Carnegie Mellon University*

The Periodic Table of the Elements. Second Edition. By R. J. Puddephatt (University of Western Ontario) and P. K. Monaghan (Sir Wilfred Grenfell College, Memorial University of Newfoundland). Oxford University Press: Oxford and New York. 1986. X + 10 pp. $10.95 (paperback). ISBN 0-19-855516-4.

This is a useful little volume suitable as a supplement to teaching of elementary chemistry. The book treats the physical and chemical properties of elements based on their position in the Periodic Table. The elemental binding energies are estimated from the ionization energy of the valence electrons, which are used to rationalize the periodic trend in the physical properties of the elements, such as the melting and boiling points, and chemical properties of their compounds, such as oxides, halides, and hydrides. The level of treatment is aimed at beginning students in Great Britain. However, in order to attain simplicity some essential aspects are sacrificed. Chemical bonding is explained in terms of the participation of the valence electrons without mentioning concepts of molecular orbitals, which would serve general chemistry students in this country poorly. Molecular oxygen is described as a doubly bonded molecule. Electron affinity is defined as the energy released in the process $F_g \rightarrow F_g^-$, for example, and it is given a positive value without explaining its conflict with the thermochemical convention. The book uses the European form of the Periodic Table with the transition group elements as A subgroup elements, a feature that might baffle a student in this country. The new Periodic Table recommended by the IUPAC is shown but not explained, as it should have been. I also found a number of figures where the abscissas have not been labeled, making them less usefull. I hope some of these shortcomings will be rectified in the future edition. Overall, I find the book of interest as it illustrates the great predictive power of the Periodic Table and thus helps to rationalize some of the descriptive chemistry which is otherwise so unattractive to teach.

Sanat K. Dhar, *DePaul University*

The Metamict State "...an unusual state of matter, amorphous because of the disruption of the crystal structure by radiation from contained or nearby radioactive atoms". By Roald Hoffmann (Cornell University). University of Central Florida Press: Orlando. 1987. viii + 104 pp. $10.95. ISBN 0-8130-0869-7.

Many chemists are familiar with Roald Hoffmann's world of frontier orbitals, correlation diagrams, etc., but besides his scientific world, poems, literature, and art have also attracted him.

The present book is a collection of poems from his hand. Roald Hoffmann's interest in poetry goes back to his time at Columbia. He started writing poems ten years ago and is now active in a poetry group at Cornell.

The book contains 47 poems divided into 5 parts. Many of the poems originate in chemistry. Poems as "Next Slide, Please", "Deceptively like a Solid", "Men and Molecules" are centered around chemistry, and many of the other poems are studded with chemistry or phenomena related to science. A part of the poem "Men and Molecules" gives a description of how chemical reactions can take place:

"Not every collision,
not every punctilious trajectory
by which billiard-ball complexes
arrive at their calculable meeting places
leads to reaction.
  Most encounters end in
a harmless sideways swipe.
An exchange in momentum,
a mere deflection.
  And so it is for us.

The hard knock must be just right.
The eyes need lock, and
glimmers of intent penetrate.
The setting counts.
A soft brush of mohair
or touch of hand.
A perfumed breeze.
Men (and women) are not
as different from molecules
as they think."

which is probably different from the way most chemists think of a chemical reaction.

The poems offer the readers the opportunity to look behind the scientific world of Roald Hoffmann. Impressions obtained during his childhood, youth, travelling, art, literature, and daily life are expressed in the poems. But he cannot escape from his chemistry (scientific) origin; it is found here, there and everywhere in the poems. Chemists for whom chemistry is more than experiments, instruments, computers, etc., will probably find many of the poems interesting and readable. For others, the poems can be the opportunity to observe that chemistry can be more than chemistry.

Karl Anker Jørgensen, *Aarhus University*

Neuromethods. Volume 5. Neurotransmitter Enzymes. Edited by A. A. Boulton, G. B. Baker, and Peter H. Yu. Humana Press: Clifton, NJ. 1986. xxv + 640 pp. $69.50. ISBN 0-89603-079-2.

Neuromethods is a series of high quality devoted to laboratory methods used to study a broad range of neuroscience topics from chemistry to behavior. Volume 5 consists of 17 review chapters dealing with the enzymes known to be involved in the synthesis or disposition of various substances thought to be involved in neurotransmission. These enzymes are of special importance in that modulating their activity is a route to development of both neuropharmocological tools and practical therapy. The known properties of each enzyme are considered along with recommended methods for isolation and measurement of enzyme activity. Each review serves as a selective introduction to the very extensive literature on these particular enzyme systems. Most chapters are up to date through mid-1985. This is clearly a reference work and not a textbook on enzyme methodology.

Peter T. Kissinger, *Purdue University*

Reactions of Coordinated Ligands. Volume 1. Edited by P. S. Braterman (University of Glasgow). Plenum Press: New York and London. 1986. xi + 1052 pp. $135.00. ISBN 0-306-42201-8.

This volume is assembled by the editor for use by graduate students and research workers in all branches of chemistry. The main focus of this work is an understanding of selected aspects of the chemistry of transition-metal, organometallic compounds from a mechanistic perspective. In this volume, several contributing authors discuss the chemistry of carbon-bound ligands in ascending order of complexity. Chapter 1 (P. S. Braterman, 773 references) contains a review of the chemistry of ligands having one, two, or three carbon atoms as donor groups. The chemistry of alkyl, aryl, and related ligands is heavily weighted. In Chapter 2 (217 references), M. D. Johnson summarizes the reactions of one-carbon ligands in complexes containing macrocyclic ligands. The majority of the reactions described in this chapter are those of organocobalt(III) compounds. The chemistry of alkylidene complexes of the earlier transition metals is reviewed in Chapter 3 (R. R. Schrock, 107 references). This author includes recent results yet unpublished and unpublished work which may not appear elsewhere. In Chapter 4(387 references), K. H. Dötz summarizes the reaction chemistry and mechanisms of carbene complexes of groups VIA, VIIA, and VIII. Compounds having bridging carbene ligands or ligand types possessing minor contributions from carbenoid electronic structures (such as acyl, alkenyl, or imino ligands) are excluded from this review. Mechanistic aspects of the olefin metathesis reaction are discussed in Chapter 5 (M. Leconte, J. M. Basset, F. Quignard, and C. Larroche, 135 references). This article covers the relevant literature to 1981/1982, and the discussion is limited to recent mechanistic and stereochemical features of olefin metathesis. P. S. Braterman reviews in Chapter 6 (104 references) mechanistic aspects of carbonylation, CO reduction, and related reactions of carbon monoxide. In Chapter 7 (308 references), G. P. Chiusoli, G. Salerno, and M. Foa discuss promotion effects in transition-metal-catalyzed carbonylation in terms of both rate acceleration and product selectivity. Hydride transfer to coordinated carbon monoxide and related ligands is reviewed by C. E. L. Headford, and W. R. Roper (Chapter 8, 129 references). The focus of this review is the formation of CHX ligands by either intramolecular migratory-insertion or intermolecular addition processes. In Chapter 9 (426 references), B. Crociani surveys the literature on reactions of coordinated isocyanides from 1974 onwards with a special emphasis on mechanistic aspects and the use of coordinated isocyanides in organic synthesis. The formation of and reactions of metallacycles are reviewed by G. Ingrosso (Chapter 10, 199 references). This review excludes metalla-cyclopropanes, -cyclopropenes, and -cyclopentadienes because of inclusion of the chemistry of these types of compounds in other chapters of this volume. Nucleophilic attack on coordinated alkenes (J.-E. Bäckvall, 161 references) and on unsaturated hydrocarbon ligands (S. G. Davies, M. L. H. Green, and D. M. P. Mingos, 110 references) is discussed, and a review of the more general reactivity of coordinated acetylenes (J. L. Davidson, 161 references) and of coordinated dienes (J. A. S. Howell, 96 references) is also included. P. A. Chaloner annd D. Parker (313 references) discuss asymmetric additions to double bonds, and P. Powell (388 references) reviews reactions of five-carbon or larger ligands having delocalized electronic systems excluding cyclopentadienyl ligands.

The material presented in each chapter is well cited though, by intention, not comprehensive in most cases. A section on recent developments is included in many chapters with recent literature citations being generally in the period of 1980–83. Selected references from the 1984–85 literature are included in some chapters. A unified and coherent treatment of organometallic chemistry from a mechanistic perspective is not presented in this volume because it is a compilation of selected review articles. However, this volume should serve as a useful resource for those research chemists who have interest in the areas of chemistry reviewed by these authors.

C. M. Lukehart, *Vanderbilt University*

Progress in Physical Organic Chemistry. Volume 16. Edited by R. W. Taft (University of California, Irvine). John Wiley & Sons: New York. 1987. ix + 339 pp. $75.00. ISBN 0-471-85263-5.

This volume focuses, as did Volumes 12 and 14 of this important series, on one of the mainstream concepts of organic chemistry: the nature of substituent effects. The first chapter, "The Nature and Analysis of Substituent Electronic Effects", by Taft and R. D. Topsom, extends the familiar Dual Substituent Parameter approach by two parameters. The gas-phase acidities of 38 compound series of widely varying structure are correlated with the three substituent parameters σ_R (resonance, determined empirically), σ_F (field, descendent of the "inductive" parameter σ_I, determined empirically), and σ_α (polarizability of substituent in face of charged probe, determined by ab initio calculations). A fourth σ, σ_χ (electronegativity, also descended from σ_I, determined by ab initio calculations), is short-range and did not affect the acidities studied. An updated table of σ's for 34 substituents is given. The ρ values obtained show a significant dependence on polarizability, since solvent is not available to aid in charge dispersal in the gas phase. The field effects are as expected, but σ_R is not adequate when the substituent and probe are both electron-poor or both electron-rich; modification must be made to account for diminished resonance. A section relating the gas-phase conclusions to solution equilibria notes that modified σ_F values must be used for certain substituent–solvent combinations due to hydrogen bonding, and that solvation assistance can enhance resonance in some cases.

Topsom contributes the next three chapters. "Substituent Effects on Ground-State Molecular Structures and Charge Distributions" concludes that bond lengths (an updated table is given) are essentially constant in the face of varying substituents, and although there are some substituent effects on bond angles and dipole moments, these do not lend themselves readily to a general interpretation. "Some Theoretical Studies of Electronic Substituent Effects in Organic Chemistry" shows how molecular orbital calculations (the methods are concisely summarized) on appropriate model structures can shed light on the nature of a variety of substituent effects, free from solvent and counterion interactions. Such calculations generate the σ_χ and σ_α values mentioned above; in addition, calculated σ_F and σ_R values correlate well with experimental ones. "Electronic Substituent Effects in Molecular Spectroscopy" discusses correlations of substituent parameters with IR frequencies (generally of aromatic systems) as well as correlations with IR intensities, which are less common but usually of better fit. There are briefer treatments of Raman, UV, PES, ESR, and mass spectra. Missing is a discussion of NMR chemical shift substituent effects.

An alternative approach is presented by M. Charton in "A General Treatment of Electrical Effects", which describes the LDR equation. *L*, *D*, and *R* correspond to the ρ's for three substituent parameters: σ_l (localized, equivalent to σ_I), σ_d (delocalized, the intrinsic resonance effect when probe electron demand is minimal), and σ_e (electron demand sensitivity). With σ_e, situations of varying resonance interaction between probe and substituent can be accommodated; there is thus no need for several σ_R scales. σ values for 124 substituents are given. Over 140 data sets, ranging from cations to anions, were correlated satisfactorily. The ratio R/D gives an electronic demand parameter η for the probe site. η can be used to show that σ_R^0 actually represents a small negative electron demand rather than one of zero.

A chapter on an unrelated topic, "Superbasic Ion Pairs: Alkali Metal Salts of Alkylarenes", is contributed by G. Gau, L. Assadourian and S. Veracini. The superbases of the title are benzylic anions whose counterions (usually lithium) are chelated by polyamines. Exchange reactions between these bases and arylalkanes allow measurement of both kinetic and thermodynamic acidities of the very weakly acidic arylalkanes in aromatic solvent. This extends directly measured pK_a scales beyond those measured with cesium salts in cyclohexylamine. The chelating polyamine can be varied to study either contact ion pairs alone or with solvent-separated ion pairs. "Sterically activated ion pairs" result when steric hindrance separates chelated counterion from the anion; abnormally reactive salts can be prepared by this method and these may be useful catalysts for addition polymerizations.

Readers should be wary of a fair number of bothersome proofreading errors, such as σ_x in place of σ_α (pp 161 and 162), wrong signs (electron population +42, p 174; σ_F coefficients −7.6, p 205, and −11.6, p 206), a missing figure (p 208), and incorrect structures. Nonetheless, this insightful volume is a valuable addition to the series, and it belongs in any library catering to chemists.

Daniell Lewis Mattern, *University of Mississippi*

Organophosphorus Chemistry. A Specialist Periodical Report. Volume 18. Edited by Senior Reporter B. J. Walker (The Queen's University of Belfast). The Royal Society of Chemistry: London. 1987. xiv + 450 pp. £98.00. ISBN 0-85186-166-0.

As part of the invaluable specialist periodical reports on organophosphorus chemistry, Volume 18 covers the literature published between July 1985 and June 1986. The format of this report is the same as it was the previous year, except with the omission of the separate chapter on Phosphates and Phosphonates of Biochemical Interest. These topics are incorporated in the appropriate sections on phosphates and phosphonates in Chapters 4 and 5, respectively. Nine chapters are presented in this volume, the topics being the following: (1) Phosphines and Phosphonium Salts (D. W. Allen, 51 pp, 387 ref); (2) Pentacoordinated and Hexacoordinated Compounds (C. D. Hall, 31 pp, 62 ref); (3) Phosphine Oxides and Related Compounds (B. J. Walker, 21 pp, 46 ref); (4) Tervalent Phosphorus Acids (O. Dahl, 30 pp, 112 ref); (5) Quinquevalent Phosphorus Acids (R. S. Edmundson, 53 pp, 160 ref); (6) Nucleotides and Nucleic Acids (J. B. Hobbs, 111 pp, 40 ref); (7) Ylides and Related Compounds (B. J. Walker, 66 pp, 162 ref); (8) Phosphazenes (C. W. Allen, 30 pp, 195 ref); (9) Physical Methods (J. C. Tebby, 31 pp, 279 ref).

A new section on "Theoretical Studies" has been added to the chapter on Physical Methods due to the increase in the number of such papers. Most of these deal with descriptions of bonding at phosphorus in strained systems and compounds with π-bonds to phosphorus. The results of the various calculations performed are summarized for some of the systems studied, but not all. There has also been an increase in the number of theoretical studies on ylides and their reactions, especially the Wittig reaction (see Chapter 7), reflecting, as the author notes, "similar developments throughout organic chemistry". While there is some overlap of these papers in Chapter 7 with those mentioned in Chapter 9, there is also notable omission of other theoretical papers on ylides from the Theoretical Studies section in Chapter 9.

The style of each chapter tends to vary as each is written by a different author (except Chapters 3 and 7). Some of the authors go into more detail about various papers, and others do not, possibly due to the great volume of material being covered. As in the two previous reports, camera-ready manuscripts were used, causing variations in the type face used and hence readability of the print. This was particularly evident in the last chapter, being obviously from a dot matrix printer, and using too small a font. Another minor irritation in this volume is the lack of coordination in the placement of the drawings and the text throughout the report.

Cynthia K. McClure, *University of Delaware*

Benzopyrenes. By Martin R. Osborne (Institute of Cancer Research, Chester Beatty Laboratory, London, England) and Neil T. Crosby (Laboratory of the Government Chemist, London, England). Cambridge University Press: Cambridge and New York. 1987. xiv + 329 pp. $79.50. ISBN 0-521-30122-X.

This book is one in a series of monographs on cancer research planned by Cambridge University Press (series editors: M. M. Coombs, J. Ashby, R. F. Newbold, and H. Baxter). As stated in their preface, the authors' intent is to cover the chemistry, biology, analysis, and occurrence of the carcinogen benzo[*a*]pyrene (BaP) and its non-carcinogenic isomer, benzo[*e*]pyrene (BeP). The book is divided into 18 chapters with a preponderance of the treatment being on BaP. The monograph is written from the point of view of a chemist, and (as recognized by the authors) treatment of biologically oriented accounts is brief. An introductory chapter is followed by chapters on the synthesis, physical properties, chemistry, and derivatives of BaP. The following five chapters then turn to biological properties of BaP (metabolism, diol-epoxides, binding to proteins and nucleic acids, effects on cells in vitro, and carcinogenesis). Chapter 11 deals with the chemistry and toxicology of BeP. The following 5 chapters review analytical methods for determination of benzopyrenes in the environment (introduction to analytical methods; sampling; extraction; clean-up and concentration; separation, detection, identification, and determination). The penultimate chapter describes occurrence of benzopyrenes in the environment and Chapter 18 gives a list of further reading for those wishing more detailed information.

This is a well executed and narrowly focused review of the subject. It contains few if any typographical errors. Those chapters dealing with the chemistry of the benzopyrenes are particularly well done. Most of the important seminal papers dealing with the subject are referenced either in the individual chapters or in the list of sources for further reading. It is recommended to scientists wishing to become conversant with the subject and as a reference to those in the field.

Kenneth D. McMurtrey, *University of Southern Mississippi*

International Tables for Crystallography. Volume A. Space-Group Symmetry. Second, Revised Edition. Edited by Theo Hahn. D. Reidel Publishing Co.: Dordrecht, Holland. 1987. xvi + 878 pp. $140.00 (institutions); $70.00 (individuals). ISBN 90-277-2280-3.

The first edition of this book, the first volume of the new "International Tables for Crystallography", was reviewed in this journal in 1984 (*J. Am. Chem. Soc.* **1984**, *106*, 6462–6463). The second, revised edition includes sections, about 20 pp, on normalizers of space groups, plane groups, and point groups, with examples of their use, and an up-to-date bibliography on the subject. Other changes from the first edition are updated literature references, added footnotes, an expanded subject index, and some changes in the diagrams of plane and space groups.

Purchasers of the first edition are directed to notices in *Acta Crystallographica* (**1984**, *A40*, 485; **1987**, *A43*, 836) for lists of errata and information on the availability of free reprints of the new sections on normalizers in the second edition.

Christer E. Nordman, *University of Michigan*

Statistical Thermodynamics of Nonequilibrium Processes. By Joel Keizer (Department of Chemistry and Institute of Theoretical Dynamics, University of California at Davis). Springer-Verlag: New York, Berlin, and Heidelberg. xiii + 506 pp. $49.00. ISBN 0-387-96501-7.

Keizer's book presents both the foundations of irreversible thermodynamics and its applications to a range of problems in a lucid manner. The theory developed in the book applies to systems both near and far from equilibrium.

Introductory chapters on stochastic processes and on the Onsager and Boltzmann theories of irreversible phenomena provide the background for the remainder of the book. The presentation of the background material is noteworthy for its clarity and precision. Chapter one includes a quite rigorous discussion of general random processes of the central limit theorem and Gaussian processes of stochastic integrals and Markov processes and of Gauss–Markov processes. Two important special cases, the Wiener and Ornstein–Uhlenbeck processes, are discussed in detail. Brownian motion theory is developed from both the Langevin and Fokker–Planck viewpoints. Important mathematical points, e.g., the non-Stieltjes integrability of white noise, which are often glossed over in other sources, are dealt with correctly. Chapter two describes the Onsager and Boltzmann theories, develops the Boltzmann transport equation, proves the H-theorem, develops the Onsager linear relaxation laws, and includes a discussion of Navier–Stokes hydrodynamics. The proof of Onsager's reciprocal relations is particularly clear. Important but subtle points, e.g., that entropy production depends only on the *symmetric* part of the Onsager relaxation matrix, are discussed lucidly.

Chapter four, which is the most important chapter of the book, establishes what Keizer calls the canonical theory of irreversible processes. The main idea is that the molecular processes which induce changes in a contracted set of extensive variables assumed to be sufficient to describe the macroscopic state of the system are identified. The rates of these molecular processes are related to conjugate intensive variables. This then permits one to develop a Fokker–Planck equation for the conditional probability density of the extensive variables. It then follows that the average values of the extensive variables obey nonlinear macroscopic transport equations. The fluctuations of the extensive variables are, additionally, assumed to obey a Langevin equation which is linearized about the average values of the extensive variables. The resulting nonlinear theory provides a synthesis of the Onsager transport laws with

Boltzmann master equation ideas. The canonical theory reduces to Onsager's linear theory near equilibrium.

The remainder of the book consists of a wide spectrum of applications of the canonical theory. These include development of expressions for the transport coefficients, analysis of electrochemical phenomena, analysis of chemical reactions and diffusion, etc. An excellent chapter deals with the molecular origins of bifurcation phenomena and chaos.

The book is well-illustrated and contains an extensive author and subject index. It is on the whole an excellent introduction to the principles of irreversible thermodynamics which should be useful to a wide range of chemists, physicists, biologists, and engineers. It could be made more accessible to beginners if it included in Chapter one a physical description of Brownian motion and an intuitive discussion of the concept of a random process. The book could be made more complete by including discussions of fully microscopic developments, e.g., the Mori theory, and their relationship to the theories described in the text.

R. Muralidhar and Steven A. Adelman, *Purdue University*

Instrumentation, Analytical Chemistry by Open Learning. By Graham Currell (Bristol Polytechnic, U.K.). John Wiley & Sons: New York. 1987. xv + 401 pp. $24.95. ISBN 0471-91369-3.

The open-learning approach has been applied to instrumentation as one of a series of 29 monographs on various topics of analytical chemistry. The ACOL team, based at Thames Polytechnic, U.K., has successfully compiled all of the important information on instrumentation in this monograph. The subject matter is well-organized and very effectively presented, with a good mixture of illustrations and "self assessment questions". All of the exercises are challenging, yet straightforward. As expected, the format is not like a typical textbook, but more like that of a workbook; nonetheless, the omission of an index was bothersome and unfortunate.

There are some weaknesses. Little emphasis is given to the linkage of instrumentation to chemical analysis. For example, much more attention could have been placed on instruments as chemical measurement systems. Instead, devices and systems are presented rather single-mindedly in the context of physical electronics. A manifestation of this approach is in the lackluster presentation of analytical figures of merit. The closest equivalent to this topic is a short discussion of instrument specifications. There is also no distinction between instrument and method figures of merit. However, these topics may be treated in the volume on "Measurement, Statistics and Computation", another title in the series.

On the whole, I can recommend this book because it does exactly what it was designed to do, namely, present instrumentation in the context of an open learning, approach. It is very readable, graphically interesting, and mostly complete in its treatment of instrumentation for chemical analysis.

Dennis C. Shelly, *Stevens Institute of Technology*

Cyclopenta[*a*]phenanthrenes. By M. M. Coombs (Imperial Cancer Research Fund) and T. S. Bhatt (Imperial Cancer Research Fund). Cambridge University Press: New York and Cambridge. 1987. xi + 249 pp. $69.50.

In 1775, Percival Pott was the first to qualitatively observe the carcinogenic effects of polycyclic aromatic hydrocarbons (PAH) when he wrote of English lads "thrust up ... hot chimneys ... and when they get to puberty, become peculiarly liable to a most noisome, painful, and fatal disease." In the past 50 years of active PAH research, these ubiquitous environmental pollutants, derived mainly from anthropogenic sources, have been detected world wide in airborne particulate matter, water, soil and sediment, raw and processed foods, and tobacco smoke.

Cyclopenta[*a*]phenanthrenes (cpp) represent a significant class of PAH which is historically linked with steroid structural elucidation and, ipso facto, long implicated as a product of aberrent steroid metabolism in animals. The recent findings that cpp compounds occur naturally in petroleum and other mineral oils has resulted in renewed interest in this hypothesis. This unique volume, part of the new *Cambridge Monographs on Cancer Research* series, is a timely account by two very experienced scientists dealing comprehensively with the chemistry, biochemistry, and carcinogenicity of cpp substances.

After a brief historical introduction, there follows chronological description of synthesis and reactivity (60 pp) and a compilation of the physical and spectral properties of 350 cpp compounds (65 pp). Next, carcinogenic, mutagenic, and metabolic activation aspects are detailed (80 pp) and a separate chapter deals with X-ray crystallographic data, MO calculations, and a discussion of attempts to correlate carcinogenicity with molecular strain (28 pp).

The volume contains a wealth of schematic and tabular data of considerable value to biologists, chemists, and toxicologists involved in PAH research. The synthetic schemes are clearly arranged; however, presentation of reaction conditions above arrows and yields would have been useful. Examination of the compilation of spectral data draws attention to the paucity of NMR data. On the other hand, the important MS data on cpp-DNA adducts is presented and extensively discussed. Literature coverage from 1907 is indicated; the most recent references are to 1985 publications. The index is adequate although the use of a special index according to a compound serial number is somewhat cumbersome to use because of nonchronological listing of the corresponding molecular formula. References are collected at the ends of each chapter thus leading to some duplication. There is no separate author index.

This represents a valuable addition to a very promising series which, when complete, will serve as a comprehensive source for the diverse interdisciplinary areas of PAH research.

V. Snieckus, *University of Waterloo*

Infrared and Raman Spectra of Inorganic and Coordination Compounds. 4th edition. By Kazuo Nakamoto (Marquette University). John Wiley & Sons: New York. 1986. xii + 484 pp. $55.00. ISBN 0-471-01066-9.

Nakamoto's book is a classic and belongs on the shelf of anyone interested in applying infrared and Raman spectroscopy, especially to inorganic compounds. The fourth edition continues the virtues of the older ones but updates the material. Part I, "Theory of Normal Vibration", is a relatively brief (94 pages) clear and serviceable introduction to the subject of vibrational spectroscopy and to normal mode analysis. It is an excellent learning aid for those without formal training in the subject, and who would be deterred by more comprehensive texts. Part II, "Inorganic Compounds", is a systematic survey of the kinds of vibrational spectra encountered for molecules of increasing complexity starting from diatoms and working up to X_2Y_{10} molecules. Part III, "Coordination Compounds", is a comprehensive survey (150 pages) of metal–ligand complexes of all the main varieties. Part IV, "Organometallic Compounds", includes the main kinds of molecules containing metals and organic fragments. Part V, "Bioinorganic Compounds", includes a variety of recent data on heme and non-heme iron proteins and copper proteins. As in previous editions, the appendices includes several useful tables, including character tables and formulas for GF matrix elements of simple molecules.

In summary, this book provides a useful introduction to vibrational spectroscopy and is also a valuable reference work for the vibrational spectra of inorganic compounds, broadly defined. It is a rich store of information in conveniently accessible form.

Thomas G. Spiro, *Princeton University*

Multinuclear NMR. Edited by Joan Mason (The Open University). Plenum Press: New York and London. 1987. xx + 639 pp. $115.00. ISBN 0-306-42153-4.

The past decade or so has witnessed the emergence of excellent, commercially available, high-resolution Fourier-transform nuclear magnetic resonance spectrometers. As a result of this technological advance, most of the magnetic nuclides in the periodic table can now be investigated in a more or less routine fashion. Chemists, in particular, have been prompt in utilizing the full capabilities of this new tool. Concomitant with this rapidly expanding research has been the need for a combination reference/advanced textbook on the subject. Examination of the contents of *Multinuclear NMR* indicates that the contributors have, indeed, produced a benchmark for future books in the field. Other texts on multinuclear NMR have appeared within the last 10 years; perhaps the most notable are the following: *NMR and the Periodic Table*, edited by Harris and Mann, Academic Press, 1978; *NMR in Chemistry—A Multinuclear Introduction*, by Kemp, Macmillan, 1986; and *NMR of Newly Accessible Nuclei—Chemical and Biochemical Applications*, edited by Laszlo, Academic Press, Volumes 1 and 2, 1983. Although these three are outstanding contributions, *Multinuclear NMR* is, in the opinion of this reviewer, the best of an excellent litter. It has admirably achieved its stated aims to "explain the fundamental processes whether of nuclear magnetic shielding, spin–spin coupling, relaxation, or multiple pulse sequences that have allowed development of high-resolution studies of solids, multidimensional NMR spectroscopy, techniques for sensitivity, and so on," and to provide as complete a coverage as possible of the diverse magnetic nuclides contained in the periodic table. The book is edited and written by and for inorganic chemists but its scope and breadth are such that it should appeal to all chemists for whom NMR has become a major part of their research.

The book contains 23 chapters which, after a brief introductory chapter by the editor, are divided into three main sections; Chapters 2–5 are concerned with the fundamental parameters of the NMR experiment, Chapters 6–21 provide extensive coverage of the magnetic nuclides organized by chemical families, and Chapters 22 and 23 constitute an introduction to the newly emerging disciplines of bioinorganic and biomedical NMR.

Chapters 2–5 present a succinct treatise on the parameters involved in NMR spectroscopy. They are written at an advanced level with a comprehensive bibliography to steer the reader to the original literature for further details. Chapter 4 on spin–spin coupling and Chapter 5 on relaxation and related time dependent processes, written by Cynthia J. Jameson and Oliver Howarth, respectively, are particularly lucid treatments of these two subjects. Both chapters outline the fundamental principles behind the measurement of coupling constants and relaxation times and present many excellent examples, especially appropriate for the inorganic chemist.

The bulk of the book, Chapters 6–21, contains a wealth of information which has been amassed over the past 10–20 years on the NMR properties of inorganic and organometallic compounds. One will not find in this book extensive coverage of the more common nuclides, e.g., ^{1}H, ^{13}C, ^{31}P, ^{19}F. One will find for these nuclides data from the inorganic literature, data that are normally not included in the "organic" NMR texts and references. Each of the chapters on the individual nuclides or chemical families of nuclides are written by acknowledged experts in the field. Although the individual chapters in this section differ in depth and scope, this does not detract from the immense amount of information.

The last two chapters, dealing with bioinorganic and biomedical applications of NMR, provide a brief but thought-provoking introduction to these rapidly expanding areas of research. In a way they represent in a nutshell the unstated but underlying theme of the entire book: an attempt on the part of the editor and contributors to produce an advanced textbook which describes the basic principles of NMR, a comprehensive presentation and discussion of the chemical literature involving the magnetic nuclides of the periodic table, and suggestions for furture avenues of research using this indispensible research tool. Have they succeeded? The answer to that question can perhaps be best stated by referring to the Foreword. In it, Professor F. A. Cotton writes that this book "is *the* one for taking to that fabled desert island when you can have only one book on any given subject." This reviewer wholeheartedly agrees. It belongs in every working chemist's library as the first source to turn to before beginning any research in multinuclear NMR. Although the cost is high the reward is great.

R. Craig Taylor, *Oakland University*

X-Ray Absorption Principles, Applications, Techniques of EXAFS, SEXAFS, and XANES. *Edited by* D. C. Koningsberger *and* R. Prins *(Eindhoven University of Technology).* John Wiley and Sons: New York. 1988. xii + 673 pp. $89.95. ISBN 0-471-87547-3.

The editors of this volume wisely note that the numerous review articles and conference proceedings on X-ray absorption can "do in general no more for the unexperienced user than to make him or her enthusiastic about the possibilities of a particular technique described". By contrast, this volume endeavours to give the reader much more detailed knowledge about experimentation and data analysis and is quite successful in doing so. The volume begins with two chapters on theory—the first by E. A. Stern on EXAFS and the second by P. J. Durham on XANES. These are followed by four chapters on instrumental and data analysis by S. M. Heald, D. C. Koningsberger, D. E. Sayers, and B. A. Bunker which discuss experimental EXAFS design, EXAFS with synchrotron radiation, laboratory EXAFS facilities, and data analysis. The book ends with five chapters on the applications of X-ray absorption with S. P. Cramen describing biochemical applications, R. Prins and D. C. Koningsberger discussing catalysis, E. D. Crozier, J. J. Rehr, and R. Ingalls describing applications to amorphous and liquid systems, J. Stohr discussing surface EXAFS (SEXAFS), and A. Bianconi describing chemical applications of XANES. The editors and all the authors are renowned within their fields and are leaders in the development of X-ray absorption. The chapters on theory and instrumental and data analysis provide thorough and in depth discussion both of the convential procedures and of difficulties which may arise in applying them. The chapters are well-integrated, consistent, and clear. Detailed discussion does not dissolve into wordiness and all the comments given are of value. The chapters on applications are all up to date and wide ranging and begin with a general statement of the problems to be addressed and of the necessary sample preparation steps before detailed application examples are given.

Overall, this is a volume of very high quality, providing considerably more detailed discussion of many theoretical and experimental topics than is found elsewhere in the literature. It would be a valuable addition to the library of anyone working in or planning to enter the field of X-ray absorption.

J. A. Tossell, *University of Maryland*