

A 20-page section on transition probabilities is followed by a 70-page section on classification of electronic states, selection rules, and symmetry of molecules containing the briefest of introductions into the use of group representations in this connection. Character tables are included in the text. The next two chapters consider the calculation of spectral quantities first by the molecular orbital method and then by the valence bond method. The examples of butadiene, the polyenes, benzene, and the acenes are considered in some detail.

The remainder of the book (100 pp.) consists of short chapters on "Antisymmetrized Molecular Orbitals" (*sic*), "The Semi-empirical Method of Pariser and Parr" (5 pp.), "The Self-consistent Field Method" (11 pp.), "Summing Up. What Next?" (8 pp.), "Free-Electron Methods" (17 pp.), and "A Brief Review of Chemical Spectroscopy" (25 pp.).

The book is clearly written in simple easy-to-follow style. It is perhaps best regarded as a source book on the cookbookery of the empirical techniques used in the simple MO and VB methods some 15 to 20 years ago. The book is weak in more modern approaches and in providing sufficient discussion of the pitfalls, drawbacks, and limitations of the various procedures.

The earlier review of previous editions of this work commented explicitly on the distribution of references by year. One would have hoped that the present volume, published in 1964, might have included considerable recent literature as an aid to the student. Of the 460 references, however, only 34 are dated within the past five years, and only 87 are within the past decade. The bulk of the references are more than 15 years old. In this day of rapidly advancing science, such a distribution can hardly be said to "enable the reader to introduce himself to actual research work in the field of electronic spectra of larger molecules."

Summarizing, we can say that the book is well conceived, clearly written, but disappointing in its lack of up-to-date viewpoint. It will serve a useful function, but no modern course or program of self-study should be based on this volume alone.

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Free Radical Reactions in Preparative Organic Chemistry. By GEORGE SOSNOVSKY, Associate Professor, Illinois Institute of Technology, Chicago, Ill. The Macmillan Co., 60 Fifth Ave., New York 11, N. Y. 1964. xvi + 438 pp. 16 × 24 cm. Price, \$17.00.

Scientists concerned with synthetic organic chemistry, or those who have a general interest in free radical chemistry, will find this book of value. The author's aim has been to deal comprehensively with a selected series of synthetically useful reactions—mainly additions to unsaturated systems—which are known to proceed, or which may likely proceed *via* free radical intermediates.

The volume contains eight chapters which are set up in a format similar to the one used in the well-known series on "Organic Reactions" (Wiley). Of the 416 pages of text, 169 are devoted exclusively to tables which illustrate the specific reactions; over 2000 fully documented examples are included.

The world-wide literature of the subject is represented in the 1481 references given at the ends of chapters. Of these, almost 200 are to articles in Russian journals (mainly since 1957), and about 180 are to patents. British, German, French, and Japanese works, among others, are also reviewed. A detailed check of over twenty references which were of particular interest to the reviewer, including those to foreign journals, showed full accuracy in citation and in quoting of data.

Very few references to studies later than 1960 are given. A subject index (20 pages) is included, but an individual author index is not. The latter omission is not very serious, however, since the alphabetical reference lists are easy to scan. The type, formulas, and tables are exceptionally clear, the book is quite free of typographical errors, and the general physical makeup is good.

In view of its extent, the author wisely omitted the topic of free radical reactions in the preparation of polymers, as such; however, many of the reactions cited are of direct interest for polymer studies. The following are the headings for individual chapters: I (13 pp.), "Addition of Hydrogen Halides to Unsaturated Compounds"; II (43 pp.), "Addition of Alkylpolyhalides to Unsaturated Compounds"; III (58 pp.), "Reactions

of Sulfur Compounds"; IV (33 pp.), "Addition-Type Reaction of Water, Hydrogen Peroxide, Alcohols, Acetals, Ethers, Carbonyl Compounds, and Saturated Compounds with Unsaturated Compounds"; V (40 pp.), "Reactions of Phosphorus Compounds"; VI (20 pp.), "Additions of Silicon and Germanium Compounds to Unsaturated Compounds"; VII (69 pp.), "Reactions of Nitrogen Oxides and Related Compounds"; VIII (132 pp.), "Halogenations."

Although the preparative theme of the book is fully adhered to, the fundamental lists of references and the supplementary reading lists lead the reader to specific theoretical aspects of the subject, and the author has interwoven comments thereto throughout the text. In seeking a rationale for including free radical reactions of preparative value, a liberal basis was resorted to. The author recognized the uncertainties inherent in assuring that a particular reaction under chosen conditions does, indeed, involve free radical intermediates, but includes those reactions in which free radicals have been well demonstrated, those which are catalyzed by free radical initiators (such as peroxides, azobutyronitrile, and organometallic compounds), or those reactions which are initiated by irradiation or thermal means—ostensibly under nonionizing conditions. Assurance of free radical intermediates is sometimes tenuous, as, for example, in the additions of water to crotonic acid or to ergot alkaloids, effected by ultraviolet irradiation; but such reactions are of considerable interest, both chemically and biochemically, and in view of the mechanistic possibilities they have been included.

Some limitations of the volume may be noted. Since the discussion of mechanism is incidental to the main theme, there are some cases where references are given to particular discussions of reaction mechanisms without including also significant later considerations. An example is the reference to the proposal of homolytic mechanisms for thermally induced additions of elementary sulfur to olefins, without further notation to the later views of Bateman, Moore, and co-workers on the probable polar courses of these reactions. It is obvious that subjects as extensive and as complex as the olefin-sulfur reactions, the free radical reactions of sulfonyl chloride with olefins or alkanes, and the behaviors of numerous other nitrogen, sulfur, and phosphorus reagents cannot be dealt with fully in a relatively short monograph. The author has, however, generally accomplished his purpose to provide basic examples of preparative value, and to cite the major references. Particularly with the series of studies of M. S. Kharasch, F. R. Mayo, W. H. Urry, and co-workers, in the several fields of investigations which they pioneered, the author has provided an exhaustive and valuable summary of the original studies and of their later extensions, besides citing the earlier review works. Much of the work of other early investigators is also brought into perspective. The text also contains descriptions of many less well-known reactions which are of potential value and which are intriguing for further study. Experts in particular areas will certainly, however, recognize many additional examples of importance which could equally warrant inclusion. In larger areas of study, the preparative aspects of semi-quinonoid radical reactions (as, *e.g.*, the oxidative formations of thyronines from iodotyrosines) and of homolytic arylation reactions, among others, are not included.

This book will help the general reader to recognize that a number of key factors have now fully combined to set the stage for a renewed growth of interest in preparative free radical chemistry. Among these are (1) the availability of a greater selection of radical initiators, (2) the availability of suitable apparatus for selective irradiation studies of all types, (3) the capability for effective separations of mixtures by preparative gas chromatography, (4) the comparative ease with which products can now be identified by combinations of chromatographic, spectroscopic, and conventional means, and (5) the realization of differences of specificities among various reagents, as for example, various halogenating agents which react by free radical paths. Hence, the timing of this volume can be viewed as fortuitous, for it marks and emphasizes the end of an era of about thirty years during which the pioneering works of many academic and industrial investigators have been integrated to lay a sound basis for future work. The earth was indeed fertile, and it has been tilled well.

A comment to the question of whether the earlier investigators have, in fact—as has been lamented by some—taken the "cream off the top" may be appropriate. From the mechanistic side, this is certainly not the case, for numerous facets of the mechanisms of the synthetically useful reactions require study by classical and new techniques, and these studies can yield infor-

mation of great interest to the preparative aspects of the work. Also, as is clearly evident from the current literature, intriguing new areas for the synthetic utilizations of free radical reactions are developing rapidly, including overlap areas between organic and inorganic chemistry, as well as those of biochemical importance.

An appreciation of the subjects summarized in "Free Radical Reactions in Preparative Organic Chemistry" is thus essential for those concerned with current and potential work in the topics covered. Therefore, all chemistry and chemical engineering libraries should certainly have this volume, and many individuals will find the price of a personal copy a sound investment. This book should also prove of direct interest for advanced undergraduates and for graduate students.

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Non-glycolytic Pathways of Metabolism of Glucose. By SIEGFRIED HOLLMANN, Physiologisch-Chemisches Institut der Medizinischen Akademie, Düsseldorf, Germany. Translated and revised by OSCAR TOUSTER, Vanderbilt University, School of Medicine, Nashville, Tennessee. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. 1964. ix + 276 pp. 16 × 24 cm. Price, \$12.00.

The original monograph by S. Hollman published in German under the title, "Nicht-Glykolytische Stoffwechselwege Der Glucose" and copyrighted in 1961 by Georg Thieme Verlag, Stuttgart, Germany, has been reviewed by this writer (*J. Am. Chem. Soc.*, **83**, 3922 (1961)). The present translation and revision by O. Touster retains the organization of the material and mode of presentation of the original version. However, the rapid progress of biochemistry in the intervening 3 years necessitated a considerable number of revisions and additions. In particular, some 200 recent references, covering the literature up to October, 1962, were added to the original list of over 1000 references. Touster, himself an authority in this field, has produced an excellent and easily readable translation. The monograph covers both animal and bacterial systems and is characterized by clearness of organization and presentation. A large number of well-printed structural formulas and schemes of reaction sequences are of aid in finding quick orientation in this rapidly expanding field. The book can be recommended to specialists and nonspecialists alike. The former will appreciate the high standards applied in accepting conclusions and the careful weighing of the experimental evidence.

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Interpretation of Mass Spectra of Organic Compounds. By HERBERT BUDZIKIEWICZ, Research Associate, Stanford University, CARL DJERASSI, Professor of Chemistry, Stanford University, and DUDLEY H. WILLIAMS, Research Associate, Stanford University. Holden-Day, Inc., 728 Montgomery St., San Francisco, Calif. 1964. xiii + 271 pp. 19 × 26 cm. Price, \$8.75.

Structure Elucidation of Natural Products by Mass Spectrometry. Volume 1. Alkaloids. BY HERBERT BUDZIKIEWICZ, CARL DJERASSI, and DUDLEY H. WILLIAMS, Stanford University. Holden-Day, Inc., 728 Montgomery St., San Francisco, Calif. 1964. 233 pp. 19.5 × 26.5 cm. Price, \$10.50.

Although they bear different names the two volumes reviewed here seem to be considered most logically as two-thirds of a trilogy. "Interpretation of Mass Spectra of Organic Compounds," the first third, deals with the fragmentation behavior of organic compounds arranged according to functional groups. The second and third parts, "Structural Elucidation of Natural Products by Mass Spectrometry," Volumes 1 and 2, present applications of the principles discussed in "Interpretation." "Structural Elucidation," Volume 1, which is reviewed here after "Interpretation," deals with alkaloids; Volume 2, which has not yet appeared, will treat other classes of compounds—steroids, triterpenes, amino acids, sugars. These are important books in a dramatically active field.

Not so long ago [*J. Am. Chem. Soc.*, **85**, 2190 (1963)], the reader could still hope that "the ideal book on mass spectrometric applications in organic chemistry" might be on the horizon. That hope has now been sent aglimmering by a single sentence in the Preface to "Interpretation of Mass Spectra of Organic Compounds," the first of the present two volumes, where it is advised that "This book is best read, at least by the uninitiated organic chemist, in conjunction with Beynon's or Biemann's texts, which offer an excellent over-all introduction to mass spectrometry, or with certain selected chapters from some of the other recent monographs."

This is a fair warning, and it should be heeded. A beginner simply should not start with this book alone; it was not intended as a primer. Much is omitted (discussions of operation and instrumentation, of appearance potentials, of molecule ion location); much is treated only briefly (negative ion spectra, high resolution mass spectra); and the discussion of metastable ions on p. xiii is incorrect, since the mathematics of the theory requires that the $m^* = b^2/a$ relationship hold only for those ions which decompose *after* acceleration. However, these limitations are beside the point; to quote again from the Preface, the authors "have tried as much as possible to avoid overlap with other mass spectrometry texts and to cover material not readily available elsewhere."

The authors' first decision, not to treat those topics well covered elsewhere, seems eminently wise. It would be anticlimatic, for example, to rehash alkylbenzenes and the propylum ion story or to cover in detail aliphatic esters after the superb chapters on these subjects by Grubb and Meyerson and by Ryhage and Stenhagen, respectively, in McLafferty's compendium. In general, the chapters of the latter book seem areas to avoid by other authors, since there they have the real ring of authority. The authors' second decision, to present material not readily obtainable elsewhere, is then the crux of the matter, and the book stands or falls to the extent that they succeed or fail in this more limited objective. To this reviewer, they succeed.

They have performed a considerable service, both to the student desiring to learn mass spectral interpretations and to the organic chemist already versed in the field who wishes to find data on a compound type in a convenient form. While nearly all of the data presented in the book are already available in the primary literature, they are not readily available. This applies especially to the wonderfully various but poorly indexed spectra of the A.P.I. "Catalog of Mass Spectral Data." The present volume is worth its price just for its assembling of the A.P.I. spectra into functional group categories. For example, if one wishes to know how amides fragment in a mass spectrometer, he can leaf through the A.P.I. spectra or he can find a page of discussion in one earlier book on mass spectrometry of organic compounds, isolated comments in a second, and no index entry in a third. However, in "Interpretation of Mass Spectra of Organic Compounds," he finds references to aliphatic, to cycloalkyl, to steroidal, and to tertiary amides, and in eleven pages of text he finds simple amides discussed at length: secondary and tertiary acetamides readily lose ketene, long-chain primary amides give a peak at $m/e = 59$, etc. This is precisely the sort of information desired by an organic chemist looking at a mass spectrum. Many other sections are similarly and uniquely useful in the book which, in many respects, seeks to describe the present state of the art. For this reason, the book is recommended to every organic chemist who seeks to interpret mass spectra.

In a subject fraught with the temptation to speculate wildly, the authors have been generally restrained and have documented carefully those fragmentations supported by deuterium labeling, though a particularly welcome addition would have been a general chapter of advice to the unwary, marking pitfalls and stressing the need for concrete evidence. In some cases metastable ion peaks are cited, but that tool could have been employed considerably more widely than it is in confirming fragmentations, as would McLafferty's odd-even rules in explaining them.

It is easy to find faults in any book. In this one coverage is rather uneven, some functional groups being accorded more than their due, others less. Those in the favored category usually have been studied in the authors' laboratory. Thus, isohexyl cyanide does not seem to deserve four pages, nor does the likelihood of encountering an unknown alkyl isothiocyanate seem to warrant the five and one-half pages devoted to this class of compound while one looks in vain for epoxides. Among the heterocycles, substituted pyrroles rate thirteen pages, substituted pyridines only four, imidazoles none. However, this unevenness is