ing modes, respectively. The previously reported complex[10] [Pd(dien)SCN]NO_3 is S-bonded, having a weak absorption at 714 cm.$^{-1}$ in Nujol.

That Pd–NCS bonding occurs in [Pd($(C_2H_5)_4$dien)-NCS]$^+$, rather than Pd–SCN as in the analogous dien complex, appears to be due to the steric hindrance caused by the four ethyl groups. This results from the fact that the steric requirements of M–SCN bonding are greater than for M–NCS. The latter is usually linear whereas M–S–C is angular in M–SCN.[11] Molecular models show that in [Pd($(C_2H_5)_4$dien)NCS]$^+$ the linear Pd–NCS is readily accommodated but that an angular Pd–SCN would experience considerable steric strain.

A small sampling of the effect of ligands on the nature of SCN^- bonding in Pd(II) and Pt(II) complexes is shown in Table I. Starting with the fact that these metal ions are of the class b type and give M–SCN, it is of interest to consider the properties of the ligands that promote M–NCS bonding. The electronic properties of the ligand have been discussed in terms of a good π-bonding ligand tending to promote M–NCS bonding.[6] This seems adequate for compounds **2**, **4**, **6**, and **8** but cannot account for **10**. Since $(C_2H_5)_4$-dien does not π-bond, steric factors are perhaps the controlling feature in this complex. This suggests that steric factors may also contribute to the M–NCS bonding in the other systems as well. It is difficult to assess the contributions of electronic and steric factors in the compounds **2**, **4**, and **6** relative to **1**, **3**, and **5**, respectively, but it should be noted that both factors operate in the same direction. Because of the large size of Sb the three phenyl groups are further removed from Pd(II) in **5** than **6**, which means that the steric effect of $Sb(C_6H_5)_3$ is smaller than that of $P(C_6H_5)_3$. The steric factors at Pd(II) for **7** and **8** are identical. This shows that electronic effects are important and suggests that small effects are often all that is required to alter the nature of SCN^- bonding in these systems.

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[10] F. Basolo, H. B. Gray, and R. G. Pearson, *J. Am. Chem. Soc.*, **82**, 4200 (1960).

[11] J. Lewis, R. S. Nyholm, and P. W. Smith, *J. Chem. Soc.*, 4590 (1961). Large bond angles for M–N–C of about 160° are known for some M–NCS systems in the solid state.

Book Reviews

Magnetism, A Treatise on Modern Theory and Materials. Volume III. By GEORGE T. RADO and HARRY SUHL. Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. 1963. xv + 623 pp. 15 × 22 cm. Price, $18.00.

This is the first published volume of a three-volume series which claims to present a comprehensive summary of the present knowledge of magnetically concentrated materials. The series is written essentially for readers with a background of chemical physics, but certain sections must bring themselves to the attention of many inorganic chemists. The materials in which magnetic exchange interactions are important are mostly the alloys and the binary and ternary compounds of the transition elements.

The most pertinent chapter from the present point of view is that by J. B. Goodenough. To a certain extent, this chapter is a condensation of that author's recent book "Magnetism and the Chemical Bond" (Interscience, 1962). Here the structural features of the oxides, simple and mixed, and the halides and some other salts of the transition elements are outlined. The description of the anion packing in spinels, perovskites, garnets, etc., is quite lucidly presented. There follows a brief and rather cryptic account of parts of the theory of atomic spectroscopy, magnetic exchange interaction, and ligand field theory. While some space devoted to defining concepts is valuable, the attempt to deal with these complex subjects in a few pages is pointless. The chapter then proceeds to describe the relationship between structural features and exchange interaction propagated by "superexchange." It is shown that the symmetry of orbital overlap predicted by ligand field theory in many cases provides the basis for superexchange coupling between magnetic ions. The relationship between the Jahn–Teller effect and the lowering of symmetry in magnetically ordered materials is brought out.

The chapter by J. S. Smart, on the evaluation of exchange integrals from experimental data, also is of some interest to an inorganic chemist. This is largely because the author deals with magnetic interactions which occur in small polymeric molecules as well as those in the more conventional "lattice" type antiferromagnetics. The exchange in $Cu_2(CH_3COO)_4 \cdot 2H_2O$ and the trimeric iron and chromium basic substituted carboxylates, for instance, is discussed. Also, exchange in systems in which the magnetic interactions are reduced by isomorphous dilution is described. Attention is drawn to the evaluation of both the "nearest neighbor" and "next nearest neighbor" exchange integrals in the more complicated systems.

The final chapter concerns the preparation of magnetically concentrated materials, mainly of the mixed oxide type. The effect of sintering on the magnetic properties is outlined. Of somewhat more interest are descriptions of methods for obtaining single crystal specimens. Flame fusion and hydrothermal synthesis techniques and results are discussed. However, most of this material is available in more extensive form in recent reviews on synthetic gemstone materials.

The remainder of the book is directed essentially at the physics of the subject. Topics include exchange in small particles and thin films, domain theory, and neutron scattering.

The book is generally well presented, and a good balance between the styles of the contributors has been maintained by the editors. Errors are not numerous, but some indicate a rather hasty preparation of manuscripts. On p. 51, there is reference to the location of oxygen positions in MnF_3. Figure 7 (p. 78) contains a reference to eq. 5, which apparently pertains to the source of the figure, rather than the present book.

To sum up, the book is likely to be of importance only to chemists interested in the solid state or in magnetochemistry at a sophisticated level.

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Advances in Inorganic Chemistry and Radiochemistry. Volume 5. Edited by H. J. Emeléus and A. G. Sharpe. Academic Press Inc., New York, N. Y. 1963. ix + 429 pp. 16 × 23.5 cm. Price, $14.50.

Each of the preceding volumes of this series contains several chapters of considerable interest to me, and now I eagerly look forward to examining each new volume in much the same way that I look forward to reading each new issue of *Inorganic Chemistry*. I have not been disappointed by this volume.

R. S. Nyholm and M. L. Tobe have written a short chapter on "The Stabilization of Oxidation States of the Transition Metals" in which about one-third of the space is spent on rather elementary considerations of energetics. A chapter by M. Schmeisser and K. Brändle rather thoroughly covers the chemistry and properties of "Oxides and Oxyfluorides of the Halogens." N. N. Greenwood reviews "The Chemistry of Gallium," particularly emphasizing low oxidation states, semiconducting binary compounds, structures, and organo compounds. I. G. Campbell has written on "Chemical Effects of Nuclear Activation in Gases and Liquids"; both bond rupture and bond formation (resulting from nuclear transformations) are discussed. O. Glemser and H. G. Wendlandt discuss "Gaseous Hydroxides"; most of this chapter is devoted to high-temperature studies of metallic hydroxides. E. K. Mellon and J. J. Lagowski have comprehensively summarized the chemistry and physical properties of "The Borazines." M. F. Hawthorne discusses a rapidly moving field: the chemistry of "Decaborane-14 and its Derivatives." R. F. Hudson correlates "The Structure and Reactivity of Organophosphorus Compounds."

Many chemists will want this volume on their bookshelves; all chemistry libraries should subscribe to the series.

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Technique of Inorganic Chemistry. Edited by H. B. Jonassen and A. Weissberger. Volume 2. **Nuclear Chemistry.** By Noah R. Johnson, Eugene Eichler, and G. Davis O'Kelley. John Wiley and Sons, Inc., Interscience Division, 605 Third Ave., New York 16, N. Y. 1963. xiv + 202 pp. 16 × 23 cm. Price, $8.00.

"Nuclear Chemistry" was written by three knowledgeable Oak Ridge scientists "principally for the student and research worker with little or no previous radioisotope experience." It is nonetheless true that, as anticipated by the authors, much of the information is of interest and value to experienced nuclear chemists. In particular, this book is designed to acquaint persons interested in using isotopes with the methods of the nuclear chemist, whose concern is the properties of the nuclei themselves. Experimental procedure, and especially modern innovations, are emphasized and are accompanied by sufficient discussion of underlying principles, plus mention of associated topics of interest. The authors have succeeded well; by careful study of this book, an experienced scientist can indeed equip himself adequately to select suitable isotopes for use as tracers, etc., and choose methods for their production and detection.

The nature of radioactive decay is taken up first, with stress on lifetime consideration, decay modes, and decay schemes. This section is logically followed by a discussion of the interactions of radiations with matter. Attention is then given to methods of producing and separating isotopes. Finally, a major portion of the book is devoted to the critical topic of detection and measurement of radioactivity and the associated problems of source preparation. "Nuclear Chemistry" was not intended as a textbook so no problem sets are included.

A really outstanding feature of the book is its bibliography, a careful screening of the voluminous material on the subject, but comprehensive to the purpose at hand. The practical aspects of radiation detection are especially well presented. The section on isotope production provides a clear view of how to select a suitable reaction to produce the isotope of interest, and the descriptions of special techniques and abnormal behavior associated with the production and chemistry of carrier-free radioelements furnishes adequate warning of the experimental pitfalls to be expected.

Any criticisms are minor. The person for whom this book was designed would undoubtedly have benefited from a brief discussion of counting statistics and their limits on the accuracy of experimental results. He might also have profited from a few more two-sentence hints about potential applications of nuclear phenomena, as was done for the Mössbauer effect, since the necessary groundwork was laid. The section on positrons seems to imply that a nucleus must muster a minimum energy of twice the electron mass, in accordance with Dirac theory, for β^+ decay to be possible, whereas the factor of $2m_0c^2$ is a result of basing energy calculations on atomic rather than nuclear masses. And finally, it's tough to have to pay $8.00 for a 202-page book, albeit such a very good one.

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Compound Semiconductors. Volume I. Preparation of III–V Compounds. Edited by Robert K. Willardson and Harvey L. Goering. Reinhold Publishing Corporation, 430 Park Ave., New York 22, N. Y. 1963. xxii + 553 pp. 17 × 25 cm. Price, $25.00.

A chemistry book that costs 5¢ per page, when the standard rate runs about 2 to 3¢, must really be saying something worthwhile. This is a slick job, a work of art, evoking the Italian connoisseur edition of "Tutankhamen." When confronted with it, the ordinary chemist, the one without a fur-lined pocketbook, is likely to feel a sense of indignation. What are these publishers up to? Do they think we are made of money? Why should I buy *that*?

Aye, there's the rub! Because we need it. There is nothing quite like it and, once you get past the whopping price tag, you find a gold mine of original material on the structure, preparation, and properties of the III–V materials. It's all there: the design for a liquid helium resistivity probe with 0.013-in. wall 0.25-in. stainless steel tubing with four wireleads wrapped with Teflon and tape; the beautiful half-tone cut showing claw growth from poor seeds of GaAs; the 1:3 H_2O_2:tartaric acid recipe for an etchant for InSb with rate 0.05; 1172 items of a III–V bibliography; etc. The only thing that's missing is the advertising, which even our beloved *Inorganic Chemistry* accepts as a way to cut costs.

Over 60 authors have contributed to this work, in many cases reviewing areas in which they themselves have made notable research contributions. These areas have been grouped in ten sections; crystal structure and bonding, purification of the elements, detection of impurities, preparation of compounds, single crystal growth, thin films, diffusion, segregation, surfaces, and thermodynamic properties. Each of these sections is in turn composed of several independent articles, wherein each author cov-