Systematic Structural Modifications in the Photochemistry of β,γ-Unsaturated Ketones. I. Cyclic Olefins [*J. Am. Chem. Soc.*, **97**, 145 (1975)]. By PAUL S. ENGEL* and MARY A. SCHEXNAYDER, Department of Chemistry, Rice University, Houston, Texas 77001.

Replace the captions for Figures 1 and 2 with:

Figure 1. Molecular orbital view of intermolecular oxetane formation from a ketone and an electron-rich olefin.

Figure 2. Molecular orbital representation of the first excited singlet state of a β,γ-unsaturated ketone and two possible photoreactions.

Book Reviews

^{13}C-Kernresonanzspektroskopie. By J. T. CLERC, E. PRETSCH (Eidgenossische Technische Hochschule, Zurich, Switzerland), and S. STERNHELL (University of Sydney, Australia). Akademische Verlaggesellschaft, Frankfurt am Main, Germany. 1973. viii + 143 pp. DM 38.

The increasing availability of fast Fourier transform ^{13}C magnetic resonance spectrometers combined with the concomitant proliferation of articles dealing with the manifold applications of this powerful instrumental technique has created a need for clear, comprehensive texts on cmr directed toward the organic chemist. To date, two excellent books, those of Levy ("Carbon-13 Nuclear Magnetic Resonance for Organic Chemists") and Stothers ("Carbon-13 NMR Spectroscopy") have admirably fulfilled this goal. Clerc, Pretsch, and Sternhell have now added a German-language entry, " ^{13}C-Kernresonanzspektroskopie," a clearly written introduction to the principles and practice of carbon magnetic resonance spectroscopy.

The book is effectively divided into two parts: Three introductory chapters briefly describe the basic principles of pulsed nmr, explain the phenomena of spin-lattice and spin-spin relaxation, and outline the important classes of carbon chemical shifts. The remaining four chapters are largely concerned with cmr practice: a description of the various types of multiple resonance experiments, a short discussion of nmr solvents (including a useful set of spectra of the most common solvents), extensive tables of chemical shifts for the major classes of compounds as well as a guide to the interpretation of spectra, and a short introduction to the practical operation of the spectrometer. Overall the explanations are clear and to the point. By far the greatest part of the book is devoted to the tables of chemical shifts (74 out of 135 pp). Each major compound class is treated in one or two pages which include the applicable additivity rules and leading references. The emphasis is on clarity rather than completeness of presentation. For example, the additivity rules used for alkanes are those of Grant and Paul, while the more complex as well as more precise rules of Lindemann and Adams are referenced. The tables are easy to use, even for the non-German-speaking chemist. The chapter on multiple resonance is especially clear; the various decoupling techniques, including gated decoupling, are illustrated by representative spectra and compared as to relative advantages. The final chapter will be particularly useful to the chemist seeking a practical introduction to instrumental operation. The list of general references is relatively short (34 citations) and the index is mainly to specific compounds contained in the tables. There are relatively few minor errors (the spectra on page 41 appear to be of isobutyl alcohol rather than isopropyl alcohol).

This new book is not as comprehensive as either the Levy or the Stothers texts. Treatment of "special applications of limited importance" has been intentionally omitted, and those chemists already well acquainted with cmr principles and techniques will find little that is new. On the other hand, the readable outline style will serve as a useful review for the initiated and a helpful introduction to the novice. Translation into English would serve a wider audience.

David E. Cane, *Brown University*

Highlights of Organic Chemistry. By WILLIAM J. LE NOBLE (State University of New York—Stony Brook). Marcel Dekker, Inc., New York, N.Y. 1974. xvii + 976 pp. $19.50.

Presumably there is some method in the Editor's madness in selecting a classically trained, middle-aged chemist with no credentials in physical or theoretical organic chemistry to review this book. Let me say at the outset that I learned a great deal as I skimmed through all the chapters, reading only a few in depth. And I expect to learn much more as I continue to refer back to it. Professor le Noble has assembled and organized a remarkable spectrum of topics centering around reactive intermediates in large part but also emphasizing structural features such as aromaticity, stereochemistry, conformational analysis, and strain and steric hindrance. The chapters on nitrenes, carbenes, radicals, carbonium ions, and carbanions contain very up-to-date examples which bear on the structures of these intermediates as well as on the nature of their transformations. The text can be wholeheartedly recommended for a course in which these topics are emphasized.

Professor le Noble's style is very engaging. While reading certain passages, it was as if I could almost hear him delivering the lecture. In other words, it is a very personal approach and that flavor enhances the quality of the book. I think his comments about the state of many controversial topics is likely to stimulate some new experiments.

I have only a couple of caveats. His introductory remarks about stereochemistry were somewhat disconcerting. To find a section entitled "configuration vs. structure" is a bit startling. He goes on to say ". . . configurations are interconvertible by twisting motions (on paper only), whereas isomeric structures are distinguished by the feature that interconversion without the breaking of bonds is not even conceivable." If that does not confuse or mislead beginning graduate students, I should be greatly surprised. Also he continues the use of the term optical isomers which I believe leading authorities are trying to blot out of our vocabulary.

The section concerning the rules of structural theory also tended to be misleading. Frankly, I had never seen these rules formulated in this way. In this context they serve as straw men which are demolished with numerous examples. For example, rule one states: Each kind of atom has a single valence number. Then we are shown examples of stable carbonium ions and free radicals, carbenes, etc., that violate that rule. Again an experienced chemist understands what he is getting at, but I foresee trouble for a neophyte.

This is truly a Highlight of (Physical) Organic Chemistry and is recommended to all readers who enjoy the intricacies of organic chemistry, even old timers of my vintage.

Jeremiah P. Freeman, *University of Notre Dame*

Group Theory and Chemistry. By DAVID M. BISHOP (University of Ottawa). Oxford University Press, London. 1973. xvi + 294 pp. $27.25.

From the author's preface: "This book is written for chemistry students who wish to understand how group theory is applied to chemical problems. Usually the major obstacle a chemist finds with the subject of this book is the mathematics which is involved;

consequently, I have tried to spell out all the relevant mathematics in some detail in appendices *to* each chapter. The book can be read either as an introduction, dealing with general concepts (ignoring the appendices), or as a fairly comprehensive description of the subject (including the appendices). ... the subject matter is suitable for a senior undergraduate course or a first year graduate course . . . ."

There are twelve chapters in this book with many helpful examples and pertinent exercises for the student. The first seven are largely mathematical, dealing with groups, matrices, and representation theory whereas each of the last five chapters involves a specific application to chemistry. The reviewer being a mathematician with a modest chemical background did not closely scrutinize these application chapters. A reasonable prerequisite for the student who wishes to achieve a moderate understanding of the mathematics would be a course in linear algebra and one in modern algebra at the undergraduate level. Actually, a good deal more mathematical maturity is needed if one is to master the representation theory. From this standpoint, "Group Theory" by Wigner (Academic Press) provides a more detailed, complete development of the mathematics and would be a helpful reference for the careful reader.

The first three chapters introduce the basic notions of symmetry, symmetry operations, and molecular point groups. Chapter One contains interesting background material and establishes a historical basis for the mathematical and chemical ideas that are developed in subsequent chapters. In Chapter Two the five basic types of symmetry operations (identity, rotation, reflection, rotation-reflection, and inversion) are introduced and illustrated. The chapter concludes with two short well-chosen applications of the use of molecular symmetry considerations to determine dipole moment and optical activity. Elementary group theory is introduced in Chapter Three. There are numerous examples concerning the determination of point groups of specific molecules as well as a general flow chart given at the end of the chapter.

In Chapter Four the relevant matrix theory is discussed. The author does not clearly point out that some square matrices are not diagonalizable. This problem recurs in the proof of Schur's Lemma given in the Appendix to Chapter Seven. Here the matrix commuting with all the matrices of the given irreducible representation is taken to be diagonalizable without first showing that one can assume this matrix is hermitian and hence diagonalizable. Chapter Five details the various methods for finding a matrix representation of a given point group. In Chapter Six, the deeper mathematical notions of equivalent representations and reduction of a representation into irreducible constituents are treated.

The mathematical development culminates in Chapter Seven where the main results of representation theory relevant to application in chemistry are presented. The author states as "The Great Orthogonality Theorem" the well-known orthogonality relations between the matrix entries of two irreducible representations of a given finite group. Characters are introduced next, and the orthogonality relations for the characters of two irreducible representations are derived. These results are used in determining the frequency of a given irreducible representation in a reducible one, a criterion for irreducibility and the reduction of a reducible representation. The last part of the chapter is devoted to how this information is used to construct character tables. Each of the remaining chapters pursues separately an application of the mathematics to quantum mechanics, molecular vibrations, molecular orbital theory, hybrid orbitals, and transition metal chemistry.

Gregory Dobbins, *Wheaton College*

The Chemistry of Organolithium Compounds. By B. J. WAKEFIELD (University of Salford). Pergamon Press Ltd., Oxford, England. 1974. x + 351 pp. $25.50.

This monograph provides a comprehensive but not exhaustive survey of the literature of organolithium compounds through 1972 (there are 1948 references). The logical organization of the book and a very useful 17-page index provide rapid access to specific information. As an added bonus, practical experimental details are presented for dealing with organolithium reagents. For example, specific procedures are recommended for the initiation of reactions of organic halides with lithium metal and for the analysis and carboxylation of organolithium reagents.

The book is divided into four parts. Part I deals with the crystal structures of organolithium reagents and with their degree of association in solution. Part II deals with the preparation of organolithium reagents by the reaction of organic halides with lithium metal, by metalation reactions, and by metal-halogen exchange reactions. Part III constitutes the major portion of the monograph and presents a survey of the use of organolithium compounds in organic synthesis. The reactions of the usual organic functional groups are each dealt with in turn. Part IV is a sketchy survey of the use of organolithium reagents in organometallic synthesis. Many tables of reactions, products, yields, and literature references are used to organize the material.

This monograph is well written and reasonably critical. However, the author assiduously avoids taking sides in mechanistic controversies involving topics such as the metal-halogen exchange reaction and carbenoid reactions. Access to this monograph will be a great aid to all chemists who deal with organolithium reagents.

Charles P. Casey, *University of Wisconsin*

Computers in Chemical and Biochemical Research. Volume 2. Edited by C. E. KLOPFENSTEIN (University of Oregon) and C. L. WILKINS (University of Nebraska). Academic Press, New York, N.Y., 1974. xii + 276 pp. $26.00.

The editors of this second volume of the series have shown much thought in their selection of the seven articles, which give a balance of computer applications and timeliness of subjects. While the title of the book suggests that only research applications are included, contributions by D. Harris on the computer in the physical chemistry classroom and by E. Toren, A. Eggert, and F. Larson on computerization of the hospital clinical laboratory indicate the impracticality of following such restrictions. Both these presentations are well done, especially in recognizing the need of tailoring methods to individual goals. The introductory paper on pattern recognition in chemistry is much welcomed, and Kowalski presents the appropriate theory in an easily understandable style.

The other four articles mainly deal with automation of chromatographic methods and collectively provide a primer on the versatility, costs, and limitations. These articles alone justify the cost of the volume for anyone anticipating the heavy expense in an initial investment as well as facing the uncertainty of obsolescence in this rapidly changing market.

Robert W. Korn, *Bellarmine College*

Statistical Thermodynamics. By B. J. MCCLELLAND (University of Salford). Halsted Press (John Wiley & Sons), New York, N.Y. 1973. xvi + 334 pp. $23.00 (cloth), $12.75 (paper).

This introductory book on statistical mechanics is part of the series "Studies in Chemical Physics," but is really geared more to the chemistry student, particularly in the applications chosen to illustrate the concepts developed. The topics covered and the order in which they are presented are fairly standard, except in that ensemble methods are postponed to the very end of the book. There probably is some merit in not burdening the beginning student with the idea of ensembles; many of the most important concepts of statistical mechanics can be taught adequately in simpler terms, and the student may better appreciate the importance and advantages of ensemble methods after exposure to an alternative although more limited approach.

The book presents the basic concepts in a clear, authoritative manner and clarifies many difficult points with very helpful, simple examples. The author is particularly careful in pointing out misconceptions and lack of rigor in the way many topics, such as the Boltzmann equation and the third law of thermodynamics, are frequently presented in introductory treatments. There are numerous problems at the ends of the chapters, but no answers are given; in addition, there are a number of worked problems within the text itself. In general, there are very few typographical errors. Unfortunately, however, the otherwise excellent discussion of the effect of particle indistinguishability, for example, is marred by an incorrectly written equation. Essentially no references are given to the original literature, but this is probably not a serious failing in a textbook of this type. There are a number of appendices and a subject index.

All in all, this is an excellent book and it is a pleasure to recommend it to anyone wanting to learn the basic ideas of statistical thermodynamics.

J. E. Mark, *Massachusetts Institute of Technology*

Computer Analysis of Thermochemical (CATCH) Data: Chromium, Molybdenum and Tungsten Compounds. By D. S. BARNES (University of Manchester), J. B. PEDLEY, A. KIRK, E. WINSER (University of Sussex), and L. G. HEATH (Brighton Polytechnic). Order from J. B. Pedley, School of Molecular Sciences, University of Sussex, Brighton, BN1 9QJ, U.K. 1974. 30 pp. £2.00/$5.76 (U.S.).

The format of this work is consistent with that of previous booklets in the CATCH series: "Halogen Compounds," "Nitrogen Compounds," "Phosphorus Compounds," and "Silicon Compounds." For each element, the first part of the table lists standard enthalpies of formation (both in kcal and kJ/mol) at 298 K. The compilation is comprehensive and contains data on pure substances and aqueous solutions. The second section gives the measured enthalpy changes for reactions employed in least-squares calculation of the standard enthalpies. The two sections are well cross-referenced and keyed to an extensive reference list citing much of the original literature. At first glance, the second section may seem somewhat redundant; however, the listing of least-squares residuals for the reactions provides a useful measure of their consistency with the entire data set.

The absence of entropy or free energy data and their temperature dependence does not seriously limit the usefulness of the first four booklets. Since most reactions of these elements occur in a temperature range bracketing 298 K, their free energy changes are dominated by enthalpy. For chromium, molybdenum, and tungsten, the majority of entries are refractory materials, and the overall usefulness of this latest CATCH booklet is limited by the inability to effect useful calculations for processes at elevated temperatures.

J. M. Haschke, *University of Michigan*

Internal Rotation in Molecules. Edited by W. J. ORVILLE-THOMAS (University of Salford). John Wiley & Sons, New York, N.Y. 1974. 606 pp. $39.95.

This timely book consists of a series of chapters dealing with selected topics in stereodynamics and includes thorough discussions of a variety of experimental methods, theoretical calculations, and, in some instances, impressive compilations of available data. Although certainly not exhaustive in its treatment of current trends in intramolecular dynamics, the book should be very useful to all involved in the burgeoning research effort in static and dynamic stereochemistry.

An interesting historical introduction is presented in the first chapter by W. J. Orville-Thomas, although recent important achievements in cyclohexane stereochemistry such as the isolation of conformationally pure equatorial chlorocyclohexane in solution were omitted. A representation of the interconversion between axial and equatorial monosubstituted cyclohexanes on page 10 proceeding *via* only one boat conformer is oversimplified. In Chapter 2, F. G. Riddell presents a necessarily critical review and general discussion of chemical and kinetic methods used to assess conformational preference, and in Chapter 3, C. P. Smyth gives a concise discussion of the use of dipole moment determinations in conformational analysis.

In Chapter 4, P. A. Park, R. J. D. Pethrick, and B. H. Thomas provide an effective discussion of the theory of ir and Raman activity including correlation theory. They also compiled an extensive list of ΔH° values for rotational isomerism about carbon–carbon single bonds.

J. A. Ladd and H. W. Wardale discuss the effects of static and dynamic rotational isomerism on nmr and esr spectra in Chapter 5, including a classical theoretical approach to calculating continuous wave nmr spectra, a more cursory discussion of the quantum mechanical approach, the spin echo method, and systematic errors encountered in such studies. N. L. Owen is concerned in Chapter 6 with studies of internal rotation using microwave spectroscopy. A brief summary of experimental and theoretical methods is included as well as compilation of barriers for a large number of compounds. A. V. Cunliffe in Chapter 7 and G. Allen and S. Fewster in Chapter 8 discuss torsional vibrations and rotational stereomutation. S. M. Walker in Chapter 9 presents a review of experiment and theory in molecular acoustics as related to conformational analysis.

In Chapter 10, A. H. Clark presents the theoretical approach to deriving molecular geometry from electron diffraction experiments. A number of actual cases are discussed including ethane derivatives, ferrocenes, vinyl, carbonyl, and phenyl derivatives, cyclic systems, and several AX_3BAX_3 systems. *Ab initio* calculations of potential barriers to rotation are discussed by A. Veillard in Chapter 11. A discussion of energy component analysis of barrier heights is presented along with a critical review of the pitfalls encountered in predicting barrier origins by this method. An impressive compilation of calculated barriers is also included.

In Chapter 12, V. M. Gittens, E. Wyn-Jones, and R. F. M. White discuss the conformational preferences and rates of ring reversal in an amazing number of 1,3-dioxanes and cyclic sulfites. The data are derived mainly from chemical equilibration and nmr studies and information is compiled for over 100 1,3-dioxanes. In Chapter 13, R. J. Abraham and E. Bretschneider are concerned with solvent effects in stereodynamics. A general theory of medium effects including assumptions and limitations is presented. An unfortunate statement is made on page 493 that the lowest practical temperature for an nmr experiment is −100°. Lest the potential user of the nmr method be misled, several groups (University of California at Los Angeles and Berkeley; Worcester Polytechnic Institute) record nmr spectra routinely below −170°, corresponding to potential barriers of about 5 kcal/mol.

While the treatments presented in this book are generally excellent and thorough, it should be noted that much important and interesting recent stereochemical data regarding amines, phosphines, and nitrogen and sulfur heterocycles have not been included.

C. Hackett Bushweller, *Worcester Polytechnic Institute*

Trends in Macromolecular Science. Volume 1. By H. G. ELIAS. Gordon and Breach Science Publishers, New York, N.Y. 1973, xxvi + 104 pp. $12.00.

This book is concerned with the dedication ceremonies for the Midland Macromolecular Institute which was held in September, 1972, in Midland, Michigan, and with the papers which were presented during the opening ceremonies. Six papers are presented in full; regrettably, only the abstract of the seventh paper is included in the booklet. The papers given by recognized leaders in the field reviewed important areas of macromolecular science which include Organic Reactions on Macromolecules, Chemistry and Morphology of Biological Macromolecular Systems, Polymers in Medicine and Structure Property Relationships for Synthetic Polymers, and an application-oriented paper describing new developments for the Fabrication of Thermoplastic Polymers.

The articles in the book were apparently written from the tape recordings of the proceedings and provide a lively and personal note which is often not seen in regular papers but can only be provided when the objective of the presentation is to give an overview of a broad subject. This has been achieved in these presentations.

Otto Vogl, *University of Massachusetts*

Molecular Structures and Dimensions. By O. KENNARD, D. G. WATSON, and (in part) W. G. TOWN, F. H. ALLEN, N. W. ISAACS, W. D. S. MOTHERWELL, and R. C. PETTERSEN (University of Cambridge, England). Oosthoek Publishing Co., Utrecht, Netherlands. Vol. I: 1970, xxiii + 489 pp, $18.00. Vol. II: 1970, xxiii + 344 pp, $14.00. Vol. III: 1971, xiii + 490 pp, $22.00. Vol. IV: 1973, xiii + 465 pp, $22.00. Vol. V: 1974, xv + 520 pp, $22.00. Vol. A1: 1972, xix + 637 pp, $70.00.

The detailed information derived from crystal structure analyses makes a substantial contribution to different areas of chemistry. Papers dealing with structure analyses appear in a variety of journals, some specializing in crystallography, some specializing in a particular class of chemicals, many dealing in general topics, and some which cater particularly to authors in a specific country. The authors of the volumes on "Molecular Structures and Dimensions" have successfully undertaken the monumental endeavor of collecting the crystallographic data for the years 1935 to the present. Volumes I through V are bibliographic. Organic and organometallic materials are divided into 86 classifications such as nitriles, carbohydrates, triterpenes, metal π complexes (arene), etc. These chemical classifications are particularly useful for retrieving work in a particular area. The same arrangement of entries is used in the continuing volumes. In addition to the bibliography, each volume contains three cumulative indices, that is, formula, transition-metal, and author. Thus it is possible to look in an index of Vol. 5, which covers the papers published in 1972-3, and have entry references to all the earlier volumes. Volumes 1 and 2 cover the years 1935 to 1969 for organic and organometallic structures (and complexes), respectively. In the succeeding volumes, these two broad categories are combined. The enormous increase in the number of publications dealing with crystal structure analyses have necessitated a separate volume for each year or two since 1969.

Aside from the bibliographic collection, Vol. AI contains several types of structural information. Bond lengths, bond angles, torsional angles, and stereodiagrams of the structure are presented for 1300 compounds whose structures were published during 1960–1965. The stereodiagrams are particularly useful for viewing the configuration and conformation in three dimensions.

The aim of these volumes, and those to follow, is to make crystallographic data readily available to all scientists. The authors have succeeded well in their aims.

Isabella L. Karle, *U.S. Naval Research Laboratory*

Analytical Chemistry of Selenium and Tellurium. By I. I. NAZARENKO and A. N. ERMAKOV. Halsted Press (John Wiley & Sons), New York, N.Y. 1973. x + 281 pp. $24.00.

This is a translation of the original Russian version published in 1971. It is one of a series of 50 volumes on the *Analytical Chemistry of the Elements* being published by Vernadskii Institute of Geochemistry and Analytical Chemistry of the Soviet Academy of Sciences.

Chapters 1 and 2 present an encapsulated review of the two elements including coverage of their chemistry, geochemistry, occurrence, industrial uses, toxicology, and physical and chemical properties. Chapter 3 deals with the qualitative analysis of selenium and tellurium. The remaining 174 pages, which constitute the bulk of the volume, are concerned with the quantitative determination of the two elements.

The coverage is thorough and comprehensive. Classical analytical techniques including gravimetric, titrimetric, electrochemical, and spectral methods are discussed along with more recent developments. The latter include flame photometry, atomic absorption, and X-ray fluorescence. Specific directions are given for the quantitative analytical determination of selenium and/or tellurium in rocks, ores, minerals, alloys and metals, air, aerosols, water, organic and biological materials, and soils. Chapter 7 is concerned with the determination of impurities in selenium and tellurium of high purity.

The translation into English is very good and errors appear to be minor. This volume should form part of the complete analytical library.

Ralph A. Zingaro, *Texas A&M University*

Polymer Science Study Guide. By G. S. KIRSCHENBAUM (Celanese Plastics Co.). Gordon and Breach, New York, N.Y. 1973. x + 135 pp. $8.50.

According to the author, the purpose of this paperback study guide is to provide practice in problem solving in organic and physical polymer chemistry. The book contains about four hundred questions and problems of varying difficulty, arranged into thirteen sections on the basis of the subject material covered. In the case of about half of these, detailed solutions or answers are given, along with a reference specifying where each solution was obtained and where further information may be obtained by the reader.

The questions themselves range from the almost trivial, such as "Why are polymers useful?", to more substantive ones on such topics as molecular weights and their distribution, solid-state and mechanical properties, spectroscopic and thermal analysis, polymerization characteristics, and polymer degradation. Unfortunately, it seems to this reviewer that very few of the questions and problems have been carefully and thoughtfully prepared. A large fraction are of the essay type such as "Define . . . , Give examples of . . . , Explain why . . . , What are the differences between . . . , Describe how . . . ," etc. Many are, in fact, simple restatements in question form of material explicitly presented in most polymer textbooks, or are questions that would automatically occur to a typical student reading such a textbook. In addition, many of the questions are ambiguously worded and there is considerable duplication between some sections. For example, some questions on molecular weights and molecular weight distributions appear twice and a question requesting the definitions of isotactic, syndiotactic, and atactic polymers appears in three different sections!

The answers, in general, are even more disappointing than the questions. Many are evasive, are really non-answers, or omit some important point in the argument. Others have simply been lifted directly from some textbook; for example, the long, half-page answer to a question on the differences between addition and condensation polymerizations was copied essentially word for word from a standard textbook by F. W. Billmeyer. Finally, there are a number of factual errors, for example, the designation of both melting and crystallization as endothermic processes in a thermogram obtained by differential thermal analysis.

In this reviewer's opinion, the book is just not very useful, and parts of it may even seriously confuse or mislead a student beginning to learn about polymer science.

J. E. Mark, *Massachusetts Institute of Technology*

Topics in Current Chemistry. Volume 50. Silicon Chemistry I. Edited by F. BOSCHKE. Springer-Verlag, Berlin–Heidelberg–New York. 1974. 177 pp. $19.70.

This volume is one of two to be published on silicon chemistry. The three chapters included in "Silicon Chemistry I" cover diverse and unrelated areas, but all include generation and reactivity of a type of silicon compound. The level of presentation is suitable as supplementary reading for a graduate course.

In the chapter on "Low-Valent Silicon," H. Bürger and R. Eujen discuss the known monovalent, divalent, and trivalent silicon species. Each section is subdivided into a specific chemical entity and their method of generation. There are 29 tables of data that include energy and structure parameters. The authors have performed a considerable service in summarizing the data from a wide variety of sources (142 references) in such a concise fashion. Although these silicon systems represent short-lived species, they are important in reactions at high temperature as well as in stellar space. This article should be of interest to all those concerned with the problems of bonding in silicon chemistry. Each of the references contains the title of the paper, a somewhat unusual practice but useful in identifying an investigator with a system in a field that is probably not well known to many group IV chemists.

The second chapter, "Organometallic Synthesis of Carbosilanes" by G. Fritz, is an extensive summary of the synthesis and reactivity of the Si-CH_2-Si linkage and comprises more than half of the bulk of the volume. The systems covered include mono- and polycyclic carbosilanes with the alternating sequence Si-CH_2-Si as well as monocyclic rings containing two or four silicon atoms in addition to a CC double bond. The majority of the work in this area has been performed in the laboratories of the author. The organometallic syntheses of these polycyclic derivatives are painful and often tedious processes as is well documented in the chapter. The weakest portion of the review concerns the structure proof which utilizes predominantly NMR techniques. No sample spectra are shown, and too often recourse is taken to a description of a spectrum without any chemical shift data. It would be necessary to consult the original literature for this information. However, it is frequently difficult to determine the original source. Several pages contain no reference notations and the chemical equations are not referenced. With few exceptions no comparisons are drawn to either the all carbon or all silicon analogs.

The last chapter, "The Chemistry of Silicon-Transition-Metal Compounds," is by F. Höfler. The literature is reviewed through 1972 for those derivatives that contain a direct silicon–metal bond. The four methods of synthesis of silicon–metal bonds are outlined, followed by a section on the few systematic spectroscopic and structural analyses that have been reported. The chemical transformations are then discussed in terms of substitution at silicon, substitution at the metal, and those reactions that lead to silicon–metal bond cleavage. The chapter concludes with a table which summarizes the known silicon-transition-metal compounds and summarizes the type of information available in the 200-plus references.

Author and Subject Indexes for Volumes 26–50 are also included.

Joyce Y. Corey, *University of Missouri—St. Louis*