

Book Reviews*

Reaction Mechanisms in Organic Analytical Chemistry. By KENNETH A. CONNERS (University of Wisconsin). Wiley-Interscience, New York, N. Y. 1973. 634 pp. \$18.50.

As the title suggests, this book is designed to provide a solid introduction for the analytical chemist to the detailed mechanistic studies of organic reactions. The book should also be useful to organic chemists seeking new methods with which to examine their reactions. The scope of the reactions considered by the author is much larger than those which are now standard analytical methods. This may have the effect of stimulating new areas of research among analytical chemists.

The book is very well organized, and the author presents a large number of reactions in a minimum of space. The initial chapters cover the kinetics and thermodynamics necessary for the topics which follow. Each chapter begins with a discussion of general principles, progresses to specific applications of those principles, and ends with a few well-selected problems (answers given). Reactions are considered in classes according to functional groups; this approach gives a great deal of coherence to the discussions in each section. Following each chapter is the list of references which should give interested readers a foothold in the current literature. Unfortunately, though the preface is dated May, 1972, references later than 1970 are very scarce.

One of the book's strengths, its brevity, also proves to be a weakness in some of the discussions. For example, any chemist unfamiliar with the work would find the discussion of Woodward-Hoffmann rules and the symmetry properties of molecular orbitals incomprehensible. All the relevant terms are used, but sufficient explanation to allow their use by the reader is not given. Another deficiency is the author's exclusive use of *cis* and *trans* in the sections dealing with double bonds rather than at least introducing the *Z* and *E* terminology which is presently gaining favor among organic chemists. The size of book also precludes the inclusion of many important organic reactions (for example, free radical reactions). The choices of the author seem somewhat arbitrary.

The positive aspects of the book, however, far outweigh the negative. This volume provides an introductory step in allowing chemists to cross interdisciplinary lines and as such should be considered as an addition to one's personal library.

C. M. Dougherty

Herbert H. Lehman College of City University of New York

Nuclear Magnetic Resonance in Biochemistry: Applications to Enzyme Systems. By R. A. DWEK (University of Oxford). Clarendon Press, Oxford, England. 1973. xviii + 395 pp. \$25.75.

This excellent book deals with the application of magnetic resonance to the study of enzyme systems. It begins, fortunately, with a brief presentation of the theory of chemical shifts, relaxation, spin-spin coupling, and chemical exchange, which enables readers other than nmr spectroscopists to follow the applications that are presented. Several areas of application to proteins are described, including their high resolution proton spectra, the binding of small ligands, carbon-13 studies, the use of fluorine-19 as a detecting probe, spin-label probes, and the use of nuclei with quadrupole moments. But the prominent feature of the text is the thorough discussion of relaxation studies in paramagnetic systems.

In each of these areas, examples from the literature are generously presented and discussed, making this text a valuable reference for those interested in studying enzyme systems by magnetic resonance methods.

Gary R. Gray, University of Minnesota

Radiation Chemistry, an Introduction. By A. J. SWALLOW (Christie Hospital and Holt Radium Institute). Wiley-Halsted, New York, N. Y. 1973. xi + 275 pp. \$12.95.

This short book by Swallow is likely to be useful as a compact summary for students, or workers in other disciplines who have a peripheral interest in Radiation Chemistry, or as a first introduction for someone planning to work in the field. The book is well organized, clearly and knowledgeably written, and includes systematic problems after every chapter. It would be suitable as a text for an advanced undergraduate or beginning graduate course and was ap-

parently intended for that application. Although the scope and level of presentation are not appropriate for someone wishing to dig more deeply into the subject, the well-chosen references (which emphasize review articles and symposia volumes, plus a selection of classical research papers both old and new) are likely to be very useful. Because of the selective nature of the bibliography, the lack of an author index is not serious; it is easy to locate an appropriate reference for further reading on any topic, at the end of the relevant chapter.

The organization is quite conventional, closely following the pattern established ten years ago in the well-known text by Spinks and Woods. The initial chapters cover radiation sources (1), interaction of radiation with matter (2), and dosimetry (3). Following a survey of the various types of reactive intermediates (4), there is a brief summary of typical behavior in inorganic solids (5), gases (6), water (7), liquid organic compounds (8), and polymers (9). Besides an abbreviation of about 50%, the only real deviation from the Spinks and Woods outline is the inclusion of a chapter on biological systems (10) and the elimination of a separate discussion of industrial processes. Although the Swallow book would likely be an acceptable choice, anyone wishing to select a textbook in this area might want to examine two other brief books by Denaro and Jayson (Ann Arbor Science Publishers, 1972) and by O'Donnell and Sangster (American Elsevier, 1970) and the longer text by Henley and Johnson (Washington, D. C. University Press, 1969). Unfortunately, the excellent book by Henglein (Verlag Chemie, Weinheim, 1969) is not available in an English edition.

Robert J. Hanrahan, University of Florida

Selected Organic Syntheses. A Guidebook for Organic Chemists. By IAN FLEMING (Cambridge University). John Wiley & Sons, New York, N. Y. 1973. viii + 227 pp. \$18.50.

For some time there has been a need for a single book suitable for advanced undergraduate and beginning graduate courses in organic synthesis. The problem has been that some books have stressed individual reactions for relatively simple functional group interconversions while others have outlined relatively complex multistep total syntheses, often in all too abbreviated form. Both types of books have some merit: the former ones help the synthetic chemist to build up an arsenal of reactions to choose among for carrying out individual transformations most efficiently; the latter allow the student of synthesis to fleetingly glimpse, after the fact, at a well-conceived and impeccably executed total synthesis of an awesome target molecule with its myriad of functional groups and stereochemical complexity. Unfortunately, learning the rudiments of the individual orchestral instruments or just listening to Beethoven symphonies does not enable an aspiring composer to succeed, and the situation is no different for the apprentice molecular architect. Perhaps it is a poor analogy, but Fleming seems to be attempting to bridge the aforementioned gap in this book. Thus, a substantial variety of "bread-and-butter" organic reactions is included, and an interesting collection of syntheses is presented and analyzed mechanistically and stereochemically in more than minimal fashion. The motivated reader can traverse from mastery of simple synthetic problems (*e.g.*, thyroxine) to an appreciation of the more difficult ones (*e.g.*, chlorophyll), including the awareness of what goes into planning the latter endeavors.

An initial chapter all too briefly introduces the generalities of synthetic planning. This is followed by a short discussion of synthesis in the 19th century and then thirty-three short chapters encompassing alkaloids (tropinone, morphine, lycopodine, colchicine, reserpine), terpenoids (dehydroabiatic acid, patchouli alcohol, caryophyllene, cecropia juvenile hormone), steroids and steroid intermediates, amino acid and peptide synthesis, β -lactam antibiotics, and theoretically interesting molecules (*e.g.*, [4]- and [18]annulenes, cyclopropanones, adamantanes), *inter alia*. While this is an admirable selection of topics, there are in my opinion several glaring anomalies that cannot be dismissed merely as a consequence of the exceptionally rapid pace of progress in the field. For example, there is no mention of the tremendous volume of work linking penicillins to cephalosporins *via* sulfoxide rearrangements. Additionally, only a single prostaglandin synthesis from among the numerous basically different routes to these vital compounds is discussed, whereas there are no less than four syntheses of colchicine!

* Unsigned book reviews are by the Book Review Editor.

Although alkaloids are well represented numerically, there is a notable lack of coverage of well-known members of the quinoline and indole families (except for Woodward's dramatic reserpine synthesis of the early 1960's). Certainly more attention to recent quinine, camptothecin, and among the various *Vinca* alkaloids might have been appropriate.

Although the writing style is generally lucid, there is occasional confusion in separating those ancillary structures used for explanatory purposes and designated by Roman numerals from actual synthetic intermediates appearing in separate flow sheets and designated by Arabic numerals. If these were combined under a single numbering system the reader might better understand each step as he comes to it. More literature and textbook references throughout would also be helpful.

In this reviewer's opinion, the ideal book for a one-semester organic synthesis course remains to be written. However, Fleming's book, augmented by appropriate additional material, including the burgeoning current literature, to replace less relevant sections, may satisfy many teachers. Graduate students, postdoctorates, and practicing chemists will find it informative and interesting on their own. Frankly, the price of the hard cover edition is exorbitant (after all, one can buy a House for the price!), and even that of the paperback is sufficiently steep to discourage most students from adding it to their personal libraries.

Peter T. Lansbury, *State University of New York—Buffalo*

Free-radical Chemistry. By D. C. NONHEBEL (University of Strathclyde, Glasgow) and J. C. WALTON (University of St. Andrews). Cambridge University Press, New York, N. Y. 1974. xvi + 572 pp. \$35.00.

This is an advanced textbook which would be most useful to the otherwise competent chemist whose field of expertise excludes free radical chemistry. It reflects a broad outlook and successfully blends several usually noninteracting approaches and bodies of knowledge, spanning the typical contents of the *Transactions of the Faraday Society* to the *Journal of the American Chemical Society* to the *Journal of Organic Chemistry*.

After discussions of methods of production (19 pp) and detection (49 pp) of radicals, their shapes (21 pp) and stabilities (29 pp), and a comparison of their gas-phase and solution chemistry (18 pp), the book consists of a moderately critical survey of their reactions presented with a physical organic and mechanistic emphasis. The various subjects are generally chosen, balanced, and presented well, although the discussion is often marred by fallacious or erroneous reasoning. The 106-page chapter on radical oxidations and reductions, including 19 pages on organic electrochemistry, is particularly welcome as its subject is the basis of much of the application of radical reactions to synthesis and also is the area out of which is likely to come interesting mechanistic work and new reactions in the future.

In addition to the frequent lapses in the care with which arguments are presented, there are negative features which detract from this fine work. Several areas are presented as being relatively unexplored, while actually the authors have neglected their homework. Theoretically based discussions, for example, of esr spectroscopy, CIDNP, radical *vs.* carbonium ion rearrangements, and the stereoelectronic basis of the preferred modes of cyclization of radicals, are usually weak and obscure. Also, there is a bias toward emphasis of a particular school of chemistry and failure to achieve breadth of coverage of the recent literature: 47 pages are devoted to the addition of alkyl radicals to olefins and aromatics; of a 36-page chapter on heteroradicals, 21 are devoted to their addition to olefins. Only 6% of all the references in the book are to work published after 1970 and, of these, more than half of those to the primary literature are to British journals; in contrast, less than ten out of more than 1100 references are to Russian journals.

On balance, this is a good book—far better than most. For those who want more than Pryor's introductory "Free Radicals" (1966) and less than Kochi's 1600-page "Free Radicals" reference set (1973), I recommend it as the best available.

Leonard Kaplan, *Union Carbide Corporation*

The *Vinca* Alkaloids: Botany, Chemistry, and Pharmacology. Edited by W. I. TAYLOR (International Flavors and Fragrances) and N. R. FARNSWORTH (University of Illinois at the Medical Center). Marcel Dekker, Inc., New York, N. Y. 1973. xx + 357 pp. \$32.75

Vinca minor, better known as myrtle or periwinkle, has a folkloric history as a hypotensive agent. Reports that the alkaloid portion

from this plant lowered blood pressure in animals led to a restudy of this genus.

The present volume represents a review of the current state of knowledge of the genus *Vinca*. The botanical side of the field is covered in three chapters respectively on the taxonomy, phytochemistry, and chemotaxonomy of the genus. The last two contain tables of the sixty odd alkaloids from these sources characterized to date. The chemistry of the *Vinca* alkaloids is covered in a chapter in which structural determinations of various typical compounds are described; selected total syntheses are indicated as well. The worker in the field may well find the charts of the characteristic mass spectral fragmentations of interest.

Vincamine, the main alkaloid of *Vinca minor*, is marketed in Hungary (as Devincan®) for treatment of cardiovascular disease. As the drug is apparently obtained by extraction from the plant, the book contains an intriguing chapter entitled "The Commercial Cultivation of *Vinca Minor*." A chapter on the pharmacology of the *Vinca* alkaloids completes the volume.

The nonspecialist should note the fact that *Vinca rosea*—source of the oncolytic dimeric *Vinca* alkaloids—is classed in the genus *Catharanthus*. Thus, neither *Vinca rosea* nor compounds such as vincristine or vinblastine are discussed in the present work.

It is distressing to find mechanical error in a book produced by photo-offset. For example, though references in Chapter 3 go through 76, the bibliography stops at reference 66. In Chapter 3 we are referred to Chapter 2, Fig. 8. The correct cross reference is Chapter 2, Chart 7 (which incidentally is missing a ring); similarly, Chapter 2, Fig. 11 should read Chapter 2, Chart 10.

Daniel Lednicer, *The Upjohn Company*

Molecular Crystals and Molecules. By A. I. KITAIGORODSKY (Academy of Sciences, Moscow, USSR). Academic Press, New York and London. 1973. xii + 533 pp. \$44.00.

The interest of chemists in the results of crystallographic structure analysis has traditionally been focussed on *intramolecular* information: molecular structure, bond lengths, bond angles, electron densities, etc. By contrast, the emphasis of this book is on the *intermolecular* information derivable from X-ray crystallographic results.

From the crystallographically determined packing of molecules in molecular crystals it is possible to derive intermolecular atom-atom potential functions. Such functions can in turn be used to calculate, in principle at least, a wide variety of mechanical and thermal properties of the crystals in question: thermal expansion coefficients, compressibilities, heats of sublimation, heat capacities, and so forth. Conversely, experimental values of these properties can, through the medium of the potential functions, be combined with data from diffraction experiments to yield information about the forces between molecules and about nonbonded interactions in general.

The author of the book, Professor Kitaigorodsky, is the pioneer in this field of research, a field which in the past several years has attracted increasingly wide interest.

Chapter 1 (133 pp) deals with the geometry of the packing of molecules in crystals, including symmetry considerations, intermolecular contacts, solid solubility, and disorder. Chapters 2 and 3 (99 pp) cover lattice energy and lattice dynamics. The nature of several types of intermolecular interaction is discussed, and atom-atom potential functions are introduced. Chapter 4 (161 pp) is a survey of diffraction and resonance methods from the standpoint of their accuracy and utility in the study of organic molecular structure and of molecular motion in organic crystals. The next two chapters (93 pp) deal with thermodynamic quantities of molecular crystals, including heat capacities, thermal expansion coefficients, and elastic properties. The pertinent theory is reviewed and experimental results are discussed. The last two chapters (156 pp) differ from the rest of the book in that their subject is *intramolecular* interactions. Conformations of organic molecules are discussed from the standpoint of nonbonded interactions and internal rotation. Many examples from the diffraction literature are treated in detail. The last chapter, with 231 references, presents a survey of conformation in macromolecules.

The volume is "neither a textbook nor a manual," according to the author, who also admits to "some imbalance" in the treatment, which covers "mainly results obtained by the author." This "imbalance," to the extent that it exists, is hardly unwelcome to English-language readers. Approximately 20% of the 700 or so literature references are to Russian-language publications. The coverage of Soviet literature extends into the seventies, while references to post-1965 non-Soviet literature are rather few.

The book is a very readable introduction to and survey of molecular crystals, their properties, the methods used to study them, and the models used to account for their properties. The style is pleasingly informal with frequent expression of the author's opinion (clearly labeled as such) and many suggestions of specific research areas where the author feels that important progress can be made. The book can be recommended to physical and organic chemists who are interested in the solid state.

C. E. Nordman, *University of Michigan*

Biosynthesis. Volume 2. A Specialist Periodical Report. Senior Reporter and Editor: T. A. GEISSMAN. The Chemical Society, London. 1973. 308 pp. £8.00.

Dr. Geissman has again produced an excellent volume on modern developments in biosynthesis. This report contains seven chapters which can be divided into two types of reviews—those which update (through December, 1972) chapters found in Volume 1 and those which introduce new topics. Among the former are chapters titled "Biosynthesis of C₅-C₂₀ Terpenoid Compounds" (J. R. Hanson), "Biosynthesis of Triterpenes, Steroids, and Carotenoids" (H. H. Rees and T. W. Goodwin), and "Biosynthesis of Phenolic Compounds Derived from Shikimate" (J. B. Harborne). There is also an updating chapter on alkaloid biosynthesis (E. Leete) which summarizes the work reported in 1972 but in addition reviews in more detail the information available on the biosynthesis of tropic acid and the successes in applying enzymology and tissue culture work to alkaloid biosynthesis. The chapters introducing new topics include "Non-protein Aminoacids, Cyanogenic Glycosides, and Glucosinolates" (A. Kjaer and P. Olesen Larsen) which focuses on biosynthetic aspects of these intriguing compounds as they have been delineated in the plant kingdom and a welcome addition on the biosynthesis of polyketides (T. Money). The final new chapter is an extremely useful one titled "Stable Isotopes in Biosynthetic Studies" (M. Tanabe). The examples chosen and the depth of treatment in this chapter allow the reader to develop a feeling for the utility of nuclear magnetic resonance and mass spectrometry in the field of biosynthesis.

The reviewers have done an excellent job of organizing and summarizing the extensive recent activity in this field. Along with a realization of our growing knowledge of how Nature makes her compounds, any reader of this work will be impressed with the increasing importance of biochemical and biological techniques in biosynthetic investigations. The Report will certainly serve as an essential source of information to any expert in the field. The neophyte, on the other hand, would not find this work a starting point but could make good use of the extensive bibliography in beginning his studies.

Paul B. Reichardt, *University of Alaska*

Progress in the Chemistry of Organic Natural Products. Volume 30. Edited by W. HERZ, H. GRISEBACH, and G. W. KIRBY. Springer-Verlag, New York, N. Y. 1973. viii + 666 pp. \$92.30.

Volume 30 continues the tradition of excellent reviews on natural products that one has come to expect for this series. Unfortunately, the price (expletive deleted) ensures that the average chemist will be using the library's copy rather than a personal one in the privacy of his study.

Chapter 1, "Bioluminescence: Chemical Aspects," is by M. J. Cormier, J. E. Wampler, and K. Hori. Comments on this chapter follow at the end of this review. Chapter 2, by L. Jaenicke and D. G. Müller, is entitled "Gametenlockstoffe bei niederen Pflanzen und Tieren" (gamete attractants of lower plants and animals). The structures and syntheses of three plant sex hormones (sirenin, ecto-carpane, and dictyoptere) are given in detail, followed by briefer treatments of several others. Chapter 3, by J. Polonsky, is on Quassinoid Bitter Principles, natural products from the botanical family of Simaroubaceae (used in the manufacture of Pernod?) many of which have at times been used as herbal medicines. The chapter covers the proofs of structure, syntheses, and biogeneses of these terpenoids. Chapter 4, by B. Franck and H. Flasch, is entitled "Die Ergochrome (Physiologie, Isolierung, Struktur und Biosynthesen)." These coloring agents of fungi (ergot) have modified hydro-xanthone structures. Chapter 5, by H. D. Locksley, is on the "Chemistry of Biflavanoid Compounds." The proofs of structure are given along with extensive lists of the distribution of these compounds in nature. One wonders what these compounds are doing in the plants, especially in the Ginkgo. The sixth chapter is an exhaustive summary of macrolide antibiotics ("Chemie der Makrolid-Antibiotica von W. Keller-Schierlein"). Proofs of structure are given for the many classes of compounds that are covered. The last chapter, "Chemie and Biologie der Saponine

(von R. Tschesche und G. Wulff)" is also an exhaustive treatment. The saponins have interesting and varied properties: ability to form suds, hemolytic activity, toxicity to fish, ability to form complexes with steroids, and antibiotic activity. Covered in detail are the isolation procedures, proofs of structure, biosyntheses, and properties of the saponins.

I am most familiar with the subject of Chapter 1 and for this reason have opinions about the handling of the material. The authors do not point out the many older reviews of bioluminescence. Further, their own review, I'm afraid, is in danger of generating more heat than light. The authors have chosen to outline the chemistry of bioluminescence in terms of two "competing" reaction mechanisms. This is unfortunate, since the chapter thus tends to be polemical in nature, and since there is no good evidence supporting the "linear" mechanism for the production of excited states. The biochemical aspects of each system (*Renilla*, firefly, *Cypridina*, bacterial, *Latia*, earthworm) are given in the chapter, and it is this information which will probably have the most lasting value. A few unfortunate statements mar the work; for example, on page 2 we read: "Bioluminescence takes place in an aqueous environment at near neutral pH, conditions which do not allow chemiluminescence to occur." While the last phrase is true for some chemiluminescent systems, it is not true for all of them.

Emil H. White, *The Johns Hopkins University*

Oxidases and Related Redox Systems. Edited by TSOO E. KING (State University of New York at Albany), HOWARD S. MASON (University of Oregon Medical School), and MARTIN MORRISON (St. Jude's Children's Research Hospitals). University Park Press, Baltimore, Md. 1973. xxiii + 883. \$49.50.

This two-volume set contains over fifty collected papers and discussions of the Second International Symposium on Oxidases and Related Redox Systems held at St. Jude's Children's Research Hospital in Memphis, Tenn., during June 8-12 of 1971. This symposium convened some 45 international researchers to present an overall picture of the oxidase field. Although the papers are accounts of original research, they contain no experimental sections. The volumes are organized according to the kind of reactions that are catalyzed with the first series of papers discussing enzymes and enzyme systems involved in metabolism. The second series of papers discuss enzyme systems involved in energy transduction processes. Each of the papers is carefully referenced and contains a transcript of the discussion that followed the presentation. A subject index is also included.

Although the aim of this publication is to provide an up-to-date primary research reference in biological oxidations, the papers are at least three years old. For a field as rapidly moving as biological oxidations, this type of publication is only going to be of transitory value. Furthermore, at a time of rising publication costs and an already congested scientific literature, it is difficult to rationalize the cost of a publication which essentially duplicates material which already exists in the scientific literature. The outstanding value of this publication, however, is that it provides a well-organized and convenient overview of an extremely important field in a single publication. Since a transcript of the discussion following the presentation is included, it is possible to evaluate the impact of a given paper on the audience. Moreover, the questions that are asked serve to clarify and focus the key problems that remain to be answered in that particular research area.

Paul van Eikeren, *Harvey Mudd College*

Mechanism in Organic Chemistry. By R. W. ALDER (University of Bristol), R. BAKER (University of Southampton), and J. M. BROWN (University of Warwick). Wiley/Interscience, New York, N. Y. 1971. x + 378 pp. \$14.75.

This is a book at the intermediate level, intended for upper-division undergraduates, beginning graduate students, or practicing chemists whose education took place before the ascendancy of reaction mechanisms. Its aim is to provide the reader with an appreciation of unifying principles of physical organic chemistry with enough examples to render them concrete, and to show some of the experimental evidence on which mechanistic conclusions are based. In order to accomplish this aim without undue bulk, the authors have written densely and have omitted all sorts of well-known reactions that they judged not to contribute sufficiently to an increase of understanding (the index contains no reference to the Beckmann, Hofmann, Curtius, or Wagner-Meerwein rearrangements, decarboxylation, the Sandmeyer reaction, etc.). It should thus not be considered to be an encyclopedic compendium of established mechanisms.

The organization is unusual, in that the conventional one according to classes of reaction type is abandoned in favor of a division according to the degree of association or dissociation of bonds to the carbon atoms reacting. The result is logical and effective and allows the subject to be presented in only five chapters: Mechanism and Reactivity; Dissociative Processes (Carbonium Ions, Carbanions, Carbenes, Free Radicals); Synchronous Reactions (Bimolecular Substitution and Elimination Reactions); Multi-center Reactions (Electrocyclic, Cycloaddition, and Sigmatropic Reactions), and Associative Reactions (Electrophilic and Homolytic Aromatic Substitution, and Addition to Olefins, Nucleophilic Addition-Elimination Reactions with Aldehydes and Ketones, Acylation, Nucleophilic Vinyl and Aromatic Substitution).

Each chapter is well provided with selected references to primary literature, and there is an author index as well as a subject index. There are exercises at the end of each chapter. They are by no means trivial but, in fact, are sophisticated, in most cases being based on actual research results (references to which are given). The reader who proceeds systematically through this book should gain a new and enhanced understanding of reaction mechanism. Good students will be stimulated; a graduate course based on this text could be a valuable experience.

Riegel's Handbook of Industrial Chemistry. Seventh Edition. Edited by JAMES A. KENT (Michigan Technological University). Van Nostrand Reinhold Co., New York, N. Y. 1974. x + 902 pp. \$37.50.

The editor gives the aim of his book as "to present, in a single volume, an up-to-date account of the many facets of the chemical process industry." The original edition appeared in 1928; for this one, "a great many of the chapters have been completely rewritten," and two new chapters have been added (industrial wastewater technology, and air pollution). The 27 chapters have been contributed by 33 industrial chemists. The problem of compress-

ing such large topics as, for example, "The Pharmaceutical Industry," into one chapter is obviously not easy. The results are generally good, but the quality is quite variable. References are given in every chapter, but their number and nature vary enormously.

There are two significant shortcomings to this otherwise potentially valuable reference work: structural formulas of the hundreds of compounds with six-membered rings are misleading or ambiguous, and the index is very inadequate. In most (but not all) chapters, a plain hexagon, which properly signifies cyclohexane, is used to represent an aromatic benzene ring. This in turn has led to the use of cyclohexanedione structures where quinone structures are needed. The situation would be bad enough if it were consistent, but in some places, notably in the chapter on pharmaceutical industry, aromatic structures are shown correctly. This is dismayingly careless editing. The worst example is an attempt to depict cyclohexanone by means of a hexagon, outside the corners of which are stuck five single hydrogens and one "C=O," seemingly implying seven carbons. Inasmuch as the plain hexagon as a symbol for benzene was abandoned nearly two generations ago, the appearance of such an anachronism raises questions about how reliably up to date this book is. Fears are heightened by the picturing of the long-disproven cyclic structure for azide ion (p 582).

For a work of reference, a good index is of the greatest importance, but in this case the index is dreadfully incomplete. As examples, the manufacture of hydrazine is described in two separate chapters (pp 103 and 595), yet only one of these is listed, and, similarly, the production of aniline from nitrobenzene is described in two independent places, but only one is listed in the index. Perhaps it is just as well, for the respective authors give different equations for the same reaction (nitrobenzene plus iron) (moreover, neither equation seems to be correct). There are numerous lesser lapses. It is a pity, for a book such as this could be a very useful reference if produced with greater care.