heterocyclic compounds. The presentation is not extensively critical, nor is it one that approaches the subject wholly theoretically or mathematically. It is a fine summation of information. These volumes are an excellent contribution and are recommended to any person interested in the subject they cover.

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Functional-Group Reactions

Survey of Organic Syntheses. CALVIN A. BUEHLER and DONALD E. PEARSON. Wiley-Interscience, New York, 1970. xii, 1166 pp., illus. $27.50.

The wide acceptance recently accorded the Fiesers' encyclopedic work detailing the utilization of a wide variety of reagents in organic synthesis is clear evidence of the demand for such reference sources in this ever expanding field of research. In an altogether different, albeit somewhat precedented, approach, Buehler and Pearson have brought together tabulations of the principal methods for synthesizing the main types of organic compounds. As they note in their preface, their goal has been to detail how a given functional group can be prepared from other functional groups. In this regard, the text bears some similarities to the earlier work of Wagner and Zook (1953). Because the method of classification is by functional group and reaction type, it will serve as an exceedingly useful complement to the Fiesers' volumes.

The book consists of 20 chapters, each of which gives individual coverage to a particular functional group. The groups covered are alkanes and cycloalkanes, alkenes and cycloalkenes, alkynes, alcohols, phenols, ethers, halides, amines, acetals and ketals, aldehydes, ketones, quinones, carboxylic acids, esters, anhydrides, acyl halides, ketenes and their dimers, amides and imides, nitriles, and nitro compounds.

The makeup of a chapter consists of classifications according to reaction type, for example: oxidation or reduction (wherein changes in oxidation level occur); solvolysis or metathesis (wherein there is no alteration of oxidation level); electrophilic addition or substitution; nucleophilic reactions; cycloaddition; and free radical reactions. Furthermore, each reaction is discussed in a uniform way. Initially, a general equation is used to illustrate the synthetic maneuver. This is followed by a discussion of the value of the reaction and its limitations, frequently with the inclusion of a limited amount of theory. Last, several examples are given, some in detail sufficient for execution in the laboratory. All steps are well referenced, with emphasis given to reviews of the subject where possible.

Most important, the authors have included the most recent developments in the field (references run generally from the mid-1950's to early 1969). In addition, they have taken the trouble to point out reliable procedures and to call attention to less tried-and-tested methods. This objectivity is a most welcome asset. Other strong points are the ease of retrieval of information (the format is quite readable) and the extensive coverage of the material.

This text is highly recommended to students and researchers who are engaged in synthesis. As with all such works, there is considerable material that could not be included. On the topics covered, however, this volume is more encompassing and up to date than any other in its field.

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Carbon Dioxide

CO_2: Chemical, Biochemical, and Physiological Aspects. A symposium, Haverford, Pa., Aug. 1968. ROBERT E. FORSTER, JOHN T. EDSALL, ARTHUR B. OTIS, and F. J. W. ROUGHTON, Eds. National Aeronautics and Space Administration, Washington, D.C., 1969 (available as NASA SP-188 from the Superintendent of Documents, Washington, D.C.). viii, 292 pp., illus. Paper, $2.75.

This volume, containing 27 papers, is divided into five major sections entitled Theoretical Aspects of CO_2 Chemistry, Carbamate Reactions (with Special Reference to Hemoglobin), Carbonic Anhydrase, Metabolic Processes Involving CO_2 or HCO_3^-, and CO_2 Exchange Rates in the Body.

Although many of the excellent manuscripts had already appeared in the literature before the symposium, the present volume brings these papers together along with edited discussions of them, either individually or in groups. Some discussions seem to have been abbreviated, whereas others appear to have been amplified after the symposium and include bibliography. Discussions were generally very lively and serve the purpose of bringing the manuscripts into focus with various problems in CO_2 chemistry and metabolism; occasionally the discusser's data are diametrically opposed to those presented in a prepared manuscript.

The reviewer particularly appreciated J. T. Edsall's very precise and critical review of the known physical properties of CO_2, H_2CO_3, and bicarbonate ion and the kinetics of their interconversion, even though much of this material is not new.

Roughton and Rossi-Bernardi present a new estimate of the pK of simple carbamates, a value needed by scientists concerned with CO_2 chemistry. A fine paper by Michael Caplow on the "Kinetics and mechanism of carbamate formation and breakdown" is also in the second section of the volume. In the final paper on carbamates, Kilmartin and Rossi-Bernardi present data obtained from studies of oxygen equilibrium curves with hemoglobin and three derived hemoglobins that indicate that the α-amino nitrogens of hemoglobin are responsible for binding CO_2 at physiological pH. This is of particular interest, for M. E. Perutz's recent hypothesis (*Nature* **228**, 726 [1970]) suggests that the α-amino groups are also essential for the heme-heme interaction and Bohr effects.

Central in the volume and to all topics discussed is carbonic anhydrase. The papers presented on this enzyme cover x-ray studies, the primary sequence of carbonic anhydrase B and C, the relationship of carbonic anhydrase B to A, the identification of histidine residue (or residues) at the active site, the site of action of inhibitors, two proposals concerning the mechanism of action of the enzyme, and tissue carbonic anhydrases. The discussions here are particularly definitive both as amplification of data and as critical review. The editors have included two papers on plant carbonic anhydrases which were not presented in full at the symposium—a fine addition, for these enzymes appear to differ significantly from the mammalian enzymes.

The final sections on carboxylation reactions and transport of CO_2 in the mammalian body are of the same high caliber as those detailed above.

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