host plant, through the agency of a volatile sex pheromone, or plant odor, does not necessarily mate or feed. Further stimuli, presented in the correct sequence and in the right context, may be necessary before these end results are achieved. Just as aphrodisiacs and courtship behavior may be essential preliminaries to mating, so the texture of a leaf of a food plant and, perhaps, its degree of turgidity may determine whether an insect will feed.

The temptation to exaggerate the practical possibilities of controlling populations of insect pests by manipulating their systems of chemical communication has, by and large, been resisted by those contributing to these volumes. The results obtained so far, often at great expense, have been useful in making surveys but apparently not, with a few possible exceptions, in directly controlling pest insects. The potentialities are so great, however, that work on pheromones, plant attractants, arrestants, repellents, and other such substances should be intensified.

In the immediate future, insecticides will certainly continue to be our mainstay in combatting insect pests, but highly selective insect attractants and repellents will probably have important parts to play in the long-term goal of controlling insect populations effectively, economically, and without harming man or his environment. However, much more detailed information is required, and, as is indicated in these volumes, this can only be obtained by close cooperation between chemists and insect ethologists and physiologists.

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Calcium in Living Systems

Biological Calcification. Cellular and Molecular Aspects. HARALD SCHRAER, Ed. Appleton-Century-Crofts, New York, 1970. x, 462 pp., illus. $24.

Recent contributions to the understanding of biological calcification have come from several disciplines. The diversity of experimental approach and the variety of the material studied have often, and quite naturally, meant that information in one sector is not common knowledge in the field as a whole. The present volume will provide a welcome and useful extension of the lines of communication by bringing together viewpoints of several disciplines and findings on calcification in mammals, invertebrates, plants, and microorganisms. The focus, appropriately specific rather than broad, is on cellular and molecular mechanisms. Since the volume is less than 500 pages in length, some aspects of calcification inevitably receive only brief statement or are omitted altogether. This is apparently by design, for the objective is to provide perspective rather than a compendium. Even so, some will wish for a more complete discussion of such topics as mechanisms of invertebrate calcium deposition, bone formation, and hormonal factors in calcification. Those who are interested in plants and unicellular organisms will appreciate the substantial coverage of calcification in these groups.

The 13 investigators contributing to the volume have provided excellent summaries of research and current thinking on various aspects of calcification. These include the crystallography of bone, the composition and ultrastructure of skeletal structures, calcification of organic matrices, and the physiology of calcium movement. A valuable aspect of the discussions is the attention given to problems that require experimental study. The illustrations in the volume are of uniformly high quality and include a hundred pages of electron micrographs and photographs. The sections on unicellular organisms and plants by F. G. E. Pautard and H. J. Arnott are comprehensive in the inclusion of various aspects of mineral metabolism. I found the style and appreciation of historical perspective of these chapters delightful. R. and H. Schraer give an interesting account, with new data, of the remarkable system of calcification by the hen's shell gland. Nearly one-fourth of the volume is devoted to a chapter on representatives of four invertebrate phyla and bovine enamel, presenting in detail the ultrastructure studies of D. F. Travis and her associates.

It is evident from reading the various presentations that the study of calcification now requires an assessment. A comparison of the differences among various calcification systems as well as of the characteristics they have in common would be most valuable in increasing our understanding of calcification mechanisms.

The bibliographies in the volume are extensive, totaling some 1100 references. Unfortunately, few studies are cited for the two years preceding publication, a circumstance that undoubtedly rests not with the authors but with the extended period in bringing the volume to conclusion.

This book will be helpful as an introduction to specific phases of calcification, and its review of several areas of research provides a breadth of view of this diversified field of study.

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Cyclic Structures

The Chemistry of Inorganic Ring Systems. IONEL HAIDUC. Wiley-Interscience, New York, 1970. Part 1, viii pp. + pp. 1–622, illus.; part 2, vi pp. + pp. 623–1198, illus. Each part, $34.50. Monographs on Chemistry: Inorganic Chemistry Section.

The significant development of research on cyclic inorganic systems that has taken place in the last decade or two has been prompted by both theory and practice—by theory to the extent that the bonding and geometry originally restricted to carbon systems are now recognized as broadly applicable and capable of yielding substances with properties unlike those characteristic of carbon compounds, and by practice to the extent that the demand for new materials with specific properties has intensified investigation of new polymeric systems. Haiduc summarizes this development in an encyclopedic but readable and understandable fashion. His inclusion of an abundance of references to the original literature, many tabulations of numerical data, and thorough indexes provides the reader with a single, invaluable source for most of the information he may need.

The introductory chapter in volume 1 gives the necessary details of classification, nomenclature, molecular structure, bonding, and equilibria essential both to an understanding of inorganic ring systems and to a systematization among the several elements. The ring index in the latter part of volume 2 illustrates a continuity in nomenclature and a correlation with designations used in organic chemistry to describe heterocycles containing carbon atoms. The detailed treatment of particular inorganic ring systems is divided among an all-inclusive chapter on homocyclic systems, a series of extensive chapters treating heterocyclic systems by periodic group of the major element, and a chapter on metal-containing coordination 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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