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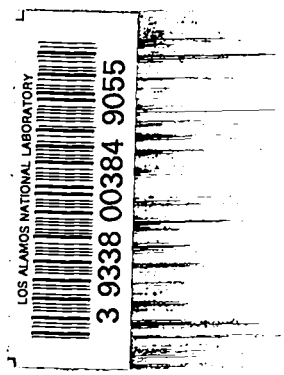

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RANGE MEASUREMENTS OF 94^{239}, 94^{238} and U^{233}

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ABSTRACT

The ranges of alphas from 94^{239}, 94^{238} and U^{233} have been measured rison with Po alphas, and are found to be 3.68, 4.08 and 3.31 cm of air.

For several problems it was thought interesting to have values of nges of alphas from the substances mentioned in the title more precise the ones reported previously,[1,2,3] and to this effect a comparison of o ra nges with the ra nge of polonium alpha particles was performed.

EXPERIMENTAL METHOD

The samples of 94 were deposited on platinum by evaporation. They re separated from the bombarded uranium with a very small amount of carrier. The uranium sample was electroplated on a copper disc. The thinness of all hese samples is borne out by the small values of the straggling coefficient bserved and reported below.

The ra nges of the alpha particles were measured by comparison with a thin polonium standard. The samples were put in front of and at a constant dis tance from a shallow (0.23 cm) ionization chamber. The chamber and the sample were enclosed in a vessel, the pressure in which could be varied and the emperature measured. We plotted curves giving the counting rate of the samples, at a constant gain of the amplifier and registering circuit, versus the air density in the chamber.

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The mean range was computed from the air density at which one obtained half the maximum counting rate according to the formula

$$(1)\quad R = R_{Po}\,\frac{\delta}{\delta_{Po}}$$

in which R is the range of the alpha particles of the substance under investigation, R_{Po} = 3.842 cm (in air 15° C. and 760 mm of Hg[4]) and δ_{Po}, δ are respectively the densities of the air at which half the maximum counting rate is observed for Po and the substance under investigation. A small correction for varying pressure in the ionization chamber is discussed below. The ranges R obtained in this way are clearly mean ranges in air at 15° and 760 mm Hg.

Various runs for each substance were performed in order to check the reproductibility of the positions in changing samples, and additional runs were made to study the influence of the minute amounts of carrier contained in the samples of 94.

STRAGGLING

The total experimental straggling parameter[4], α, obtained by taking $\alpha = 2\,s/\sqrt{\pi}$ in which s is the difference between the extrapolated and mean range is reported in the following table together with the mean ranges.

	Mean Range	α
Po	3.842 cm	0.09 cm
94^{239}	3.68	0.11
94^{238}	4.08	0.12
U^{233}	3.31	0.12

Our straggling figures are higher than the ones obtained under the best possible conditions[4]; this is due to several factors, including the

4. Holloway & Livingston, Phys. Rev. 54, 18, 1938.

comparatively low specific activity of the substances studied which requires some sacrifice in the geometrical conditions to keep the counting time within reasonable limits.

CORRECTION FOR DEPTH OF DETECTOR

Formula (1) is nearly exact if R is close to R_{Po}, otherwise it needs some small corrections due to the fact that varying the density of the air also produces a change in the residual range that the alpha particle must spend in the shallow ionization chamber in order to trip the counter. If we call ε the minimum residual range at 760 mm of Hg and 15° C that an alpha particle must spend in the chamber in order to produce enough ions to trip the counter, formula (1) must be replaced by

$$(2)\quad \frac{R - \varepsilon}{R_{Po} - \varepsilon} = \frac{\delta}{\delta_{Po}}$$

In order to determine ε we reduced the air density in the chamber until only half of the polonium particles were counted. This occurred at a density of 0.20 of the density of air at 760 mm of Hg and 15° C. Under these conditions the alpha particles reaching the chamber had a residual range of 2.8 cm and would produce approximately 3000 ion pairs per millimeter in air at 760 mm of Hg and 15° C or 1350 in our chamber with the air at 1/5 the density. This number of ions corresponds to a residual range of 0.08 cm in air at 760 mm of Hg and 15° C. This was obtained from the curve of specific ionization versus range for a single alpha-particle as given by Holloway and Livingston[4].

Formula (2) with ε = 0.08 cm was used for calculating the range of U^{233}.