The Isotopic Constitution of Rubidium, Zinc and Argon

With the same mass spectrograph as was employed for the study of potassium[1] a similar investigation has been made for rubidium and zinc. No new isotopes were found. From measurements of the peak heights of the known isotopes their relative abundances were computed. By measuring the background in the regions where one might expect other isotopes it was possible to set upper limits for their abundance.

For rubidium an abundance ratio $Rb^{85}/Rb^{87} = 2.68 \pm 0.02$ was found. Assuming a packing fraction of -8.2 for rubidium, the chemical weight computed from the above abundance ratio would be 85.45 in good agreement with the international value, 85.44. The following upper limits of abundances relative to Rb^{85} can be set: Rb^{80}, Rb^{81}, Rb^{82}, Rb^{89} and Rb^{90}, 1/100,000; Rb^{83}, 1/60,000; Rb^{84}, 1/12,000; Rb^{86}, 1/13,000; Rb^{88}, 1/22,000.

In zinc the isotopes 64, 66, 68, 67 and 70 were found. The relative abundances agree well with Aston's[2] revised values. With Aston's value for the packing fraction of zinc, the chemical weight of zinc, when calculated, was found to be 65.31. This is in fair agreement with Aston's value, 65.33, but is in distinct disagreement with the International value, 65.38. Recently, Stenvinkel and Svensson[3] from their investigation of the band spectum of zinc hydride claim to have found the isotopes Zn^{65} and Zn^{63}—both more abundant than Zn^{70}. From the present work it is possible to say that Zn^{65}, Zn^{63} and Zn^{69} are present in zinc to less than 1 part in 40,000, 80,000 and 60,000, respectively. These abundances compared to Zn^{70} would be 1/200, 1/400 and 1/300, respectively.

Argon was studied in another mass spectrograph very similar to that employed in the above investigations. The presence of the rare isotope, A^{38}, reported by Zeeman and de Gier[4] was confirmed. From a measure of the peak heights it was found that $A^{40}/A^{36} = 325$ and $A^{36}/A^{38} = 5.1$. In addition, the following upper limits can be set for the abundances of hypothetical isotopes relative to A^{40}: A^{41} and A^{39}, 1/10,000; A^{42} and A^{37}, 1/20,000.

I wish to express my appreciation to Professor John T. Tate for his valuable suggestions and criticisms of the work.

ALFRED O. NIER

Department of Physics,
   University of Minnesota,
     January 17, 1936.

[1] Nier, Phys. Rev. 48, 283 (1935).
[2] Aston, *Mass Spectra and Isotopes* (1933), p. 119.
[3] Stenvinkel and Svensson, Nature 135, 955 (1935).
[4] Zeeman and de Gier, Proc. K. Akad. Amsterdam 37, 3 (1934).

An Infrared Absorption Band of Heavy Water Vapor

An infrared band of D_2O vapor has been observed at 1.5291μ with a one-meter absorption tube heated to 100°C. Although the sample of D_2O was 98 percent, as given by the manufacturer, the maximum absorption in the zero branch was only 5 percent. This is considerably less than the absorption of the corresponding band of H_2O.

The line separation is irregular in the positive and negative branches, indicating a combination band, but the

TABLE I. D_2O band.

μ	ν (cm^{-1})	$\Delta\nu$ (cm^{-1})
1.5090	6626.8	
		12.1
1.5118	6614.7	
		7.1
1.5134	6607.6	
		10.0
1.5157	6597.6	
		11.7
1.5184	6585.9	
		9.9
1.5207	6576.0	
		17.7
1.5248	6558.3	
		18.6
*1.5291	6539.7	
		27.1
1.5355	6512.6	
		9.3
1.5377	6503.3	
		11.4
1.5404	6491.9	
		12.7
1.5434	6479.2	

* Band center.

resolving power was insufficient to obtain the fine structure. However the center of the zero branch was definitely located and the following comparisons are drawn.

Sleator and Barker[1] found the bands corresponding to the fundamental frequencies ν_1 and ν_3, and Bonner[2] has calculated ν_2 assuming the D_2O molecule to be identical with the H_2O molecule except for mass differences.

MOLECULE	ν_1	ν_2	ν_3	ν_3
D_2O	1179 cm^{-1}	$(2655)^2$	2784 cm^{-1}	$(2790)^2$
H_2O	1596	$(3600)^3$	3742	$(3756.5)^2$
$\frac{\nu_n(D_2O)}{\nu_n(H_2O)} =$	0.7375	0.7387	0.7440	0.7427

From the average value of the ratio of the fundamental frequencies for D_2O and H_2O the band for D_2O found at 1.5291μ should correspond to an H_2O band at 1.1327μ. There is an H_2O band center at 1.1340μ. Mecke[3] gives this band at 1.135μ and represents it by the vibration quantum numbers (1, 1, 1).

The calculated value of (1, 1, 1) vibration frequency for D_2O by Bonner's[2] equations:

$$\nu_0 = W_1 V_1 + W_2 V_2 + W_3 V_3,$$
$$W_1 = X_1 - X_{11} - \tfrac{1}{2}X_{12} - \tfrac{1}{2}X_{13},$$
$$W_2 = X_2 - X_{22} - \tfrac{1}{2}X_{12} - \tfrac{1}{2}X_{23},$$
$$W_3 = X_3 - X_{33} - \tfrac{1}{2}X_{13} - \tfrac{1}{2}X_{23},$$

gives $\nu_0 = 6544$ cm^{-1} while the experimental value is 6540 cm^{-1}.

A similar calculation of ν_0 by Mecke's equations gives $\nu_0 = 6543$ cm^{-1}, so that neither set of equations is to be preferred in the light of the present experimental data. (See Table I.)

W. V. NORRIS
   University of Oregon
H. J. UNGER
   University of Idaho, S. B.
R. E. HOLMQUIST
   University of Oregon
January 14, 1936.

[1] W. W. Sleator and E. F. Barker, Phys. Rev. 46, 336 (1934).
[2] L. G. Bonner, Phys. Rev. 46, 458 (1934).
[3] R. Mecke, Zeits. f. Physik, 81, 313 (1933).