

In order to fix exactly the true wave-length, we intend to take more interference pictures with étalons of different thickness. Further, by continued observations, we hope to diminish the possible error of our spectrographic measurements.

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¹ L. Vegard, *NATURE*, **117**, 356; 1926.

² L. Vegard, *Geophys. Publ.*, **9**, No. 11; 1932.

³ L. Vegard, *Z. Phys.*, **75**, 30; 1932.

⁴ L. Vegard, *Geophys. Publ.*, **10**, No. 4; 1933.

⁵ L. Vegard and L. Harang, *Geophys. Publ.*, **10**, No. 5; 1933.

⁶ L. Vegard and L. Harang, *Geophys. Publ.*, **11**, No. 1; 1934.

⁷ J. J. Hopfield, *Phys. Rev.*, **37**, 160; 1931.

Isotope Effect in Band Spectra of Hydrides and Deuterides

THE comparison between the band spectra of hydrides and deuterides has shown, as is well known, that the ratio ρ^2 of the reduced masses, for example

$$\rho^2 = \frac{\mu_{\text{AgH}}}{\mu_{\text{AgD}}}$$

(where $\mu_{\text{AgH}} = Mm_{\text{H}}/(M + m_{\text{H}})$, $\mu_{\text{AgD}} = Mm_{\text{D}}/(M + m_{\text{D}})$, m_{H} = mass of the proton, m_{D} = that of the deuteron), calculated in this way, does not agree with the ratio ρ^2 as deduced from the atomic weights. As a possible explanation, E. Hulthén and W. Holst¹ have suggested that the electronic system takes part in the rotation and vibration of the molecule and gives a contribution to the effective moment of inertia.

A theoretical discussion may perhaps be interesting. If the hydride (deuteride) contains an atom with high atomic number, we can assume the distribution of electrons to be spherically symmetrical and start from the distribution of the corresponding negative ion. A suitable expression for the electronic density is that given by H. Jensen²:

$$D = \frac{N}{4\pi P_0 r_0^3} \cdot \frac{c-X}{X^3} (1 + cX)^3; \quad X = \sqrt{\frac{r}{r_0}}, \quad r_0 = \frac{a_{\text{H}}}{Z^{\frac{1}{2}} \lambda}$$

Z = atomic number, N = number of electrons, $a_{\text{H}} = h^2/4\pi^2 m_e e^2$, where m_e = mass of the electron.

P_0 is to be determined by $\int_0^\infty D 4\pi r^2 dr = N$, λ and c are constants corresponding to $1/\lambda$ and c in the table of Jensen², and to μ and k in the table of Nagy³. Calculating the moment of inertia, we get:

$$I_e = m_e a_{\text{H}}^2 \times Z^{\frac{1}{2}} \times 7.96 \times f\left(\frac{N-Z}{Z}\right)$$

where $f\left(\frac{N-Z}{Z}\right)$, depending on λ and c , is a function

of $\left(\frac{N-Z}{Z}\right)$ only. If $\left|\frac{N-Z}{Z}\right| < \frac{1}{10}$, which is certain

in our case, we can write:

$$f\left(\frac{N-Z}{Z}\right) = 1 + 3.84 \left(\frac{N-Z}{Z}\right) + 9.4 \left(\frac{N-Z}{Z}\right)^2.$$

An opportunity for comparison with experimental results is given by the careful investigations⁴ of E. Hulthén and E. Knave on silver hydride and silver deuteride. In this case the total angular momentum of the electrons is 0, and the corrections

of Kronig and Van Vleck, being proportional to its square, also equal 0. So we obtain a lower and an upper limit for the ratio ρ^2 , taken from the rotational structure of the band spectra AgH and AgD, ρ^2 min. = $\frac{\mu_{\text{AgH}}}{\mu_{\text{AgD}}} = 0.50497$, and ρ^2 max. = $\frac{\mu_{\text{AgH}} + I_e/a^2}{\mu_{\text{AgD}} + I_e/a^2} = 0.50545$ (a = nuclear distance). ρ^2 max. is obtained if all the electrons take part in the rotation.

E. Hulthén and Knave have found $\rho^2 = 0.50527$ from the B -values. Thus the correction is 60 per cent of the theoretical maximum. Using the electronic density D mentioned above, the calculation shows that this correction will be obtained, provided the four outermost electrons take part in the rotation. This is the same as saying that the electrons outside a sphere with radius $1.7 a_{\text{H}}$ are constrained by the hydrogen nucleus to take part in the rotation.

We may verify the reliability of the expression D for the electronic density by calculating the nuclear distance of AgH to the first approximation. Starting from the charge distribution D of the negative silver ion, we determine the distance from the Ag nucleus at which a positive particle can be in equilibrium. The result, $2.78 a_{\text{H}}$, is in good agreement with the experimental value⁵ $3.05 a_{\text{H}}$ and indicates that the moment of inertia will be somewhat greater than our I_e , if the effect of the hydrogen nucleus on the electronic distribution is taken into account.

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¹ Holst and Hulthén, *NATURE*, **133**, 496, 796; 1934. *Z. Phys.*, **90**, 712; 1934.

² Jensen, *Z. Phys.*, **77**, 722; 1932.

³ Nagy, *ibid.*, **91**, 105; 1934.

⁴ E. Hulthén and E. Knave, *Physica*, in press. I am indebted to the authors for being informed of the results before publication.

⁵ E. Knave, "Dissertation", Stockholm, 1932.

Internal Recombination during Photo-dissociation of Polyatomic Molecules

IT has been generally admitted that, in the primary decomposition of a molecule by absorption of light, free atoms or unsaturated radicals are produced. In an extensive investigation upon the photo-decomposition of carbonyl compounds, Dr. R. G. W. Norrish and his co-workers¹ have advanced the view that an aldehyde molecule can be disrupted into a saturated hydrocarbon and a carbon monoxide molecule in one process. This is equivalent to a recombination of the liberated hydrogen atom and alkyl radical at the moment they leave the remainder of the molecule.

The possibility of such a process can be tested directly if the magnitude of the absorbed quantum is large enough to produce excited atoms, or radicals which will recombine to form an excited molecule emitting its characteristic spectrum. By observing this emission under conditions which prevent the possibility of secondary processes, that is, at very low gas pressures, we should get definite proof of the existence of such an internal recombination.

An investigation in this direction has been undertaken in this laboratory. Polyatomic molecules containing halogen atoms instead of alkyl radicals,