The results for the other metals are more or less alike, but these are not given to save space. Table II shows that the ligand vibrations (NH_3 stretching and deformation vibrations) are pure vibrational modes corresponding to the symmetry coordinates. The Co–N stretching and NCoN deformation modes (ν_6 and ν_7) are coupled with each other moderately but they are not coupled with the ligand vibrations. When we look at the results of Table I, NH_3 rocking frequencies change considerably with metal ions. This arises mainly from the change of the angle deformation force constants *H*(HNM), which are also listed in Table I, but not from the coupling of NH_3 rocking and M–N stretching modes.

TABLE II

PER CENT POTENTIAL ENERGY DISTRIBUTIONS (PED) FOR $[Co(NH_3)_6]^{3+}$ (F_{1u} SPECIES)[a]

Symmetry coordinates	ν_1	ν_2	ν_3	ν_4	ν_5	ν_6	ν_7
S_1 NH_3 asym. str.	100						
S_2 NH_3 sym. str.		100		1−			
S_3 NH_3 deg. def.			94+		5−		
S_4 NH_3 sym. def.				100+			
S_5 NH_3 rocking			3+		90+	5−	2+
S_6 M–N str.					1+	71+	28+
S_7 NMN def.					7−	29−	64+

[a] Only the relative signs for the L-matrix are given.

With regard to the Co–X stretching mode of the halogenoammine complexes, we should revise our previous assignment, as Watt and Klett pointed out. The far-infrared spectrum of $[CoCl_2(NH_3)_4]^+$ is shown in Fig. 1, compared with $[CoCl_2(en)_2]^+$. By this comparison we can reasonably assign the sharp band at 353 cm.$^{-1}$ to the Co–Cl stretching mode. The observed and calculated frequencies are shown in Table III. The broad strong band at 290 cm.$^{-1}$ of similar feature to the 325 cm.$^{-1}$ band of $[Co(NH_3)_6]^{3+}$ is assigned to NCoN deformation vibration of E_u species. The calculated value of this vibration by using the same value of the force constant *H*(NMN) is in good agreement with the observed value. In $[CoCl_2(en)_2]^+$, the broad band near 290 cm.$^{-1}$ is assigned to the skeletal deformation mode similar to that for $[CoCl_2(NH_3)_4]^+$, which is also supported by a normal coordinate analysis.[5] If we assign the 290 cm.$^{-1}$ band to a Co–Cl stretching mode, we should assign the 353 cm.$^{-1}$ band to a NCoN deformation mode. This is unreasonable, because the band feature is quite different from the NCoN vibration band for $[Co(NH_3)_6]^{3+}$, and also the observed frequency deviates from the calculated one. *K*(Co–N) is assumed to be the same as in $[Co(NH_3)_6]^{3+}$ and *K*(Co–Cl) is calculated to be .00 mdyne/1Å. A normal coordinate analysis has also been done for $[CoX(NH_3)_5]^{2+}$. For $[CoCl(NH_3)_5]^{2+}$, the 457 cm.$^{-1}$ band is assigned to the antiphase (Co–N, Co–Cl) stretching mode of A_1 species and the doublet (487 and 479 cm.$^{-1}$) is assigned to the Co–N stretching mode of E species.

TABLE III

OBSERVED AND CALCULATED FREQUENCIES OF $[CoCl_2(NH_3)_4]^+$

$[D_{4h}]$		Calcd.	Obsd.	Vib. mode
A_{2u}	ν_1	3239	3253	$\nu(NH)_a$
	ν_2	1616	1585	$\delta(NH_3)_d$
	ν_3	829	815	$\delta(NH_3)_r$
	ν_4	347	353	$\nu(MX)$
	ν_5	186	186	$\delta(NMX)$
E_u	ν_6	3240	3252	$\nu(NH)_a$
	ν_7	3164	3161	$\nu(NH)_s$
	ν_8	1617	1585	$\delta(NH_3)_d$
	ν_9	1339	1300	$\delta(NH_3)_s$
	ν_{10}	833	815	$\delta(NH_3)_r$
	ν_{11}	485	501	$\nu(MN)$
	ν_{12}	311	290	$\delta(NMN)$
	ν_{13}	127	(167)	$\delta(NMX)$

(5) I. Nakagawa and T. Shimanouchi, to be published (Eighth International Conference on Coordination Chemistry, Vienna, 1964).

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Book Review

Organoboron Chemistry. Volume 1. Boron–Oxygen and Boron–Sulfur Compounds. By HOWARD STEINBERG. Interscience Publishers, John Wiley and Sons, Inc., New York, N. Y. 1964. xxxii + 950 pp. 16 × 23.5 cm. Price, $33.

This book, which is one of three volumes planned by Dr. Steinberg, deals with organic compounds having boron–oxygen and boron–sulfur linkages. The next two volumes will deal with boron–nitrogen, boron–phosphorus, and boron–carbon compounds. The arrangement of material follows a detailed outline; the same outline is given in the Table of Contents (which alone encompasses 24 pages!). The research results reported in over a thousand publications are mentioned. There are 21 chapters and each is ended with a list of references and of compounds (including what physical properties are available). For example, Chapter 15, which deals with "Coordination Compounds Derived from Polyhydric Alcohols and Phenols," has about 55 pages of text, 45 pages of tables, and 169 references.

This book clearly demonstrates the large amount of available qualitative data on boron–oxygen compounds containing organic groups. Unfortunately the available amount of quantitative data, such as structures, rates, and equilibrium constants, lags far behind. The material in Chapter 21 ("Hydrolytic Stability") exemplifies the type of data that we need more of.

The author has done a monumental (and, I believe, successful) job in bringing together the data on these compounds into one volume, and the resulting encyclopedic nature is useful to those interested in this field. Nevertheless, the strengths of the book are also the weaknesses; for example, several types of synthetic methods for the preparation of a class of compounds are listed, yet rarely does the reader get any feel for the preferred method.

Also, since the approach is more typical of the organic chemists, one wishes for the unifying concepts of the physical chemists or for carry-over of the new structural data on inorganic boron–oxygen compounds. To some extent, this is not the fault of the author, but rather it stems from the lack of appropriate data in the journal and patent literature.

In many cases, Dr. Steinberg has tried to make a distinction between what is speculation and what is proven in the literature and in general this reviewer agrees with his conclusions. The number of typographical and scientific errors is very small for a book of this size.

The book is one which should be available in chemical libraries, since its primary usefulness will be for reference purposes. Only a few chemists will need it for their personal collection of books.

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BOOKS RECEIVED

October, 1964

H. Eyring, Editor. "Annual Review of Physical Chemistry." Annual Reviews, Inc., Palo Alto, Calif. 1964. vii + 577 pp. $8.50.

Roy M. Adams, Editor. "Boron, Metallo-Boron Compounds and Boranes." John Wiley and Sons, Inc., 605 Third Ave., New York, N. Y. 1964. xxiii + 765 pp. $27.50.

Robert M. Gould, Editor. "Patents for Chemical Inventions." Advances in Chemistry Series, No. 46. American Chemical Society, Washington, D. C. 1964. viii + 117 pp. $4.

Alexander Newton Winchell and Horace Winchell. "The Microscopical Characters of Artificial Inorganic Substances: Optical Properties of Artificial Minerals." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1964. xiii + 439 pp. $14.50.

C. B. Amphlett. "Inorganic Ion-Exchange Materials." Topics in Inorganic and General Chemistry, Volume 2. American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York 17, N. Y. 1964. x + 141 pp. $6.50.

M. Jacob and G. F. Chew. "Strong-Interaction Physics." W. A. Benjamin, Inc., 1 Park Ave., New York, N. Y. 1964. xi + 154 pp. Clothbound, $9; paperback, $4.95.

Fred Basolo and Ronald Johnson. "Coordination Chemistry." W. A. Benjamin, Inc., 1 Park Ave., New York, N. Y. 1964. xii + 180 pp. Clothbound, $3.95; paperback, $1.95.

H. J. Emeléus and A. G. Sharpe, Editors. "Advances in Inorganic Chemistry and Radiochemistry. Volume 6." Academic Press Inc., 111 Fifth Ave., New York, N. Y. 1964. ix + 530 pp. $16.

Additions and Corrections

1962, Volume 1

G. W. Watt, L. E. Sharif, and E. P. Helvenston: Iridium Complexes of the Type $[\mathrm{Ir}^{n+}(\mathrm{en}\text{-}x\mathrm{H})_y]^{(n-yx)+}$.

Page 7. In column 2, line 1 of the last paragraph, 0.5347 should read 1.5347.—G. W. Watt

1963, Volume 2

Fred E. Saalfeld and Harry J. Svec: The Mass Spectra of Volatile Hydrides. I. The Monoelemental Hydrides of the Group IVB and VB Elements.

Page 48. In Table III, the appearance potentials of PH_3^+ and PH_2^+ should be 10.5 and 13.4 e.v., respectively, not 11.5 and 14.4 e.v.

Page 49. In Table VI, the bond energy of PH^+–H should be 3.0 e.v., not 2.0 e.v.—Harry J. Svec

Fred E. Saalfeld and Harry J. Svec: The Mass Spectra of Volatile Hydrides. II. Some Higher Hydrides of the Group IVB and VB Elements.

Page 53. In Table IV, the heat of formation of P_2H_4 should be 6.9 kcal. mole^{-1}, not 9.9 kcal. mole^{-1}.—Harry J. Svec

1964, Volume 3

R. J. Woodruff, James L. Marini, and J. P. Fackler, Jr.: The Reaction Product of Bis(2,4-pentanediono)titanium(IV) Dichloride with Anhydrous Iron(III) Chloride.

Page 688. In Fig. 1, spectra a and b are mislabeled; the a and b labels should be exchanged.—J. P. Fackler, Jr.