



further enriched to a concentration of 1:70 by the method of evaporation at very low temperature¹ became available later, and its spectrum is shown in the lower part of the figure. Comparison of the two tracings demonstrates the enrichment achieved by this method. Rough photometric estimates of the intensities agree with the concentration of the samples measured in the mass spectroscopy.

The background which appears in the tracings is largely due to the finite width of the helium lines, not to instrumental effects. The intensity ratio 1:700 does not, therefore, represent the limit of sensitivity of the method.

In the highly enriched sample, the satellite could also be photographed and measured with a single étalon. The helium-3 line was found to have a separation of $-0.83 \pm 0.03 \text{ cm}^{-1}$ from the helium-4 line.

A theory of isotope shifts in two-electron spectra due to mass effects has been developed by Hughes and Eckart^{2,3}. It is based on the assumption of hydrogen-like wave functions with effective nuclear charges. On the basis of their calculations for the $2P$ states, the value of the effective charge Z_e for the $1s$ electron in the $3P$ states can be assumed to be 2.00, giving a value of $Z_p = 0.996$ for the $3p$ electron in the 3^1P state. This gives an isotope shift of the line 2^1S-3^1P of -0.77 cm^{-1} , which is outside the limits of error of the experimental value. The difference may be due to the approximations contained in the theory, or to the influence of factors other than the pure mass effect.

Details of the spectroscopic method will be published elsewhere.

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¹ Rollit, B. V., and Hatton, J., *Phys. Rev.* (in the press).

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Vibrating Electrodes in Polarography

THE constant diffusion conditions necessary for polarographic work have hitherto been attained by use of the dropping-mercury electrode, the streaming mercury electrode¹, the rotating platinum micro-electrode², or even by a fixed micro-electrode and a constant electrolyte streaming-rate³.

We have found that a platinum micro-electrode vibrating at a constant frequency (100 cycles per second) with an amplitude considerably greater than its linear dimensions gives constant diffusion condi-

tions, and with such an electrode we have obtained reproducible polarograms. The electrode is free from irregularities due to external vibration and gives smoother curves than those obtained with the dropping-mercury cathode.

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² Laitinen, H. A., and Kolthoff, I. M., *J. Phys. Chem.*, **45**, 1079 (1941).

³ Muller, O. H., *J. Amer. Chem. Soc.*, **69**, 2992 (1947).

Evidence of Geological Age against Decay of Tin-115 to Indium-115 by Electron Capture

ACCORDING to a rule of nuclear stability, it is improbable that two neighbouring elements (neighbouring Z) have stable isotopes of the same nominal mass, that is, stable neighbouring isobaric pairs should not exist. A few apparent exceptions to this rule are known, one of which is the pair, ^{115}In and ^{115}Sn .

In indium, the relative abundance of In^{115} is 95.5 per cent, and in tin, the relative abundance of Sn^{115} is 0.4 per cent: In^{115} is thus an abundant indium isotope, whereas Sn^{115} is a minor tin isotope; this has caused some nuclear physicists, for example, Fluegge¹, to suggest that Sn^{115} has probably decayed by orbital electron capture to In^{115} during the life-period of the earth.

Recently Kohman² has discussed β -stability of all nuclei, and by means of his β -stability diagram has been able to predict that for the pair, Sn^{115} and In^{115} , Sn^{115} should be unstable, which accords with the above suggestion by Fluegge¹. Kohman² refers to an earlier paper by Eastman³, which, on the basis of atomic mass calculations, would also favour decay of Sn^{115} to In^{115} . A later paper by Eastman⁴ invokes geochemical evidence, namely, the association of traces of indium with tin in tin minerals, as indicative of electron capture decay to indium-115. Since this publication appeared, many more tin minerals have been analysed, notably cassiterite; in some, traces of indium have been found, whereas in others no indium could be detected. Of considerable interest is a paper by Itsikson and Rusanov⁵ which reports analyses of many specimens of cassiterite from the U.S.S.R.: the useful conclusion is made that although specimens of cassiterite associated with sulphide veins usually contain traces of indium, specimens from pegmatite are likely to be free from detectable quantities.

Direct observations on the production of characteristic X-radiation which would result from electron capture decay by tin-115 have been made by Zingg⁶. His results are inconclusive, as, in three specimens of tin he examined, very feeble activity could be detected, whereas in a fourth specimen no activity was observed. Later, similar observations by Rusinov and Igel'nitzky⁷ failed to reveal the presence of any X-radiation, and these authors set the minimum value for the period of half-life (T) for Sn^{115} as greater than 1.0×10^{13} years.

As a result of the considerable diversity of opinion and experimental evidence mentioned above, I have attempted to utilize geochemical evidence of the type referred to before, for establishing whether significant decay of tin-115 by electron capture decay has taken place or not. For this purpose, three requirements have to be fulfilled: the absolute age of the mineral has to be known; this age must be extremely great—