in reference to that of helium.[2] The mass of Li^{7+} was measured in reference to that of H_3^{2+} by a less direct and less accurate method than was possible in the case of Li^6. If the mass-scale were strictly linear the mass of Li^7 could be obtained by direct extrapolation. Because of the divergence of the mass-scale from absolute linearity it is necessary to apply a small negative correction to the mass secured on the basis of a linear mass-scale. This correction is easily found and was known from the dispersion data secured from earlier plates. The probable error introduced by this corrected extrapolation may conservatively be taken as ±0.0003 mass units and it has been included in the probable error given in the first paragraph.

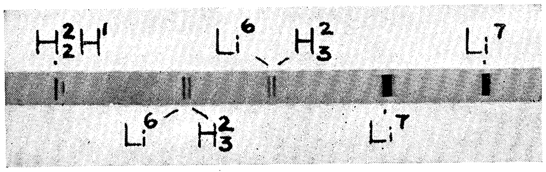

FIG. 1. Mass-spectra of Li^6 and Li^7.

The mass ratio of the isotopes of lithium secured in this investigation does not agree with the value from the band spectrum analysis[3] but it is in good accord with the ratio from Costa's earlier mass-spectrograph measurements.[4]

The author is indebted to Dr. W. F. G. Swann for his interest and helpful discussions. The writer wishes to express his appreciation of the generous gift by Professor G. N. Lewis of the fractionated hydrogen used in this work.

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[1] These particular spectra cannot be used for the determination of the relative abundance of the lithium isotopes owing to the conditions of voltage existent while the spectra were taken. The fiducial line appears next to $H_2^2H^1$.

[2] K. T. Bainbridge, Phys. Rev. **44**, 57 (1933).

[3] Andrew McKellar, Phys. Rev. **43**, 215 (1933). F. A. Jenkins and Andrew McKellar, Bull. Am. Phys. Soc. **8**, No. 4, 23 (1933).

[4] J. L. Costa, Ann. de Physique **4**, 425 (1925).

Comparison of the Masses of H^2 and Helium

The mass of H^2 has been measured from twelve spectra as 2.01363±0.00004 referred to helium[1] as 4.00216 and 2.01363±0.00008 referred to O^{16} when the probable error in the helium-oxygen ratio is taken into account.

Fig. 1 is a contact print of eight of the spectra used in this comparison of the mass of H^2 with that of helium. The individual spectra are indicated, as in some cases two spectra were taken at the same position of the plate. Each spectrum gives two determinations of the mass of H^2 one from the comparison of He H^{1+} with H_2^2 H^{1+} and another from the comparison of He H^{2+} with H_3^{2+}.

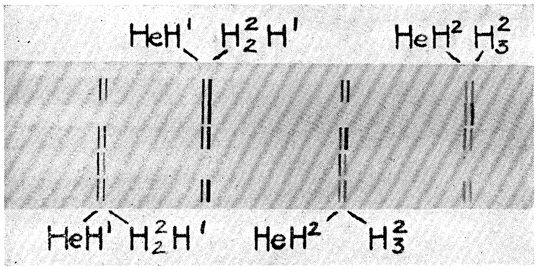

FIG. 1. Mass-spectra for the comparison of the masses of H^2 and He.

The measured positions of the HeH^1 and HeH^2 molecular ions provided the dispersion measurements for these spectra. The mass of H^1 was taken as 1.007775 and the mass of He as 4.00216, as their ratio had been determined from a previous investigation.[2] An error of 1 part in 1000 in the dispersion determination could only introduce an error of 1 part in 200,000 in the determination of the mass of H_2^2 H^{1+} or an error of 1 part in 240,000 in the mass of H_3^{2+}.

This sensitiveness to possible errors in the dispersion constants is an ordinary advantage inherent in the measurement of close doublets. In addition it can be shown that the use of two related doublets, as in the present determination, greatly simplifies the detection and elimination of small systematic errors. Also corrections for nonlinearity of the mass scale appear only in the fifth decimal place if a single mass determination of H^2 is derived from the average of the two values obtained from the "five" doublet and from the "six" doublet. The probable error in the evaluation of the mass of H^2 from twelve spectra was calculated on the basis of twelve average determinations, not twenty-four single values. Moreover it can be shown that the mass of H^2 is evaluated in terms of He alone and the mass determination of H^2 is insensitive to whatever value is selected for H^1 in the range ±0.1 percent from the figure 1.007775. Similarly, in obtaining the dispersion from the separation of the HeH^1 and HeH^2 lines, the final mass determination of H^2 is not sensitive to the value of H^2 used to obtain the mass of HeH^2.

The writer is greatly indebted to Professor G. N. Lewis who very generously gave the writer some "heavy water" containing $H^2 : H^1$ in the approximate abundance range of 1 : 2 to 2 : 3.

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June 14, 1933.

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[1] F. W. Aston, Proc. Roy. Soc. **A115**, 487 (1927).

[2] K. T. Bainbridge, Phys. Rev. **43**, 103 (1933).

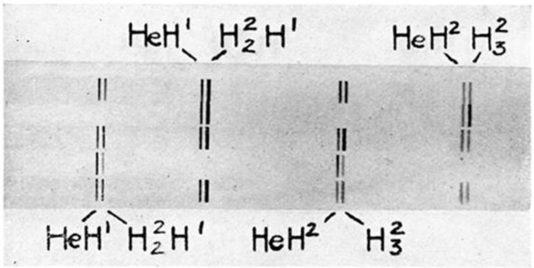

FIG. 1. Mass-spectra for the comparison of the masses of H^2 and He.