graphic behavior of the synthetic and isolated substances were identical. Tests of the biological activity of synthetic kinetin are in progress.[11]

(11) NOTE ADDED IN PROOF.—The biological activity of synthetic kinetin now has been found to be the same as that of the isolated substance in tests on tobacco tissues.

CONTRIBUTION FROM THE DEPARTMENT OF BOTANY
DEPARTMENT OF BIOCHEMISTRY
UNIVERSITY OF WISCONSIN
MADISON, WISCONSIN
CARLOS O. MILLER
FOLKE SKOOG
FRANCIS SHIGEO OKUMURA
MALCOLM H. VON SALTZA
F. M. STRONG

RECEIVED MARCH 30, 1955

SELF-EXCHANGE OF BORON IN BORON HYDRIDES

Sir:

The considerable interest in the reaction kinetics[1–3] and in the structures of the boron hydrides[4] has prompted us to investigate the self-exchange of boron in various boron hydrides.

We have found that the exchange of boron between isotopically-normal diborane and B^{10}-enriched diborane is quite rapid at 25°, the rate being similar in magnitude to that observed for the deuterium exchange between diborane and hexadeuteriodiborane.[3] In contrast, we have found that no boron exchange occurs between isotopically-normal pentaborane and B^{10}-enriched pentaborane at temperatures up to 100° in the liquid phase or up to 250° in the gas phase. At the latter temperature the pentaborane undergoes considerable decomposition to give hydrogen and non-volatile solids (no volatile boron hydrides could be detected). It should be noted that hydrogen exchange between deuteropentaborane and pentaborane has been observed at 200°, but not at room temperature. The reactions have been followed by mass spectrometric analysis.[5] B^{10}-enriched diborane is prepared from $B^{10}F_3$[6] in the conventional manner[7] and B^{10}-enriched pentaborane is obtained by pyrolysis of the diborane.[8]

The rapid exchange of boron in diborane is consistent with the accepted diborane structure of two borines held together by two bridge hydrogens[9] and with the widely accepted reaction mechanism involving diborane dissociation.[1–3] It is interesting that pentaborane, with a pyramidal structure[10] involving direct B–B linkages, does not undergo boron exchange even under conditions which bring about copious decomposition. It is concluded that dissociation fragments do not exist in pentaborane under ambient conditions. However, the hydrogen atoms appear to be sufficiently labile at elevated temperatures for self-exchange.

This study of the self-exchange of boron, as well as that of hydrogen, is being extended to cover all known boron hydrides.

(1) R. P. Clarke and R. N. Pease, THIS JOURNAL, **73**, 2132 (1951); J. K. Bragg, L. V. McCarty and F. J. Norton, *ibid.*, **73**, 2134 (1951).

(2) S. H. Bauer, A. Shepp and R. E. McCoy, *ibid.*, **75**, 1003 (1953); H. G. Weiss and I. Shapiro, *ibid.*, **75**, 1221 (1953); A. T. Whatley and R. N. Pease, *ibid.*, **76**, 1997 (1954).

(3) P. C. Maybury and W. S. Koski, *J. Chem. Phys.*, **21**, 742 (1953).

(4) W. H. Eberhardt, B. Crawford, Jr., and W. N. Lipscomb, *J. Chem. Phys.*, **22**, 989 (1954); J. R. Platt, *ibid.*, **22**, 1033 (1954).

(5) A Consolidated model 21-103 mass spectrometer operating at 70 volts was used in this study.

(6) The $CaF_2 \cdot B^{10}F_3$ complex, obtained by allocation from the Atomic Energy Commission, Oak Ridge, Tenn., is heated to 250° *in vacuo* to release $B^{10}F_3$, which is then condensed in anhydrous ethyl ether.

(7) I. Shapiro, H. G. Weiss, M. Schmich, S. Skolnik and G. B. L. Smith, THIS JOURNAL, **74**, 901 (1952).

(8) A. B. Burg and H. I. Schlesinger, *ibid.*, **55**, 4009 (1933).

(9) W. C. Price, *J. Chem. Phys.*, **16**, 894 (1948); **15** 614 (1947).

(10) W. J. Dulmage and W. N. Lipscomb, THIS JOURNAL, **73**, 3539 (1951); K. Hedberg, M. E. Jones and V. Schomaker, *ibid.*, **73**, 3538 (1951).

RESEARCH LABORATORY
OLIN MATHIESON CHEMICAL CORPORATION
PASADENA 1, CALIFORNIA
I. SHAPIRO
B. KEILIN

RECEIVED APRIL 2, 1955

BOOK REVIEWS

Comprehensive Inorganic Chemistry. Volume Three. The Halogens. By ROBERT C. BRASTED, Associate Professor of Chemistry, School of Chemistry, University of Minnesota. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. 1954. x + 250 pp. 16 × 24 cm. Price, $5.00.

One who examines this book may wonder just what group of readers the author is addressing. The answer is to be found in the preface which says: "Comprehensive Inorganic Chemistry is an eleven-volume reference work on the chemical elements and their inorganic compounds. It is comprehensive in the extensiveness of the fields covered rather than in the fullness of their treatment; hence, the volumes are offered individually as a ***vade mecum*** for the advanced worker—whether industrial or academic—not as an encyclopedic work. Their purpose, therefore, is to serve as a ready reference to those engaged in chemical manufacture and development and to those in advanced studies in chemistry in institutions of higher learning. . . ."

An advanced worker in inorganic halogen chemistry will be particularly interested in those portions of the book dealing with his own areas of specialization, because the point of view of the writer probably will differ from his own. He may not always agree with the author, but he probably will see new problems for research.

The author has read extensively in the recent literature on the halogens and has organized the subject matter under headings indicated by the chapter titles: (1) Fluorine, (2) Chlorine, (3) Bromine, (4) Iodine, (5) Astatine, (6) The Hydrohalides, (7) Oxycompounds of the Halogens, (8) Positive Halogens, Interhalogens and Polyhalide Anionic Complexes, (9) The Pseudohalogens (Halogenoids) and Related Compounds. Chapters 1–5 inclusive deal largely with the preparation and properties of the free elements and include discussions of many compounds with particular emphasis upon fluorides. Only a little information is given about astatine. To this reviewer the most interesting chapter is that on the oxycompounds. This is an up-to-date summary with some emphasis upon mechanism of reactions.

The book is not a text and it is not a complete reference book to the literature; it is, instead, a book on certain aspects of halogen chemistry of active interest. Even on these topics it is not a complete survey of the literature.

On the whole the book is good; however, it is not perfect. Some parts of it are so brief that they are difficult to under-