of N_2 fixation that have been researched. I found the chapters on the N_2-fixing organisms most interesting. One never ceases to be amazed at the various ways in which different biological agents have "solved" the problem of growing in environments where fixed nitrogen is in short supply, and each chapter in this section discusses in detail a different N_2-fixing mechanism.

Particularly helpful to those who wish to enter the field is a chapter on methodology. This chapter not only describes the various methods that can be or are being used to measure and detect dinitrogen fixation, but also presents in an easily followed style many helpful hints and techniques that can save researchers many hours of trial and error. These are clues and pieces of information that tend to be omitted from more formal articles, and without them experiments are difficult to repeat. As an example, the types of tubing or plastics that can be used to hold the biological agent when measuring N_2 fixation are described with respect to their permeability to gases. Such information is extremely valuable, especially if one is using a particularly O_2-sensitive organism.

The chapters dealing with the *Rhizobium*-root-nodule systems, covering such topics as the infection process, morphogenesis, bacteroid formation, leghemoglobin, and ecological requirements, are well done. There is hardly an aspect that has not been covered; the authors not only have done their homework well but have presented the material in an effective way. The comments concerning root nodules also apply to the chapters on blue-green algae in which the requirements to support N_2 fixation are well documented and the fascinating subject of the development of heterocysts is thoroughly discussed. Topics that particularly interested me (possibly because I am less familiar with them) are found in the chapter concerning the associations of blue-green algae with plants such as liverworts, mosses, and ferns and the role of actinomycete-like organisms in root-nodule N_2 fixation.

The chapter on nitrogenase (the enzyme system) presents a good review of the requirements for the various N_2-fixing systems. It is not as detailed and informative as the other chapters, but it need not be, since these topics have all been reviewed extensively elsewhere. The chapter on genetics will be of interest to everyone studying N_2 fixation because it describes the beginnings of what will be a most important field of research that will eventually tell us whether or not we can put the *nif* genes into non-N_2 fixers and make them N_2 fixers.

The only major fault I can find with the book is its price.

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New Uses for Lasers

Chemical and Biochemical Applications of Lasers. Vol. 1. C. BRADLEY MOORE, Ed. Academic Press, New York, 1974. xii, 398 pp., illus. $29.50.

This collection of articles by chemists who have been working with lasers for many years reviews a number of significant applications of lasers in chemical research. The emphasis is on those fundamentally new measurements and experiments that can be achieved by the application of laser sources to chemical problems. The editor intends to present material suitable for the expert as well as the scientist unfamiliar with the subject, and the contributors have for the most part succeeded in doing that. Chapter 1 is devoted to an introductory survey of available lasers, the way that they work, and their special properties as tools for research. In addition, each of the other ten chapters includes an overview of its subject for the nonexpert. Many of the original experimental laser techniques are described with comments on their limitations and capabilities.

For photobiologists and biochemists the book offers chapters on Raman spectra of biological molecules, kinetic studies of rapid solution reactions by the laser temperature jump method, and laser studies of rapid reactions in photosynthesis and vision. Some of the most elegant work done on biological systems is accomplished with picosecond pulsed-laser technology. The variety of laser techniques described may provide powerful ways to probe the structural and kinetic details of living systems.

The dynamics, chemical reactions, and energy transfer of laser-excited molecules are considered as applied to both molecular beams and bulk gas phase processes. The laser is capable of stimulating a number of unusual and selective chemical reactions. Such results provide strong motivation for a more detailed understanding of intra- and intermolecular energy transfer, internal conversion of electronic excitation, intersystem crossing, and predissociation. These subjects are discussed with many examples. It is shown how laser photodetachment studies of negative ions lead to the first reliable determinations of an important thermodynamic property, electron affinities. Optical analogs of pulsed magnetic resonance phenomena provide a new approach to using the coherence of laser sources to probe relaxation and orientation effects of excited states.

Many of the contributors include speculations about future work. It is evident that much of the laser research discussed is still in its infancy, but the book leaves no doubt that lasers have already made tremendous contributions in the study of chemistry.

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Pest Control Chemistry

Organophosphorus Pesticides. Organic and Biological Chemistry. MORIFUSA ETO. CRC Press (Chemical Rubber Co.), Cleveland, 1974. xii, 388 pp., illus. $44.95.

Phosphorus esters have been found to be biologically active not only as insecticides but as acaricides, fungicides, herbicides, nematicides, rodenticides, plant growth regulators, synergists, and insect sterilants. Their importance is related to their high activity and their variety in biological action as well as to their short persistence in the environment. The chemistry and biochemistry, both pure and applied, of these pesticides are of interest to the biologist, the toxicologist, and the environmental scientist, as well as to the synthetic organic chemist.

The first three chapters of this book deal with nomenclature, basic phosphorus chemistry, synthesis, important chemical reactions, and phosphate ester analysis. This section is well organized and expertly and lucidly written. Chapter 4 deals with the biochemistry and metabolism of organophosphorus compounds and with the mode of action, selective toxicity and resistance, interaction with other chemicals, and side effects of organophosphorus insecticides. This chapter is also well organized, but the biochemistry of resistance is only casually reviewed. Chapter 5 is a résumé of important information concerning the

physical constants, toxicity, and use of the commercial and important experimental organophosphate pesticides. The limited information available on the mode of action of pesticides other than insecticides is also described in this chapter. Individual pesticides are presented according to their use and chemical group. If a reader is interested in a specific pesticide and knows the chemical, common, or commercial name, he must consult the subject index in order to locate the information about it in chapter 5.

Eto has thoroughly reviewed the literature through the middle of 1974. This readable book will prove useful for students and other beginners as well as for specialists. It provides over 1000 reference citations and a reasonably good subject index, though it lacks an author index.

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Organolithiums

The Chemistry of Organolithium Compounds. B. J. WAKEFIELD. Pergamon, New York, 1974. x, 336 pp., illus. $22.50.

In the 44 years that have elapsed since the first report of the preparation of an organolithium compound by the reaction of an organic halide with metallic lithium by Ziegler and Colonius, the chemistry of organolithium compounds has developed broadly and in great depth. The organolithium reagents now play an important role in organic and organometallic synthesis. The discovery that they could initiate the polymerization of 1,3-dienes, styrene, and other olefins to give commercially useful materials led several companies to produce a number of alkyllithiums on a large scale. Their commercial availability has greatly accelerated the rate of development of organolithium chemistry, and this field has flourished during the last ten years. As a graphic illustration of this, D. W. Slocum's survey of organolithium chemistry in 1973, soon to be published in the *Journal of Organometallic Chemistry,* covers 347 references. The first such annual survey of organolithium chemistry, written by this reviewer to cover the 1964 literature, cited only 89 references.

The question of structure and bonding has been a fascinating aspect of organolithium chemistry, and the research efforts devoted to these problems have made important general contributions to our knowledge of "electron-deficient" compounds. In view of the importance of organolithium compounds, it is surprising that a book devoted exclusively to them has not been available until now. The 1970 Houben-Weyl volume on organoalkali compounds was devoted mostly to organolithiums, but the constraints of the Houben-Weyl concept restricted the scope of the coverage. Other monographs and review series have had chapters on organolithium compounds, but these have dealt with specific aspects of their structure or chemistry. The book under review thus fills a need, and it will be welcomed by synthetic organic and organometallic chemists.

A summary of a such a vast field (several thousand references) that is restricted to about 270 pages of text, exclusive of reference sections, must of necessity be very concise. The author has succeeded admirably in his stated aim of presenting an account of organolithium chemistry that is comprehensive but not exhaustive. The book is organized into four parts dealing with the constitution of organolithium compounds, their preparation, their use in organic synthesis, and their applications in the synthesis of organometallic compounds of other metals.

The brief chapter on the constitution of organolithiums nicely summarizes what is known about the solid state structures of these compounds, about the nature of organolithium species in hydrocarbon and in donor solvents, and about the configurational stability of organolithiums in solution. The preparative routes to organolithiums are covered well and the discusssions of mechanisms are useful. The longest part of this book is devoted to the use of organolithiums in organic synthesis —additions to multiple bonds, alkylation reactions, and so forth. An excellent chapter discusses organolithium compounds as precursors for reactive intermediates: carbenes, arynes, cycloalkynes and cycloallenes, ylides. The final part presents a good summary, with many examples, of how organolithiums serve in the preparation of organic derivatives of the main group and transition metals. A useful index concludes the book.

This well-organized, well-written, critical survey presents an excellent overview of the field. It is indispensable for all chemistry libraries and will be well worth the price to individuals who wish to become better acquainted with this highly reactive and versatile class of organometallic reagents.

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Nuclear Properties

Nuclear Magnetic Resonance Spectroscopy of Nuclei Other than Protons. T. AXENROD and G. A. WEBB, Eds. Wiley-Interscience, New York, 1974. xvi, 408 pp., illus. $18.95.

This book consists of 25 relatively short chapters, most of which were written to supplement lectures at a NATO Advanced Study Institute held in 1972. The purpose of the institute was to acquaint young research workers with the difficulties of and chemical uses for new techniques that now make possible the routine observation of important nuclei such as ^{2}H, ^{11}B, ^{13}C, ^{15}N, ^{29}Si, and ^{31}P. That purpose seems to have carried through into the book. Thus, the first three chapters, two of which were written quite carefully and lucidly by E. D. Becker, first provide the reader with an introduction to the relevant magnetic and relaxation properties of nuclei other than protons and next introduce him to pulse and Fourier transform methods as applied in NMR (nuclear magnetic resonance) spectroscopy. For the student who might wish to acquire a more detailed mastery of the material, adequate references to available specialized texts are provided.

Following the discussion of experimental methods, several aspects of nitrogen NMR are considered by the editors of the book. In one chapter Webb concisely reviews recent efforts to calculate nitrogen chemical shift values; two later chapters by Axenrod and co-workers treat ^{15}N coupling constants. The structural effects that influence measured ^{15}N-H coupling constant values are presented, and factors that determine ^{15}N-^{15}N spin couplings are discussed. Together, the several chapters on ^{15}N NMR provide a useful summary of the more important information available about that potentially interesting subject.

Several chapters are also devoted to ^{13}C NMR spectroscopy. The chapter