behavior and enter these sites. In contrast, shape differences between **1** and **1a** in the aromatic extremities are probably different enough for effective molecular discrimination. Analogous arguments when applied to all growth faces lead to an overall 1:1a stoichiometry of nearly 2:1 for **2a**, while the **1**–**1b** system appears to be a substitutional solid solution.[12]

It is noteworthy that minor geometrical differences between **1a** and **1b** result in a considerable amplification of the structural differences between **2a** and **2b**. Weak but nontrivial forces may discriminate between subtle shape variations and include molecules of the "right" shape or contour with a high degree of selectivity. These studies have implications in the deliberate design or crystal engineering of organic crystal structures stabilized by C–H···O and Cl···Cl interactions and also in the kinetics of solid-state topochemical processes.

Acknowledgment. We thank the DST (SERC), New Delhi, for financial support.

Supplementary Material Available: Tables of atomic coordinates, thermal parameters, F_o/F_c values, and intramolecular bond lengths and angles (7 pages). Ordering information is given on any current masthead page.

Book Reviews

Basic Organometallic Chemistry. By I. Haiduc (Babes—Bolyai University, Romania) and J. J. Zuckerman (University of Oklahoma). Walter de Gruyter: Berlin, New York. 1985. XXVIII + 488 pp. $64.90 (Hardcover). Student edition: XXVIII + 376 pp. $29.90 (Paperback). ISBN 3-11-007184-3.

The purpose of this book is to provide a textbook for the neophyte organometallic chemist. It is published in both a Professor's edition, which contains an appended bibliography of secondary literature references, and a paperback student edition, without the bibliography and at a much lower price.

The text is divided into three parts: Part I is an introduction to general concepts and techniques of organometallic chemistry, including chapters on the scope and history of organometallic chemistry, the metal–carbon bond, laboratory techniques, and literature; Part II contains a descriptive listing of the synthesis, structures, and reactions of the organometallics of the non-transition elements including boron and silicon but not phosphorus; and Part III starts with an introduction to the electronic nature of transition-metal organometallics and continues with a listing of transition-metal organometallics based on ligand type. The emphasis throughout is on preparation and structure, reactions are only briefly covered, and mechanistic and spectroscopic aspects are not covered at all. There are few references to the primary literature, but the bibliography of reviews, texts, and monographs is extensive.

The text is a rewrite of I. Haiduc's 1974 Romanian-language work and attempts have been made to include updated information (to 1984).

Because of the lack of reaction, mechanistic, and spectroscopic content, this book may not be suitable as the sole source for a survey course in organometallic chemistry; however, the detailed structural and preparative listings would be of use to the advanced student.

Dennis D. Davis, *New Mexico State University*

Higher Excited States of Polyatomic Molecules. Volume III. By Melvin B. Robin (AT&T Bell Laboratories). Academic Press: Orlando, FL. 1985. xv + 465 pp. $49.50. ISBN 0-12-589903-3.

In the last decade since the publishing of the first two volumes, significant advances have been made in the study of the electronic states of molecules above 60 000 cm^{-1}, both in the volume of research and in the introduction of new techniques. Dr. Robin attempts to place both the mass of data and the changes in this field of the last decade into the context of a closely reasoned review and discussion. This volume should be used in conjunction with his first two volumes, which have now become part of the standard reading for anyone interested in the electronics of molecules, including graduate students and researchers in other fields who want to gain quick access to the work done on electronic spectroscopy of molecules. Theoreticians have found this work especially helpful in guiding them through the experimental literature; experimentalists have found the presentation in the context of molecular orbitals and the comparison with current calculations a way to organize otherwise disparate information. The present volume will certainly be used in the same manner.

Dr. Robin focuses his attention on the question of at what energies electronic states occur. He writes as a chemist to chemists. This is not a handbook in spectroscopy; very little vibrational or rotational spectroscopy will be found. Arguments for state assignments are presented only when there is an active controversy or the author feels that the method of an assignment would illustrate a point under discussion. These topics are covered in Herzberg's "Polyatomics", which with the publication date of 1966 is no longer complete as an entree into the current literature on particular molecules.

In this third volume, Robin concentrates on the literature, and this book must be read with a research library nearby. New material of the author primarily consists of interpretations. His understanding and presentation of halogenated organic compounds is masterly, and his discussion of SF_6 has been completely reworked to bring order to the study of this molecule. The discussion of polyene spectroscopy is less complete, and heavy reliance has been placed upon the work of others, taken at face value, in writing this section, but Robin again is able to present a complex topic with cohesion and his own thoughts in the section on polyethylene. There is no section on polyacetylene. Other than main group hydrides, oxides, and halides, inorganic and organometallic chemistry is sparsely represented, probably a defect in the field and not in the book.

The techniques of Temporary-Negative Ion resonances (TNI) and MultiPhoton Ionization (MPI) are briefly presented. The data presented rely heavily upon these two new techniques and on both electron energy loss and optical spectroscopies. This emphasis represents the research of the last decade. Little is mentioned of currently available techniques of mostly future value: e.g., UV Raman spectroscopy, two-color, double-resonance laser techniques, and molecular jet cooling.

Overall, Dr. Robin writes enthusiastically and to the reader personally. Occasionally an expression will stiffen the reader's spine: Rydberg "progressions" or "series" or even "sequences", pass without particular notice, but a Rydberg "parade" brings me right to attention! Nor can I accustom myself to "exhaltation" or "elevation" as synonyms for "increase" in a scientific discussion. Yet, these terms will probably become endearing to those who need to become acquainted with this field and to workers in this field, who will probably buy, read, and reread this essential volume written with both enthusiasm and care.

Paul C. Engelking, *University of Oregon*

Soil Chemistry. Second Edition. By Hinrich L. Bohn (University of Arizona), Brian L. McNeal (University of Florida), and George A. O'Connor (New Mexico State University). John Wiley and Sons: New York. 1985. XIV + 341 pp. $29.95. ISBN 0471-82217-5.

This is the second edition of a text designed for soil scientists at the advanced undergraduate or beginning graduate level. It presumes only a basic freshman course in chemistry. Although this book is not written for chemistry majors, those readers of this journal who are interested, as I am, in the applications of chemistry to soil science will find this book useful. It discusses the major aspects of this subject in an informative way, with many example plots and tables taken from the soil-chemistry literature. In keeping with its primary objective as a textbook, all chapters have problem assignments attached and most of these have been expanded in this new edition. Sections of a number of chapters have been substantially revised and the discussion of organic components of soil has been expanded to a new, separate chapter for this edition.

The other major revision has been to use S.I. units throughout, following the standards of the Soil Science Society of America. This conversion has been made rather hurriedly, it appears—the table of S.I. units in Chapter 2 has a number of errors, the conversion to kJ of the heats of hydration rounds off −1090 to −10 kJ mol^{-1} for H^+, and although the Debye–Hückel closest approach, a, in the same chapter was converted

to nm from Å, the B value quoted (without units) for the correction $BaI^{1/2}$ was not correspondingly adjusted.

This entire second chapter, Chemical Principles, is best ignored by chemists. The authors attempt to summarize thermodynamics and kinetics in one chapter, including the details of activity coefficients for non-ideal solutions. The result must be extremely difficult for a student not previously exposed to these concepts and is in fact quite misleading in a number of places. It would seem logical, for example, to attribute the relatively high boiling point of H_2O to hydrogen bonding, which is later introduced as important in silicate layer structures. Instead, the incorrect statement is made that H_2O is more nonlinear than H_2S as a justification of the high boiling point—this error persisted from the first edition. Other errors in this chapter of a glaring nature to a physical chemist occur in the discussion of activity coefficients and reference states and in the appendix on thermodynamics, where the "continual loss of entropy" by the earth should have been "continual gain of entropy". I realize the difficult problem posed to the authors of this book. Their text could have been much better if they could have assumed the users had at least a semester of physical chemistry. That is apparently not the case for most users of this text.

The authors are clearly more at home in discussing the mineralogy of soils, soil interactions with aqueous solution, and effect of specific ions on soil properties. These subjects provide the main text of this book and are clearly presented. This book provides considerable information about soil chemistry. It also provides many interesting practical applications of physical chemistry to soil science. Chemists interested in these applications can benefit from reading this book.

Lawrence H. Bowen, *North Carolina State University*

Computer Aided Chemical Thermodynamics of Gases and Liquids. By Paul Benedek and Ferenc Olti (Eötvös University). John Wiley & Sons: New York. 1985. xxvii + 731 pp. $85.00. ISBN 0-471-87825-1.

Most chemists and chemical engineers have access to personal computers, making it possible, in principle, for them to solve a wide range of complex practical and theoretical problems. However, many of these scientists have neither the time nor the inclination to write their own programs and must rely on programs written by others. More often than not the desired program is not immediately available.

As far as the chemical thermodynamics of gases and liquids is concerned, this volume provides a much needed service. Not only does it contain over 80 Basic programs but it also includes a very rigorous mathematical development in each area covered and shows chemists and chemical engineers how to develop programs of their own. Examples are given for each program so that the reader can see the output format in each case. In addition to the Basic programs, the database for over 200 compounds is given in the Appendix.

The coverage of the thermodynamics of gases and liquids is very comprehensive. Among the topics covered are classical and quantum mechanics, efforts of pressure and temperature, equations of state, conservation principles, equilibrium, thermodynamic potential functions, elements of statistical mechanics, enthalpy, phase equilibria in one-component systems, mixtures, and vapor–liquid equilibria. The nomenclature used in the discussions may bother some readers at first. For example, the quantity called free energy with the symbol F is the Helmholtz free energy $E - TS$, while the Gibbs free energy, symbol G, is called the free enthalpy.

The book is very well written. The only significant typographical error occurs in Chapter 8, where enthalpy is spelled ethalpy in the heading of all the even-numbered pages. The most serious defect in the book is the complete omission of all references, which I found disturbing in a number of instances.

I would not recommend this volume for someone studying the thermodynamics of liquids and gases for the first time. However, I would highly recommend it to chemists or chemical engineers who need to solve complex theoretical or practical problems.

M. H. Lietzke, *University of Tennessee*

Structure and Spectra of Molecules. By W. G. Richards (Oxford University) and P. R. Scott (Charterhouse, Godalming). John Wiley & Sons: New York. 1985. ix + 172 pp. $22.95. ISBN 0471-90577-1.

This book is intended to give the beginner (undergraduate level?) a compact and well-balanced introduction to molecular spectroscopy. Included are treatments of rotational, rotation–vibration, vibrational, electronic, photoelectron, and resonance (ESR and NMR) spectroscopies together with basic theories of molecular spectroscopy. Sections describing experimental techniques and instrumentation as well as summaries and problems are provided for each chapter. The authors have done an excellent job in condensing all these materials into a small volume of only 172 pages.

Any authors of introductory textbooks face dilemmas in choosing "essentials" from the vast amount of materials available. In this book, the authors decided not to give a formal introduction to group theory for the sake of brevity. Unfortunately, this resulted in somewhat awkward and uneven presentation of molecular orbitals. For example, the molecular orbitals of H_2O were designated with the C_{2v} point group notations while the D_{6h} point group notations were conspicuously omitted in the energy level diagram of benzene. In my opinion, the inclusion of a short chapter on group theory would be justified since it is essential for the discussion of electronic and vibrational spectra of polyatomic molecules. I also would have liked to have seen numerical answers for the problems. Otherwise, this book is well-written and nicely produced at a reasonable price. It is a good textbook for an introductory molecular spectroscopy course.

Kazuo Nakamoto, *Marquette University*

Symmetry and Structure. By S. F. A. Kettle (University of East Anglia). John Wiley & Sons: New York. 1985. x + 330 pp. $34.95. ISBN 0-471-90501-1. **Symmetry in Bonding and Spectra. An Introduction.** By B. E. Douglas and C. A. Hollingsworth (University of Pittsburgh). Academic Press: New York. 1985. xii + 456 pp. $39.00. ISBN 0-12-221340-8.

The applications of group theory to chemical problems are so pervasive that at least a limited familiarity with symmetry and group theory is an essential aspect of a chemical education. These volumes are both intended as textbooks and are viewed as providing this necessary introduction to group theoretical techniques. Although the details of their execution are quite different, the overall plan for both books is very similar. Both begin with an introduction to the basic concepts of group theory, with care being taken to include only those concepts deemed essential for chemical applications. The remainder of each volume is devoted to applications of group theory to chemical bonding and electronic structure, electronic and vibrational spectroscopies, and chemical reactivity. As these applications would suggest, both books have an inorganic slant; however, they contain material of sufficient generality to be of value to all chemists.

Kettle's book is intended as an undergraduate text. A unique feature of this volume is its exclusive use of models and pictures for developing the concepts of symmetry and group theory. The premise behind this approach is that chemists prefer to think in terms of models and pictures rather than mathematics and will thus find it easier to follow a pictorial, rather than mathematical, development.

The different symmetry operations and character tables are gradually introduced in the first half of the book through examination of the electronic structures of increasingly complex molecules. Throughout this development, extensive use is made of "chemical intuition". Following a discussion of some of the properties of groups, Kettle concludes with a survey of some of the applications of group theory in vibrational and electronic spectroscopies, simple Hückel theory, and Woodward–Hoffmann rules. A summary of the relevant mathematics is included in the appendices, which constitute approximately one-third of the book. Good use is made of problems and examples in the body of the text, although the addition of more solutions, and supplemental problems at the end of each chapter, would be helpful. The pictorial development, in the absence of the mathematical background, tends to give group theory a somewhat ad hoc appearance, with new symmetry operations seemingly introduced at will. Nevertheless, this book should be largely successful in its goal of allowing group theory to be introduced earlier in the undergraduate curriculum. It is a quite readable text and the numerous illustrations should provide a good introduction to the use of symmetry in chemistry.

The more rigorous text of Douglas and Hollingsworth both introduces symmetry concepts and provides the mathematical tools necessary for the student to apply these concepts to new problems. As before, the intent is to introduce *only* that portion of group theory which is necessary for chemical applications. Douglas and Hollingsworth describe their text as apropriate for advanced undergraduate or beginning graduate students. While the development of group theory is self-contained and would be appropriate to either group, the application sections are relatively sophisticated and could be a bit overwhelming, even for well-prepared undergraduates or beginning graduate students. The student that has prior familiarity with quantum mechanics, molecular bonding, term symbols, and electronic and vibrational spectroscopy will find this book an excellent description of symmetry and its common applications to diverse chemical problems. The less sophisticated student may find supplemental study necessary in order to appreciate some of the applications.

Douglas and Hollingsworth discuss essentially the same applications found in Kettle's book, although in significantly greater detail. They describe a number of applications which are often omitted from introductory texts, including the enumeration of stereoisomers, correlation diagrams in low symmetry, CD selection rules, vibrational spectra of cage

and framework molecules and of single crystals, and the symmetry implications of transition-metal-catalyzed reactions. In addition to worked examples throughout the text, there are numerous supplemental problems, together with solutions. Each chapter includes a list of suggested supplemental reading.

Both books emphasize the utility of group theory as a tool for understanding chemical problems, and both are principally motivated by the chemistry rather than by the mathematics. Each presents a satisfying picture of the common basis for understanding seemingly diverse chemical phenomena. As the text for a course in chemical applications of group theory, Kettle's book could present some problems. In am concerned that the lack of supplemental problems and the relegation of the mathematics to the appendices might leave students poorly prepared to apply group theory to original problems. However, as a nonmathematical introduction to symmetry and its uses in chemistry, Kettle's book is an excellent offering and should find a wide audience. It will be useful for introducing students to symmetry at an earlier stage in their studies.

The text by Douglas and Hollingsworth, in contrast, would be excellent for a graduate course in chemical applications of group theory. Having read this book, students should be able to apply group theory to almost any area of chemistry. With appropriate supplements, this could also be used for a course in physical methods in inorganic chemistry. Even established scientists may find this to be a useful review of symmetry, especially in view of the breadth of the applications which are discussed.

James E. Penner-Hahn, *University of Michigan*

Selective Toxicity. By Adrien Albert (Department of Chemistry, Australian National University, Canberra, and Department of Pharmacological Sciences, School of Medicine, State University of New York, Stony Brook, NY). Chapman and Hall: London and New York. 1985. XII + 750 pp. $69.95/cloth; $34.95/paper. ISBN 0-412-26020-4.

This book is a classical textbook dealing with the selectivity of toxic agents. The first edition, developed from a series of course lectures given by the author, was published in 1951. The most recent edition, the seventh, has been revised to reflect data published in the literature up to September 1984. Selectively toxic agents are those which can influence one cell without harm to another. Such agents include the following, among others: drugs, insecticides, fungicides, and herbicides.

The book is loosely divided into two parts. The first introduces the author's thesis, that there are three main principles whereby an agent can exert selectivity: comparative distribution, comparative biochemistry, and comparative cytology. Well-exemplified chapters are devoted to each of these principles. The second section is an in-depth review of specific topics influencing selectivity including the following: metabolic inhibition, ionization, steric factors, covalent binding, metal binding, and surface chemistry.

With a considerate review of historical data, an emphasis on examples to support the discussion, and an inclusion of the most recent literature, the textbook reads like a well-presented lecture. Chemists, biologists, and chemical engineers interested in the pharmaceutical or agricultural chemical industry will find it useful, either as a reference text or as supplemental reading. I recommend, however, that the best use of this book would be for teaching both undergraduate and graduate students in pharmacology and medicinal chemistry.

Edward V. Sargent, *Merck & Co., Inc.*

Syntheses of Fluoroorganic Compounds. Edited by I. L. Knunyants and G. G. Yakobson (Institute of Organic Chemistry, Novosibirsk, U.S.S.R.). Springer-Verlag: Berlin, Heidelberg, New York, Tokyo. 1985. xv + 299 pp. $69.00. ISBN 3-540-15077-3.

The authors' intent has been to establish an "Organic Syntheses" type of reference book for the preparation of fluoroorganic compounds using chemical methods that can be reproduced in any normally equipped organic chemistry laboratory. Therefore, they have excluded methods such as fluorination with elemental fluorine and electrochemical fluorination, which require specialized equipment.

The book is a condensation of the two-volume "Sintesy Flororganichekih Soedinenii", Khimia Publishers, Moscow. Around 300 of the most interesting of the original >500 preparations, along with some new preparations, are included in this work.

The book has an introduction, four main chapters with reference sections, a Subject Index, and a Formula Index. The chapters cover the following: Safety Measures; Fluoroaliphatic Compounds; Fluoroaromatic Compounds; Aromatic Compounds with Fluorinated Side Chains.

The individual syntheses are best found by using the formula index and include a name, the structure, empirical formula, molecular weight, physical properties including solubilities, and approximate toxicity when known. These are followed by references for Methods of Preparation and the recommended Procedure with Notes.

The important chapter on safety measures is deservedly in the front. The recommended procedures, warnings, and treatments are apparently from long experience. However, there can be no guarantees of information about drug dosages and applications found in the book and the publisher recommends that users should check the accuracy of the information in other pharmaceutical (medical) literature.

This book will be a welcome addition to any library serving organic chemists and to individuals desiring to quickly synthesize fluorinated organic compounds as intermediates unavailable elsewhere. I would recommend that anyone using the preparations double-check all of the calculated amounts, since regrettably there are a number of typographical errors in the text, including one in a chapter heading in the Table of Contents.

Donald E. Butler, *Warner Lambert/Parke Davis Research*

Methods for the Oxidation of Organic Compounds. Alkanes, Alkenes, Alkynes, and Arenes. By Alan H. Haines (School of Chemical Sciences, University of East Anglia). Academic Press: London and New York. 1985. XIX + 388 pp. $83.00. ISBN 0-12-315501-0.

This volume is one member of the new "Best Synthetic Methods" series (A. R. Katritzky, O. Meth-Cohn, and C. W. Rees, Eds.). The series is designed to provide a survey of reaction techniques with the practicing chemist in mind.

Oxidation of organic compounds has been artificially divided into two broad classes. The present work deals with oxidation of alkanes, alkenes, alkynes, and arenes. A companion volume will deal with the oxidation of alcohols, alkyl halides and sulfonates, carbonyls, ethers, and 1,2-diols and related compounds.

The book consists of five chapters (Introduction, Alkanes, Alkenes, Alkynes, and Arenes) and an appendix. Each chapter is further organized into the various oxidative modifications on the subject class (i.e., Formation of alkenes, Aromatization of cyclic systems, Formation of alcohols, etc., Formation of aldehydes and ketones, and Formation of carboxylic acids in the Alkanes chapter), with tables in the appendix keyed to each chapter and subsection.

Each subsection lists the reagents that are known to effect the given transformation, along with an experimental example. This is where this work diverges from others on oxidation. The inclusion of a specific example with experimental is very helpful to the chemist surveying the literature for solutions to a specific problem. It can point out experimental incompatibilities during the planning stages of a synthetic project rather than when a very precious intermediate is at stake.

This book and its companion volumes will find a valuable place in the library of any practicing organic chemist. It deals with the choice of reaction conditions in a unique way and will complement the other reaction and reagent survey series currently available.

James A. Thomas, *Warner Lambert Company*

Current Topics in Photovoltaics. Edited by T. J. Courira and J. D. Meakin. Academic Press Inc.: Orlando, FL. 1985. XV + 279 pp. $62.00. ISBN 0-12-193860-3.

This book is the first of a series to be published annually presenting comprehensive specialist reviews of major developments in photovoltaics. Five topics are treated in this first volume. Each topic is covered in a self-contained chapter and attempts an up-to-date assessment of both theory and state-of-the-art application.

The first chapter, by S. J. Fonash and A. Rothwarf, dealing with Heterojunction Solar cells, emphasizes theoretical aspects governing compatibility or mismatch of electron affinities at heterojunctions such as $Cl_xZn_{1-x}S/Cu_2S$. The authors discuss barrier formation for ideal interfaces, effects of atomic dipoles, interface states, and intermediate layers, as well as cascade models. Although the mathematical models of heterojunctions are treated rigorously, the range of interactions possible, and the uncertainties of many parameters needed to form the models, militate against high correspondence between theory and experiment. The chapter emphasizes the wide range of choice and flexibility in the art of design as these features present interesting challenges for further work.

Copper Ternary Chalcopyrite Solar Cells form the subject of the second Chapter by L. L. Kazmurski and S. Wagner. The most promising cell of this type to date appears to be $Cd(Zn)S/CuInSe_2$. It is an authentic thin-film device which has reached and exceeded 10% conversion efficiency. Initial stability tests are favorable under a variety of conditions. However, it is a high-current low-voltage device. In addition the three-source deposition scheme poses processing problems for large-scale production, and the long-term availability of indium is uncertain.

The third chapter by Yoshihiro Hamakawa focuses on Amorphous-Silicon Solar Cells. It presents an excellent review of recent advances in developing Si:H-based solar cells and their performance characteristics. Drift currents are discussed in detail. The latter section of this chapter

gives a thorough discussion of key technologies for improving the efficiency of these cells, including multilayer cell structures and stacked junctions with polycrystalline semiconductors. A table of the characteristics of some of the most promising cells forms a useful reference resource.

One of the best-written chapters is the fourth, by L. M. Fraas, on Advanced Concentrator Solar Cells. Use of Fresnel lens type collectors with high quality small area solar cells permits a useful combination of high performance and expensive cell materials with low-cost wide-area collectors. A section on multicolor cells with efficiencies greater than 30% gives a comprehensive overview of the possibilities for tailoring multicomponent devices with optimum efficiencies in different regions of the spectrum, using a beam-splitting device to focus different regions of the spectrum on appropriate components. Current test installations are evaluating costs of arrays and pay-back times as well as energy efficiencies.

The final chapter, by R. Hill and J. D. Meakin, gives a realistic and comprehensive review of CdS/Cu_2S thin-film solar cells and compares performance characteristics with earlier work on single crystal CdS. Careful analysis of the improved stability of CdS/Cu_2S or $Cd(Zn)S/Cu_2S$ and potential large scale production efficiencies of 12% together with cost-effective processes leading to factory-gate costs of about 50¢ per Wp, make the continuing development attractive. The CdS/Cu_2S cell may be due for a successful commercial comeback.

Tentative topics for Volume 2 include further applications of photovoltaic devices to both space and terrestrial systems, photoelectrochemical solar cells, MINP solar cells, effects of doping in silicon cells, as well as techniques for characterization of solar cells.

The comprehensive nature of the review of the theoretical aspects of photovoltaic effects combined with the informed identification of the most promising trends in technological development make this volume well worth its modest cost for persons seriously interested in improving and extending the applications of photovoltaic systems.

M. Clare Markham, *St. Joseph College*

Modern Experimental Organic Chemistry. Fourth Edition. By R. M. Roberts, J. C. Gilbert, L. B. Rodewald, and A. S. Wingrove. Saunders College Publishing: Philadelphia. 1985. XXV + 803 pp. $37.95. ISBN 0-03-063018-5.

The experiments in this student laboratory text appear to have been selected to illustrate many of the highlights of the subjects covered in most contemporary organic lecture courses. Each of the experiments is preceded by a discussion section of the theoretical as well as practical aspects of the experiment. Many of the exercises that were included at the end of each experiment in the previous editions have been retained and expanded upon. The authors have made several deletions and additions in the experiments presented as a result of a comprehensive user survey conducted by the publisher.

As a new feature of this edition, the authors have divided the exercises into two groups: "Pre-lab Exercises" and "Post-lab Exercises". The latter group serves to reinforce the concepts illustrated by the laboratory experiment. The "Pre-lab Exercises", are contained in a paperback ancillary book that accompanies the text and is designed to test the student's knowledge of the experiment in advance of actual performance in the laboratory. Like its predecessors, this edition has continued to give strong emphasis to laboratory safety and has excluded hazardous chemicals from the experiments.

After reorganization, the fourth edition has been divided into 28 chapters or exercises. These include the following: an introduction and discussion of laboratory safety and keeping a laboratory notebook; a discussion of laboratory techniques and apparatus; recrystallization and melting points; distillation and boiling points; extractions; chromatography; stereoisomers; an introduction to spectroscopy and infrared spectroscopy; nuclear magnetic resonance spectroscopy; structure determination using IR and NMR spectroscopy; ultraviolet and visible spectroscopy and mass spectroscopy; alkanes; preparations and reactions of alkenes; alkynes; dienes and the Diels–Alder reaction; kinetic control and equilibrium control of a reaction; electrophilic aromatic substitution; nucleophilic aliphatic substitution and preparation of haloalkanes and chemical kinetics; oxidation reactions of alcohols, carbonyl compounds, and arenes; reduction of double bonds (alkenes, carbonyl compounds, and imines); reactions of carbonyl compounds; organometallic chemistry; multistep organic synthesis; polymers; carbohydrates; amino acids and peptides; methods of identification of organic compounds; and a discussion of the literature of organic chemistry.

A survey of the chapters and exercises leaves the reader with several general impressions. The text has a particularly thorough, yet readable, treatment of the major separation techniques in the organic laboratory and will be helpful when teaching introductory students with a wide range of backgrounds. The section on qualitative analysis is very complete and well-written and could be used without much supplementary material. The integration of spectroscopy with laboratory bench methods in this section makes it more useful when teaching modern organic structure determination. The inclusion of a chapter on stereoisomers and experiments dealing with the isolation of enantiomers and the resolution of a racemic mixture is an excellent idea. The extensive use of spectroscopy in many of the exercises is also quite good. The text has a wide range of experiments designed for the well-equipped organic laboratory. However, some of the experiments may require modification of some sections in those teaching laboratories which do not have ample resources for special equipment and supplies.

Edward J. Parish, *Auburn University*

Data for Radioactive Waste Management and Nuclear Applications. By Donald C. Stewart (Argonne National Labortory, retired). Wiley-Interscience: New York. 1985. x + 297 pp. $54.50. ISBN 0-471-88627-0.

Knowledge of the relevant properties of radioactive materials is the first and most important prerequisite for correct handling of such materials and for proper management of the wastes generated during their use. A major difficulty involved in work with radioactive materials, ranging from laboratory operations with tracer levels of radioisotopes to the design of repositories for thousands of tons of high-level wastes, is the difficulty in obtaining the necessary data, which are usually widely scattered over a large number of compilations, publications, and reports. Although several books and reviews on nuclear waste management were published in recent years, it is still necessary to search through extensive bibliographies in order to locate the required physical and chemical data.

Donald C. Stewart's book represents a major breakthrough in organizing the data base for radioactive materials in a concise, systematic, and readily applicable form. This book is written with a view to the applications of radioactive materials, yet without sacrificing the scientific quality and critical evaluation of the data. The author included in the book, in a very clear and concise form, compilations of data including physical properties of radionuclides (especially common fission products, activation products, and actinides), chemical properties such as redox potentials and solubilities, technical and geological data related to radioactive waste immobilization and disposal, as well as data which are directly applicable to safety analysis (e.g., shielding, health physics, radiation damage, nuclear criticality, and decontamination).

However, this book is much more than a compilation of numerical data. It contains a brief but very useful description of subjects which are hard to summarize in table or graph form, such as the principles of calculation of the buildup of waste products and methods of immobilization of wastes. A brief summary of relevant government regulations is included. The book includes practical rules of thumb, step-by-step calculation procedures, and numerical examples for the calculation of exposure rates and shielding. An excellent list of more than 220 references, mostly consisting of review articles, is included. The book emphasizes the need for more quantitative data where such data are missing, e.g., in the calculation of the total decay energy of the natural uranium and thorium series and of actinide buildup during fuel burnup.

Almost inevitably, the pioneering effort represented in Stewart's book suffers from several minor errors and omissions. For instance, the half-lives given for radium isotopes (Ra-226, Ra-228) in several tables (1.11, 2.5, 2.10) are incorrect. The most important oxidation states of ruthenium (4,8) are missing from Table 4.1. The treatment of waste-form leachability suffers from inaccurate definitions and inconsistent units. Several sections (e.g., ion exchange decontamination) require updating. The compositions and volumes of liquid and gaseous waste streams generated in pressurized-water and boiling-water reactor operations are not described. The management of the intermediate-level accident wastes at the Three Mile Island reactor is not mentioned.

A brief description of processes which lead to the generation, separation, and concentration of radioactive species, such as neutron activation, fuel enrichment/depletion, and fuel reprocessing, could contribute to the completeness of the description of the properties of the resulting products.

These slight defects notwithstanding, this book is an invaluable addition to the literature of nuclear science and technology and an essential tool for every laboratory or facility using radioactive materials, as well as a basic educational resource for every student of radioactivity, nuclear science, and engineering and health physics. The careful arrangement of the text, tables, and graphs and the clear print make this book even more attractive.

Aaron Barkatt, *The Catholic University of America*