figuration are, in a sense, unique. The discussion presented here shows that an extension of the Allison-Williams notation, which conserves the relation with an extended dispersion formula similar to (1), gives the uniqueness of the configuration of Fig. 1-II by the property that it is the only three-crystal configuration for which the sums of Eq. (2) are all zero.

Samuel K. Allison

University of Chicago,
Chicago, Illinois,
June 4, 1937.

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[1] J. W. DuMond, Phys. Rev. **52**, 872 (1937). The Editor of the Phys. Rev. kindly permitted me to read the manuscript.

[2] S. K. Allison and J. H. Williams, Phys. Rev. **35**, 149 (1930).

[3] Cf. A. H. Compton and S. K. Allison, *X-Rays in Theory and Experiment* (Van Nostrand, 1935), p. 718.

The Isotopic Constitution of Osmium

Aston[1] found osmium to consist of the isotopes 186, 187, 188, 189, 190 and 192. It is the purpose of this communication to show that in addition to the above isotopes an extremely rare isotope, Os^{184}, exists, present to about one part in 5700 in osmium.

A new high resolving, high intensity mass spectrometer especially designed for the detection of rare isotopes and the measurement of relative abundances was used in this investigation. A complete description of this new apparatus will appear in the November 1 *Physical Review*. For the time being it may be said that its operation is similar to that of the smaller apparatus previously described.[2] Positive ions are produced by the collision of electrons with the gas or vapor studied. The m/e analysis of the ions formed is accomplished by a 180° magnetic analyzer.

OsO_4 vapor was admitted to the apparatus through a capillary leak. $(OsO_4)^+$, $(OsO_3)^+$, $(OsO_2)^+$, $(OsO)^+$ and Os^+ ions were observed. Fig. 1 shows a typical mass spectrum obtained in the Os^+ region. In addition to the previously known isotopes may be seen the relatively weak peak in the 184 position. That this new peak really represents a new isotope may be concluded from the following:

(1) The peak corresponding to Os^{184} was observed not only in the Os^+ spectrum but also in the $(OsO_2)^+$, $(OsO_3)^+$ and $(OsO_4)^+$ spectra. In each case the relative abundance found agreed within the experimental errors. No study was made of the OsO^+ spectrum as $Os^{184}O^{16}$ would fall in the 200 position in coincidence with Hg^{200}, one of the strong isotopes of Hg. As very slight traces of Hg are sometimes found in the apparatus it was felt that the results here might not be reliable.

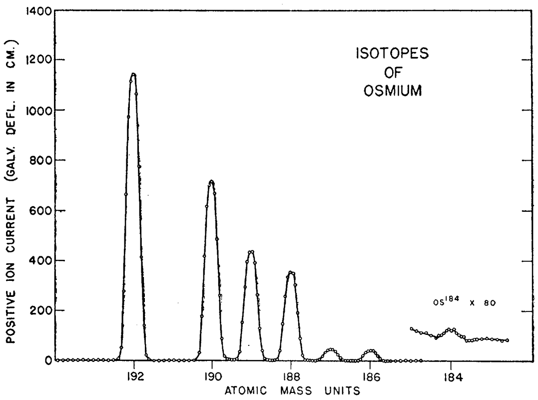

Fig. 1. Mass spectrum showing the isotopes of osmium. The region about Os^{184} is drawn to 80 times scale. Positive ion current is expressed in terms of centimeters deflection of galvanometer at its highest sensitivity. One centimeter represents about 2.5×10^{-15} amp.

(2) The abundance ratio of Os^{186} to Os^{184} in the $(OsO_4)^+$ spectrum was studied over a threefold range of pressure, and it was found to be constant within the limits of error. When the pressure was reduced by a large amount the rare peak completely disappeared in the background, as was to be expected if it was due to a rare isotope and not some residual impurity.

Table I.

Mass number	192	190	189	188	187	186	184
Abundance	100	64.4	39.4	32.4	4.01	3.87	0.043
Aston's values	100	59.0	40.9	31.5	1.41	2.35	

(3) Previous experience with the apparatus enables one to conclude that the peaks observed were not "ghosts."

Table I shows the isotopes along with their abundances relative to Os^{192}. Aston's values, converted from percentages, are included in the table for comparison. I believe that my abundances relative to Os^{192} are correct to one percent for Os^{190}, Os^{189} and Os^{188}. The values for Os^{187} and Os^{186} may be in error by three percent and the value for the new isotope Os^{184} may be correct to only 10 percent. When allowance is made for the packing fraction of -1 and the factor 1.000275 in going from the atomic to the chemical scale a chemical atomic weight of 190.21 is found for the above figures. Aston's values yield the weight 190.28. The present International Value, 191.5, lies outside of the errors possible in the mass-spectrographic method.

A search was made for other isotopes but none were detected. The following upper limits may be set for their existence relative to Os^{192}: Os^{194}, 1/10 000; Os^{193}, 1/6000; Os^{191}, 1/3700; Os^{185}, Os^{183} and Os^{182}, 1/14,000.

The present investigation definitely verifies the existence of the relatively rare isotope Os^{187}, which together with Re^{187} forms an isobaric pair of adjacent elements.

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September 28, 1937.

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[1] Aston, *Mass Spectra and Isotopes*, p. 157.

[2] Nier, Phys. Rev. **50**, 1041 (1936).

Erratum: The Efficiency of Counters and Counter Circuits

On page 324 of the (Phys. Rev. **52**, 322 (1937)) above paper the sentence beginning in line 16 of the first column should be amended as follows:

> "Thus the efficiency of the entire counting apparatus is given by Eq. (2), with τ_i in place of τ_r."

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