

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 X 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 X 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 X 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 propylium 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