ISOTOPE ABUNDANCE IN PLATINUM.

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In our previous investigation* to deduce the isotopic constitution of platinum from a hyperfine structure study of its arc lines, we have concluded that platinum contains, in decreasing order of abundance, the isotopes 196, 195, 194 and 192. From eye-estimates of the intensities of the components of λ 3408·13 Å and λ 3042·63 Å, the relative abundance of the isotopes was estimated. Due to the difficulties inherent in a visual estimate of the relative intensities, the actual evaluation of the correct relative abundance had to wait till the microphotograms of the structure pattern of λ 3408·13 Å were obtained.

The necessary microphotographs have now been obtained with a Cambridge Recording Microphotometer. Light transmitted through the structure pattern is incident on a slit over a standard Osram photoelectric cell. The potential developed across a second cell (used as a Koch resistance) by the passage of the photoelectric current is measured by a Lindemann electrometer, the image of whose needle is projected on to a revolving drum camera carrying a bromide paper. As the plate is moved forward synchronously with the rotation of the drum, the density changes of the plate are automatically recorded on the photographic paper. In Plate III, two microphotographs of the same order in the structure pattern of λ 3408·13 Å are reproduced. Fig. 1 is obtained with a slit width of 5/600 mm.; the components are well separated, but the narrow slit brings out the grains in the background. Fig. 2 is taken with a slit width of 8/600 mm.; the three central components are merged together, while the background effect is not prominent. Many more curves were also obtained and the intensity estimates were conducted in two ways. Firstly, the component intensities were so adjusted and their contours were so sketched as to give the observed resultant curve here reproduced; the extreme components due to Pt 195 were assumed to have the theoretical ratio of intensities, *viz.*, 10 : 8. This

* Venkatesachar and Sibaiya, *Proc. Ind. Acad. Sci.*, 1935, 1, 955–960.

result arises out of the fact that the upper level $5d^86s6p\ z^5D_4^\circ$ is considered to be unsplit, while to the lower level $5d^86s^2a^3F_4$ is attributed a separation of 0·475 cm.$^{-1}$ The nuclear spin of Pt 195 being $\frac{1}{2}\frac{h}{2\pi}$, the fine quantum numbers of the level a^3F_4 are 9/2 and 7/2. The intensities of the components being proportional to the quantum weights $(2f+1)$, it follows that the ratio of the intensities of the components is 10 : 8. In the second method the microphotometer curve was obtained over three consecutive orders; the peaks of corresponding components were joined by smooth curves all of which ran nearly parallel to each other. The intensities were estimated with the same assumption as before.

The average value for the relative abundance of the isotopes obtained from more than three determinations in each method is as follows :—

Mass Number	..	196	195	194	192
Relative Abundance	..	16	13	10	~2

The order of abundance is consistent with the one given earlier by visual estimates of intensities. The calculation of the atomic weight from the above relative abundance of the isotopes gives a value which is nearer 195·0 than 195·2. The existence of heavier isotopes, especially Pt 198, in smaller abundance may account for this difference. But with the present data the chemical atomic weight must be considered to be somewhat high.

We desire to express our grateful thanks to Dr. Royds who has kindly taken microphotograms of the original negative on the Cambridge Microphotometer of the Kodaikanal Observatory.

Note added in proof :—

While the paper was in press two letters regarding the isotopes of platinum have come to our notice. Fuchs and Kopfermann (*Naturwiss.*, 1935, **23**, 372) have concluded by hyperfine structure analysis that platinum consists of three isotopes 196(8), 195(8) and 194(5); their results are in general agreement with our previous conclusions (*Proc. Ind. Acad. Sci.*, 1935, 1, 955–960), except for the fact that they have not obtained any evidence for the existence of platinum isotope 192. Their estimate of the relative abundance of Pt 196 and Pt 194 agrees with ours and shows by inference a positive isotope shift in platinum. More recently a letter by Dempster has appeared in *Nature* (1935, **135**, 993); using a spark discharge between platinum electrodes and a new type of mass-spectrograph, he finds in platinum the isotopes 196, 195 and 194 with nearly equal abundance, while the decidedly less abundant 198 is considerably more abundant than 192. This would require that the faintest component in our pattern (−0·176 cm.$^{-1}$ of λ 3408·13 Å) has to be attributed to 198 instead of 192,

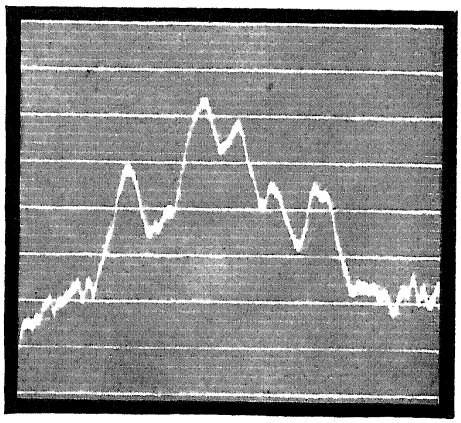

FIG. 1.

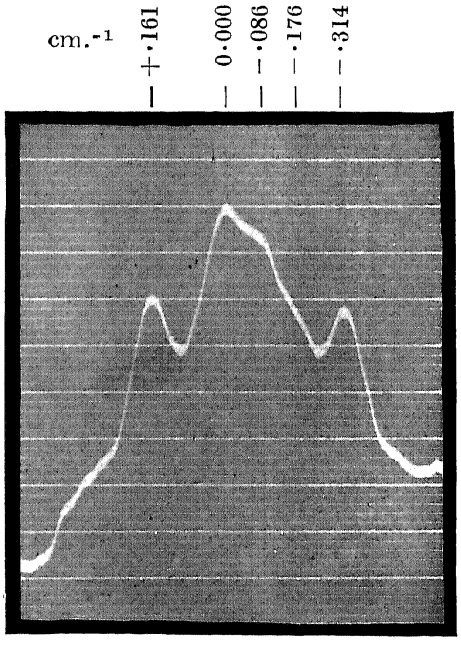

FIG. 2.

Microphotograms of the Structure Pattern of PtI λ 3408·13Å.

thus leading to a negative isotope shift. The relative abundance of the isotopes would then be as follows :—

Mass Number	..	194	195	196	198
Relative abundance	..	16	13	10	~2

This distribution of isotopes gives again a value for the atomic weight near 195·0. The isotopes of platinum in decreasing order of abundance will be 194(16), 195(13), 196(10) and 198(~2) instead of 196(16), 195(13), 194(10) and 192(~2) ; there can be no doubt that isotopes 196 and 194 are markedly unequal in abundance. Mention must however be made of the fact that if the new interpretation is accepted it leads to the rather unusual result that the centre of gravity of Pt 195 lies nearer to Pt 196 than to Pt 194. In all known cases the centre of gravity of the hyperfine structure components due to an odd isotope falls nearer the even isotope of lower mass number. Before a final decision is reached as to which of the two above interpretations has to be accepted, one has to wait till the details of Dempster's investigation are published.

Summary.

The relative abundance of the isotopes of platinum is estimated from an analysis of the microphotograms of the structure pattern of Pt I λ 3408·13 Å ($a^3F_4 - z^5D_4^\circ$). Assuming a positive isotope shift, the isotopes of platinum with their relative abundance are as follows :—

Mass Number	..	196	195	194	192
Relative abundance	..	16	13	10	~2

Dempster's recent letter to *Nature* however suggests a negative shift and the added note gives, in decreasing order of abundance, the isotopes 194(16), 195(13), 196(10) and 198(~2). This interpretation is not consistent with the usual observation that the centre of gravity of an odd isotope lies nearer to the lighter even isotope. The computed atomic weight in either case lies in the neighbourhood of 195·0. Other isotopes in small abundance may account for the divergence between the computed atomic weight and the chemical atomic weight.

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