

from the fundamental view point of the methods of preparation. The physical and chemical properties of oxygen are then reviewed, special attention being paid to the reaction with hydrogen. A brief mention of the diamagnetic  $O_4$  molecule reminds us how little we know about this elusive species.

In the third chapter ozone is dealt with in some 20 pages, and hydrogen peroxide is covered in the last chapter, ending with short sections on the controversial superoxides of hydrogen, and the ionic peroxides and superoxides. Most of the references in that chapter concern work done since publication of the ACS Monograph on "Hydrogen Peroxide," in 1955.

The main criticisms which come to mind after reading this book are the rather limited scope and somewhat arbitrary selection of topics. Certainly addition of a review covering recent work on the physics and chemistry of water would have made it of greater interest to a wider audience. Also the fact that it is published two years after it was written detracts somewhat from its timeliness. Of the few misprints spotted here and there, two may be mentioned here. The labeling of the first two excited states of the  $O_2$  molecule in the lowest electronic configuration,  $^1\Sigma_g^+$  and  $^1\Delta_g$ , have been interchanged in Figure 2-7. Then, to render unto Caesar . . . , etc., ref 47 on p 47 should not read N. Bartlett, *et al.*, because the epoch-making discovery of the first stable compound of a rare gas was a single-handed exploit.

The physical presentation is quite good but the price seems rather stiff in view of the small size.

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**Anorganische und Allgemeine Chemie in Einzeldarstellungen. Band VI. Boron-Nitrogen Compounds.** By KURT NIEDENZU and JOHN W. DAWSON, U. S. Army Research Office, Duke University, Durham, N. C. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1965. viii + 175 pp. 16 × 23.5 cm. \$6.75.

The interest and the competence of the two authors of this book on the subject on boron-nitrogen chemistry is unquestioned. They were the prime movers in the sponsorship by the U. S. Army of an international symposium at Duke University in Durham, N. C., April 23-25, 1963. The effect of the stimulus of this meeting upon the field of boron-nitrogen chemistry will be felt during the coming decade.

Their book is an excellent one, developing in a logical sequence in the first three chapters the amine-boranes with the boron-nitrogen dative bond, the aminoboranes, which may be considered formally isosteric with a carbon-carbon double bond, and then the borazines, which as a class has been looked upon as the inorganic analog of benzene. This portion is essentially the heart of the monograph. The remaining three chapters comprise less than one-fifth of the book. They present cyclic boron-nitrogen systems other than borazine, which have until recently received scant attention. This is followed by a chapter on heterocyclic systems containing carbon, boron, and nitrogen, which is good, but not as inclusive as possible. The final chapter presents the physical and chemical nature of boron nitride. Included, as a very useful appendix, is a summarization of the literature on  $^{11}B$  nuclear magnetic resonance spectra of boron-nitrogen compounds.

One of the strong features of the book is the presentation of all points of view in the discussion of various structures, which have been proposed for the reaction product. By so doing, the authors have not editorialized but have presented all the data as completely as possible. Examples of this type of approach are shown when the interaction of trihaloboranes with primary amines is discussed and also in describing the various products derived from the reaction of ammonia with diborane under varying conditions.

Another important aspect of this book, which makes it useful not only from theoretical considerations but for the synthetic chemist as well, is the inclusion of practical procedures for synthesizing some of the representative and key compounds. Such detailed descriptions obviate in part the need for those interested in obtaining a compound from performing a total literature survey. Additionally,

they give the researcher an insight into the practical problems of handling these compounds.

The authors in the preface state that the chemistry of nitrogen derivatives of the higher boron hydrides is to be considered in the realm of boron hydride chemistry. This would certainly seem appropriate. They might have also mentioned that nitrogen-containing aromatic, aliphatic, and heterocyclic boronic acids would be better discussed in a treatise on boronic acids. It would appear from this that the purpose of this book is not to present a total survey of all nitrogen-containing boron compounds but to deal with those compounds where there is an interaction between boron and nitrogen atoms and to discuss the chemical and physical properties of these substances. Special interest centers upon the key boron-nitrogen linkage and the conditions which affect it.

This monograph is highly useful, not only for the specialist interested in boron-nitrogen chemistry *per se*, but also for those individuals who want to obtain an insight into this rapidly expanding field.

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**Advances in Quantum Chemistry. Volume 1.** Edited by PER-OLOV LÖWDIN, Department of Quantum Chemistry, Uppsala University, Uppsala, Sweden, and Quantum Theory Project, University of Florida, Gainesville, Fla. Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1964. 16 × 23.5 cm. 100s.

The time when the properties of molecules and solids can be accurately calculated by quantum mechanics is getting closer. Some of the advances are reported in this volume.

E. A. Hylleraas' pioneering work on helium has long been a landmark. In this volume he describes improvements in his early calculations of two electron systems including the methods of Pekeris and the Sherr-Knight method.

J. C. Slater gives an interesting survey of calculations of the energy bands in solids and shows the progress that has been made with his "Augmented Plane Wave" procedure. The stage has been reached where such calculations can help to guide experimental research in solids. F. A. Matsen outlines some group theory methods which are an alternative to the usual spin theory treatment of electrons in quantum chemistry.

R. Daudel discusses the principal methods of calculating molecular electronic wave functions. Sadhan Basu develops the "Theory of Solvent Effects on Molecular Electronic Spectra." The author uses the Onsager procedure in estimating the effect of dielectric constants on electronic energy levels. Little has been done as yet to calculate the effect of shorter range forces.

P. G. Lykos in his chapter the "Pi Electron Approximation" is concerned with various extensions to Hückel theory. He considers contributions to chemical reactivity, electronic spectra, and magnetic resonance.

Y. L'Haya in his chapter "Recent Developments in the Generalized Huckel Method," besides making a general evaluation of possible methods of approximation, gives calculations on the ethylene molecules in some detail.

G. G. Hall considers the "Accuracy of Calculated Atomic and Molecular Properties." He is concerned with different methods of estimating the accuracy of calculations of various properties. With sufficiently optimized orbitals, interesting calculations for properties can be made for some polyatomic molecules.

J. O. Hirschfelder, W. Byers Brown, and S. T. Epstein outline the recent developments in perturbation theory. They are concerned with exploiting such results as the Hellman-Feynman theorem, expansion of perturbations in powers of the reciprocal of the nuclear charge, and the general condition for convergence of perturbation calculations. They conclude their chapter with an interesting catalog of recent developments.

The book as a whole is a useful report on quantum mechanical advances by leaders in the field. It will be most interesting to those who have had introductory courses in quantum chemistry. Qualified readers should find it instructive and generally helpful.

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