

reference cited disproves. There is also a certain lack of critical judgment in some places where it appears called for. As an example, in discussing dinitrogen difluoride (p. 102), the statement is made that it exists as *trans*-1,2-difluorodiazine and 1,1-difluorodiazine. It is further stated that (reference cited). . . "has confirmed these structure by infrared spectra." Granted that N_2F_2 is a simple compound; the use of the word "confirmed" nevertheless reveals, in the reviewer's opinion, an overly sanguine view of what can generally be accomplished with infrared methods. It is worth noting that recent microwave spectral and electron diffraction studies strongly indicate that the second N_2F_2 isomer is *cis*-1,2-difluorodiazine.

Part IV of the book consists of appendices: character tables, *F* and *G* matrix elements for simple molecular types, an outline of a normal coordinate analysis of metal acetylacetonates, a wave length to wave number conversion table, and group frequency correlation charts.

Despite whatever critical comments I have felt compelled to make, I do feel that Nakamoto has written an excellent book which deserves wide use. An abundance of tables and diagrams adds greatly to the book's utility as a reference source. Any chemist who makes use of infrared spectroscopy will find this volume a valuable addition to his bookshelf.

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THEODORE L. BROWN

Inorganic Syntheses. Volume VII. Edited by JACOB KLEINBERG. Inorganic Syntheses Series, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1963. xi + 253 pp. 15 × 23.5 cm. Price, \$8.95.

"Inorganic Syntheses," Volume VII, contains 65 independently tested and checked preparations. Only ten of these represent alternative procedures for preparing compounds previously listed in earlier volumes of the series. The editor appears to have maintained the high standards set by his predecessors. Format and general organization employed in previous volumes have been retained. Chapter headings are the Mendeleev periodic subgroups. The placement of compounds in chapters is determined by the principal element in the compound. Author, formula, and subject indexes are cumulative. A total of 454 syntheses are listed for the entire series.

While the transition metals are represented predominantly by classical complexes in Volume VII, preparations are also given for some cyclopentadienyl carbonyls and their derivatives, triiron dodecacarbonyl, and sodium salts of carbonyl hydrides. Of the representative elements noteworthy preparations of compounds of gallium, indium, silicon, germanium, phosphorus, and sulfur are listed. Syntheses of isotopically labeled Na_2S^{36} , S^{36} , NaF^{18} , H^2Cl^{36} , $SOCl_2^{36}$, $SiCl_4^{36}$, BCl_3^{36} , $GeCl_4^{36}$, PCl_3^{36} , $Fe^{55,59}$, $(C_2H_5)_2$, and $Fe^{55,59}(C_2H_5)_2^+$ are given also.

Volume VII represents a useful addition to the "Inorganic Syntheses" series.

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SHELDON G. SHORE

Solubility Constants of Metal Oxides, Metal Hydroxides and Metal Hydroxide Salts in Aqueous Solution. Edited by W. FEITKNECHT and P. SCHINDLER. International Union of Pure and Applied Chemistry. Butterworths, London, England, 1963. v + 69 pp. 15.5 × 24.5 cm. Price, \$2.25.

Several years ago a project was undertaken by a Subcommittee of the Analytical Section of I.U.P.A.C. to compile literature data on solubility products of inorganic substances and stability constants of metal ion complexes.

The present monograph is an extension of this work. The critical survey of solubility data in aqueous solution of metal oxides, metal hydroxides, and metal hydroxide salts includes the following members of the periodic table: Be, Mg, Ca; Sc, Y, and the rare earths; Ti, Zr, Hf, Th; Cr, Mn, Fe, Co, Ni; Cu, Ag, Au; Zn, Cd, Hg; Al, Ga, In, Tl; Sn and Pb. In several cases where the substance exists in more than one form, solubility data are given for each form. In some cases, also, data are given for more than one oxidation state of the metal. The monograph should be quite useful not only as a reference for solubility data, but also in setting a pattern for reporting such data.

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MILTON TAMRES

Nonstoichiometric Compounds. *Advances in Chemistry Series, No. 39.* ROLAND WARD, Symposium Chairman. American Chemical Society, 1155 Sixteenth Street, N.W., Washington 6, D. C., 1963. vii + 253 pp. 15.5 × 23.5 cm. Price, \$7.00.

This volume is a collection of papers presented at the symposium on nonstoichiometric compounds sponsored by the Division of Inorganic Chemistry at the American Chemical Society meeting in March, 1962, at Washington, D. C. All of the papers, including review papers by A. D. Wadsley, G. G. Libowitz, J. S. Prener, and M. J. Sienko, were invited. In addition, J. S. Anderson contributed a more general survey on "Current Problems in Nonstoichiometry" as the introductory paper. Twenty-three papers, ranging in length from six to fourteen pages, comprise the volume.

A wide range of phenomena and structural concepts can be included under the heading of nonstoichiometric compounds, and a good sampling of this variety is found in this symposium. Anderson's opening paper deals with the problems associated with a thermodynamic treatment of defect structures. Wadsley's paper on the metallic oxides points out relationships between the crystal structures of some nonstoichiometric phases and the structures of chemically similar substances of fixed composition in which the different phases are ordered and identifiable. In a paper on the metal hydrides, Libowitz describes an attempt to interrelate the interaction energy of hydrogen vacancies, the hydrogen content, and the equilibrium pressure of hydrogen above a hydride. Prener takes up the chalcogenides and outlines a statistical thermodynamic theory for predicting the equilibrium concentration of lattice defects. His paper includes a review of crystal structure data on the chalcogenides. Sienko's paper is primarily devoted to the transport and magnetic properties of the tungsten and vanadium bronzes, and these properties are discussed in terms of a band model. Each of these review papers provides an excellent summary of the current situation in the particular area of nonstoichiometric compounds. Shorter but equally authoritative reviews are contributed by L. Kihlborg on molybdenum oxides, by L. E. J. Roberts on fluorite-type oxides, and T. R. P. Gibb on metal hydride models. The remaining fifteen papers, of a total of 23, report new research results.

The value of such a collection of symposium papers may be questioned on several counts, none of which relates to the nature or quality of the papers themselves. First of all, for whom are such publications intended? This volume, and several others in the *Advances in Chemistry* series, strike me as being too advanced and parochial to serve as a good introduction or survey for one just entering the field or for the casual seeker of information. On the other hand, a person active in this particular area of inorganic chemistry finds that the time lapse between the symposium and the publication of the papers, over a year in this case, makes the volume of relatively minor use. Happily, some of the authors have compensated somewhat for the delay by including later information and by making revisions on the basis of the discussions at the symposium.

My second complaint is that volumes in this series are much too expensive. This one, at seven dollars, is simply not worth the price to either experts or neophytes in the field. I question whether it is worthwhile to make such an elaborate production of a symposium volume. Even though paper-bound, this one is handsomely set in type and printed on coated paper. Could production time be saved and prices reduced by using photo-offset or some similar method of reproduction? Symposium collections are most valuable when published as rapidly and cheaply as possible.

Finally, I would point out that more than one-third of the papers in this symposium are reports of new research results, rather than being reviews or surveys of some aspect of the symposium topic. While one can defend the practice of including such papers in a symposium, I feel that their *publication* is more appropriate in the regular journals.

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Progress in Inorganic Chemistry. Volume 5. Edited by F. A. COTTON. Interscience Publishers, Division of John Wiley and Sons, Inc., New York, N. Y., 1963. 464 pp. 15 × 2.23 cm. Price, \$14.00.

Discussed in this volume are four topics: dinitrogen trioxide by I. R. Beattie, phosphines by L. Maier, polarography of coordination compounds by A. A. Vlček, and the coupling of vibrational and electronic motions in molecules (part III) by A. D. Liehr.

Beattie's chapter on dinitrogen trioxide is a 26-page review of the history, preparation, and physical properties of this substance. Included is an interesting account of how several early investigators were led to suppose that nitric oxide and nitrogen (IV) oxide do not react with each other because on mixing the two gases there occurred no change in pressure. It is stated that the only reliable preparation of an equimolar mixture of nitric oxide and nitrogen(IV) oxide involves mixing nitric oxide with a calculated quantity of dry nitrogen(IV) oxide or oxygen. Several methods for obtaining pure nitric oxide are given; not listed is perhaps one of the simplest methods: passing tank nitric oxide through narrow-annular traps cooled to -140° . The questionable " π -only" description of the nitrogen-nitrogen bond in dinitrogen trioxide is given. Physical properties discussed include the equilibrium constant for the reaction $N_2O_3 \rightleftharpoons NO + NO_2$, freezing point and vapor pressure data, infrared and raman spectra, ultraviolet spectra, and thermodynamic functions at 25° .

Maier's long, 167-page chapter on phosphines is a well-organized, thorough review of the literature from 1950 through March, 1962, on the preparation and reactions of primary, secondary, and tertiary phosphines. Included are extensive tables listing methods of preparation and physical properties (melting points and boiling points, refractive indices, and densities). To the reviewer's surprise, the greater nucleophilicity of phosphines compared to amines is attributed to mainly steric effects in the amines. On the whole the author succeeds in presenting in an efficient and readable manner a large body of information. The chapter is documented by over 500 references, many to the foreign literature.

Vlček's 168-page chapter on the polarographic behavior of coordination compounds is an interesting blend of facts, experimental methods, and theory. The imagination, vigor, and thoroughness with which workers in this field have pursued an obviously complex phenomenon are presented in considerable detail. Not infrequently the discussion assumes a knowledge of the special theory and techniques of polarography greater than that possessed by the reviewer (not much!). Happily, there are included a generous number of illustrative examples, many of

which may interest a broad spectrum of inorganic chemists. Section headings are: Electrode Behavior of Metal Complexes, Mechanism of the Electrode Reaction, Type of Experimental Information, The Electrode Reaction Proper, Reactions Preceding Electrode Reaction Proper, Products of Electrode Reactions, Relations between the Structure and Electrode Behavior of Complexes. Probably the section of most general interest is the last section. There the author discusses how polarography can contribute to our understanding of chemical bonding by determining through a systematic study of the effects of structural changes on the polarographic behavior of complex compounds the "localization of electron changes."

Liehr in a 43-page chapter continues his now-often seen, but for this no less remarkable treatment of the potential energy surfaces of molecular systems of assumed high symmetry. Molecules are classified into groups according to the number of identical nuclei they contain and to each group is assigned the highest possible nuclear symmetry, irrespective of the number of valence-shell electron pairs present in the member molecules. Under "Trigonal Molecules," for example, are listed H_3 , C_3 , O_3 , and I_3^- ; under "Tetragonal," H_4 , C_4 , P_4 , ICl_4^- , and $PtCl_4^{-2}$. "It is to be emphasized," the author states in a parenthetical passage, "that all our discussion has been based on permutational symmetry principles alone, and not on any particular mode of chemical bonding. Therefore, our results are perfectly general and in no ways approximate." But, just between us chemists, what can we do with these results? Very little. The author's excursions from the actual equilibrium configurations of molecules are usually so great that it is impossible to obtain reliable numerical values for the parameters in his theory. Nature, he concludes at one point, is innately perverse.

This volume will probably find its chief use among chemists interested in either phosphines or the polarography of coordination compounds. It contains a cumulative index for Volumes 1-5.

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BOOKS RECEIVED

December, 1963

- HANS B. JONASSEN and ARNOLD WEISSBERGER. "Technique of Inorganic Chemistry." Volume I. John Wiley and Sons, Inc., 605 Third Avenue, New York 16, N. Y. 1963. vii + 268 pp. \$9.50.
- HANS B. JONASSEN and ARNOLD WEISSBERGER. "Technique of Inorganic Chemistry." Volume III. John Wiley and Sons, Inc., 605 Third Avenue, New York 16, N. Y. 1963. vii + 345 pp. \$11.50.
- GEORGE A. OLAH. "Friedel-Crafts and Related Reactions" Volume I. "General Aspects." John Wiley and Sons, Inc., 605 Third Avenue, New York 16, N. Y. xxxiv + 1031 pp. \$29.50.
- E. CARTMELL and G. W. A. FOWLES. "Valency and Molecular Structure." Butterworths, Inc., 7235 Wisconsin Avenue. Washington, D. C. 1961. xii + 294 pp. \$7.00.
- ROGER LAURENCE WILKINS. "Theoretical Evaluation of Chemical Propellants." Prentice-Hall, Inc., Englewood Cliffs, N. J. 1963. xiv + 463. \$15.00.
- FREDERICK A. LOWENHEIM. "Modern Electroplating." Second Edition. John Wiley and Sons, Inc., 605 Third Avenue, New York 16, N. Y. 1963. xvi + 769 pp. \$16.00.
- CARSON D. JEFFRIES. "Dynamic Nuclear Orientation." Interscience Tracts on Physics and Astronomy, No. 23. Interscience Publishers, Division of John Wiley and Sons, Inc., 605 Third Avenue, New York 16, N. Y. 1963. vii + 177 pp. \$5.95.