LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

The Isotope Effect in the Lyman Series of Hydrogen

By using water containing a high concentration of the hydrogen isotope H^2, six members of the Lyman series of hydrogen have been observed as close doublets. Plates were taken in the first and second orders of a 3 meter grazing incidence vacuum spectrograph. As a source we used a discharge tube similar to that designed by C. R. Jeppesen of this department (to be described in a subsequent number of this journal). In a small side tube was placed a drop of "heavy" water. Water vapor was allowed to leak through a small capillary into the discharge tube where it was dissociated by the discharge, liberating hydrogen gas. The gas diffused through the slit into the main tube of the spectrograph, but pumping speeds were great enough to maintain a pressure of 10^{-3} mm Hg in the spectrograph while the pressure in the discharge tube was several mm Hg. The discharge was excited by a 25 kv Thordarson transformer.

The first six members of the series were photographed in the first order. The first four of these were sufficiently intense to be reproduced in Fig. 1. The first member of the series was photographed also in the second order, against iron standards put on the plate by sending light from an iron arc through a quartz window on the end of the discharge tube. This second order doublet also is shown in Fig. 1. Microphotometer records show the H^1 component to be partially self-reversed. The relative intensity of the doublet lines is about 2 : 1, the H^1 component being the stronger. This is due to the dilution of the H^2 in the original sample of water by H^1 present in the aluminum electrodes, the walls of the tube, etc. In the original sample the ratio of H^2 to H^1 was about 2 : 1. It is interesting to notice that the H^1 component is broader than the H^2 component. This agrees with the theory of broadening of lines due to the Doppler effect, according to which the H^1 line should be 1.41 times as broad as the H^2 line.

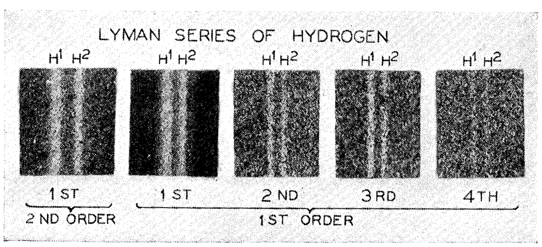

FIG. 1.

The theoretical wave-lengths of the first six members of the series were computed following Penney.[1] Houstoun's[2] value $R(H^1)=109{,}677.76$ cm^{-1} was used. The isotopic wave-length shifts and the wave-lengths of the H^2 lines were calculated by explicit formulas kindly furnished by Professor R. T. Birge. With Bainbridge's[3] value for the atomic weight of H^2, $R(H^2)=109{,}707.56$ cm^{-1}. The experimental values of $\Delta\lambda$ were obtained as follows: for the first member of the series, from direct comparison with iron standards, for the other five members, from dispersion values obtained by using the computed wave-lengths of the H^1 lines as standards. All these values are listed in Table I.

TABLE I. *Wave-lengths and frequencies of lines in the Lyman series of H^1 and H^2.*

$\lambda(H^1)$ vac.	$\nu(H^1)$	$\lambda(H^2)$ vac.	$\Delta\lambda$ Calculated	$\Delta\lambda$ Observed
1215.664A	82,259.57 cm^{-1}	1215.334A	0.330A	0.330A
1025.718	97,492.71	1025.439	0.279	0.276
972.533	102,824.31	972.269	0.264	0.266
949.739	105,292.07	949.481	0.258	0.262
937.800	106,632.59	937.545	0.255	0.274*
930.744	107,440.88	930.491	0.253	0.258

Good agreement was obtained between theoretical and measured values of $\Delta\lambda$ except for one case. The fifth member of the series, marked with an asterisk, gave an experimental value of $\Delta\lambda$ larger than that predicted. This doublet was found difficult to measure, probably because of the presence of a faint line near one of its components.

We acknowledge with pleasure the generosity of Professor G. N. Lewis of the Chemistry Department in furnishing us the "heavy" water used in this work.

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May 3, 1933.

[1] W. G. Penney, Phil. Mag. **9**, 661 (1930).
[2] W. V. Houstoun, Phys. Rev. **30**, 608 (1927).
[3] K. T. Bainbridge, Phys. Rev. **41**, 115 (1932).

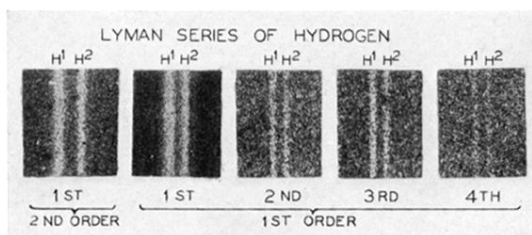
LYMAN SERIES OF HYDROGEN
H1 H2
H1 H2
H1 H2
H1 H2
H1 H2
1 ST
2 ND ORDER
1 ST
2 ND
3 RD
4 TH
1 ST ORDER

Fig. 1.