It is very interesting to remark here that the logarithms of the vibrational frequencies in the ground states of the molecules of five alkalis and of four halogens, together with four elements in the sixth group in the periodic table, vary linearly with the logarithms of their atomic weights, as shown in the accompanying figure (Fig. 1). The points corresponding to K, Cl, S were displaced downwards. This anomaly appears also in the fifth group: N, As, Bi lie on a straight line and P below the line.

Full accounts of the experimental results will shortly be published elsewhere.

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Stark Effect for the Hydrogen Isotopes

RECENTLY we have taken several photographs of the Stark effect in a mixture of the two hydrogen isotopes, using deuterium kindly supplied by Prof. Urey. The measured zero field separation of each pair of Balmer lines persists in high fields with small variations as noted below.

The minimum field for good resolutions in the Stark effect is fortunately the same for nearly all the Stark components of each Balmer pair. It varies, however, from about 50 kv./cm. in $H_\delta^{1,2}$ to 130 kv./cm. in $H_\alpha^{1,2}$.

From left to right in the accompanying photograph (Fig. 1) of $H_\gamma^{1,2}$ one finds alternately components of H_γ^2 and H_γ^1. The maximum field of 52 kv./cm. is sufficient to show the character of the lines, and to separate completely the two Stark effects.

The displacements are not exactly those given by the Epstein theory, even when one allows for the second order effect. The irregularities are made especially clear in the present analysis through variations in the separation of protium-deuterium pairs of Stark components. At maximum field, the pair of moderate intensity immediately to the right of the centre of the σ image (Epstein $\Delta = 3$) have a separation 9 per cent higher than that of the corresponding pair on the left. The contrast is even more pronounced in the π images. From the evidence it appears improbable that these irregularities are constant for all field strengths. According to measurements on $H_\gamma^{1,2}$, they are too large to attribute entirely to variations in the fine structure separations for the two isotopes.

In moderately high fields, the central σ component of H_γ^2 appears to swing sharply to the red, as though the second order effect were abnormally high. This is found to be due to a superposed new molecular line which is clearly resolved through its large red shift in fields of 70 kv./cm. Like most molecular lines on our plates, the new line has appreciable intensity only in rather high fields. With a given mixture of isotopes, we find that at zero field the deuterium line is always stronger in $H_\gamma^{1,2}$ than in $H_\beta^{1,2}$. In the accompanying photograph, the light hydrogen line is clearly much the stronger in the normal spectrum. With the application of even low fields, however, the energy passes more to H_γ^2, so that at maximum field the two patterns are of almost equal strength. The intensity variations suggest as their principal origin collisions of the second kind, between atoms of the two isotopes. This phenomenon might be expected to become most prominent in cases of perfect resonance which exist at fields where components of the isotopes cross. In the region between the strong central σ components, and at moderate fields, it may be noticed that a component of H_γ^2 persists, while the component of H_γ^1, which should cross at this point, is certainly weaker, and appears to be lost. On the above grounds, one may tentatively say that collisions of the second kind are more probable when the light atom is the one excited. There may be, however, a selective action whereby certain pairs of isotopic states are preferred in energy transfers; for the relative intensities of corresponding components of H_γ^2 and H_γ^1 are clearly not constant throughout the photograph, and in $H_\beta^{1,2}$ these fluctuations are more marked. This amounts to the statement that

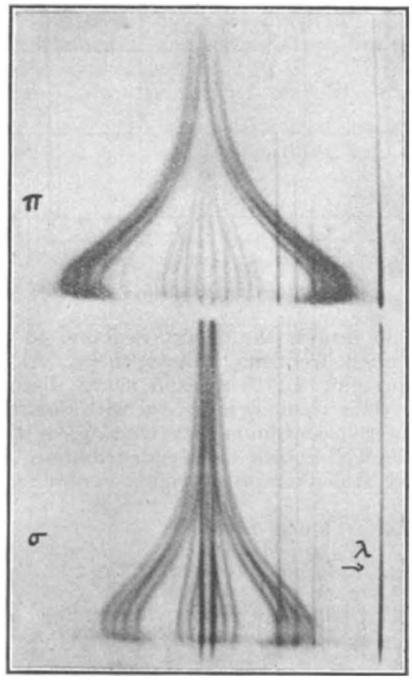

FIG. 1. The spectral line $H_\gamma^{1,2}$ in fields up to 52 kv./cm.

there are departures from the Schrödinger intensities, and that the departures are not the same for the two isotopes.

A great many new molecular lines are found with moderate displacements. The research is being extended to include a study of the molecular spectra as well as the atomic spectra with varying proportions of the isotopes.

Explosions occur in Lo Surdo sources when a small amount of oxygen is allowed to mix with the deuterium at a total pressure of one to two millimetres. Under such conditions, explosions are not observed with light hydrogen. In the present case they appear to be set off by a rather intense heating of the cathode surface.

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