

AN ATTEMPT TO MEASURE THE RANGE OF THE ALPHA PARTICLE OF THORIUM.\*—By J. L. NICKERSON, M.A., Dalhousie University, Halifax, N. S.

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ABSTRACT.

The range of the alpha particle from thorium has been found from Wilson Chamber photographs to be  $3.75 \pm .1$  cm. at  $15^{\circ}\text{C}$ .

The problem of measuring the range of the alpha particle of thorium has always presented difficulties on account of its small activity.

The results of earlier workers are:

In 1906. .Bragg <sup>1</sup> .....	3.4 cm approximately
“ 1911. .Geiger and Nuttall <sup>2</sup> ..	2.72 cm
“ 1917. .J. Joly <sup>3</sup> .....	2.90 cm (considered high <sup>4</sup> )

These values are all at  $15^{\circ}\text{C}$ . and 76 cm. of mercury.

The present work, performed under the supervision of Dr. H. L. Bronson, was suggested by Dr. G. H. Henderson as a continuation of the work of Mr. G. C. Laurence who determined the ranges of Uranium I and Uranium II<sup>5</sup>. Since these elements are active Mr. Laurence used a Wilson expansion chamber containing active sources of considerable area and of thickness equivalent to an absorbing powder of one millimeter of air.

Thorium is even more inactive than uranium so we expected to have greater difficulty in getting a sufficient number of tracks. The active sources were obtained by arcing between water-cooled metallic thorium electrodes by means of a 10,000 volt, 500 watt transformer. The pressure of the air was of the order of 10 cm. of mercury. The total arcing time was 6 hours in periods of 5 to 10 minutes with intervals for cooling. The deposit of the evaporated material was accumulated on mica strips wound around the inside of the Pyrex glass tube

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(1) Bragg. Phil Mag 11, pg 754, 1906.

(2) Geiger and Nuttall. Phil Mag 22, pg 613, 1911.

(3) Joly. Proc Roy Inst Great Britain 22, pg 115, 1917.

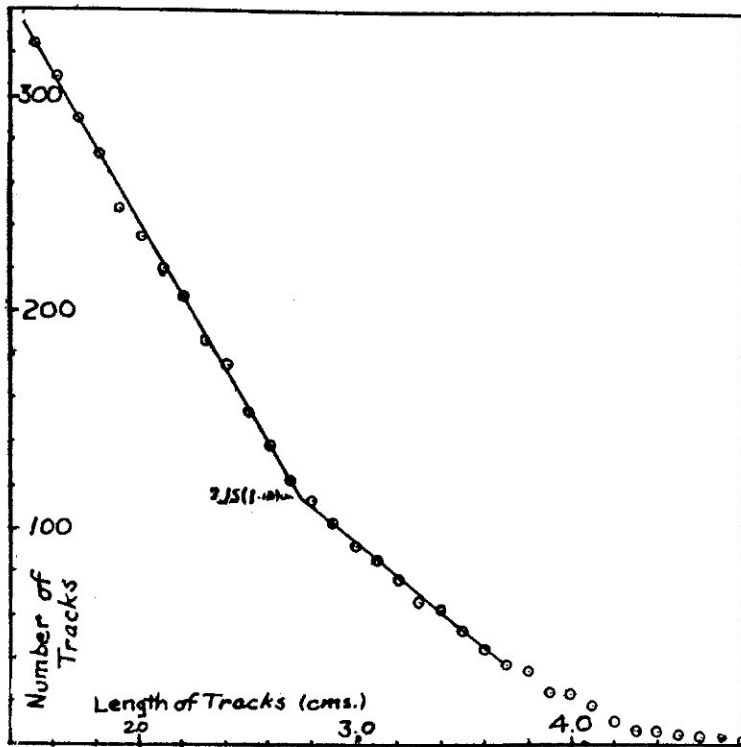
(4) Bulletin of the Research Council (Washington) No 51, pg 68, 1925.

(5) Laurence. Trans N. S. Inst Sci., XVII, part 1, pgs 103-106.

“ also Phil Mag Vol V, pgs 1027-1028, May 1928.

forming the chamber in which the arcing took place. The thickness of deposit used was equivalent to one millimeter of air. This was estimated by weighing to .0001 gm and extrapolating from the table of Marsden and Richardson<sup>6</sup>. A total area of 9 sq. cm. of active source was inserted in the chamber.

As a result of much work more than 800 photographs were taken from which 323 accurately measurable tracks were obtained. (All tracks shorter than 1.50 cm. were disregarded). For each track more than 100 expansions were required and as



the whole thorium family was present the number of expansions per thorium track was very large. These tracks were corrected, as in the work of Mr. Laurence, for vapor pressure (to bring to dry air), finite thickness of source, obliquity to the photographic plate and temperature as determined by an external thermometer.

RESULTS. (All results are for 15° C. and 76 cm. Hg).

(6) Marsden and Richardson. Phil Mag 25, 1913.

The number of tracks of length greater than "x" were plotted against "x" (taking a point every millimeter) and the results obtained are shown in the figure.

A distinct bend in the curve at 2.75 cm. with a probable error of .10 cm. in the determination of this point. This would be due to the thorium alphas.

There are also dips in the curve at 3.70 cm., 3.90cm. and 4.30cm. The dip at 4.30cm. could be accounted for by thorium X, of known range 4.35 cm., which is certainly present as an impurity in the thorium used. We would also expect to have some tracks from radiothorium the isotope of thorium. These would be at 4.02 cm. and correspond to the 3.90 cm. dip within 3%, i. e., within the probable error at this point since it depends on a small number of tracks. The 3.70 cm. dip, if real, has a possible explanation in the foreshortening of the tracks by striking the top or the bottom of the chamber.

#### DISCUSSION.

Since the straggling of the longer alphas of the thorium family causes a masking of the humps in the curve it is very improbable that piling up more tracks from active sources of the same type would improve matters sufficiently to give a more accurate value of the thorium range. To overcome this difficulty one should separate thorium and its radiothorium from their decay products by chemical means and, working rapidly, prepare sources, insert them in the chamber and take photographs up to a time not exceeding 12 hours after the separation. This would be an exceedingly slow and laborious process. For this reason the more easily prepared arced sources from thorium containing its decay products were used in the present work with the hope that an accurate value of the range would be obtained.

In conclusion I wish to express my appreciation of the advice and assistance of Dr. Bronson and other members of the Physics department at Dalhousie, to Mr. Laurence for initiating me into the technique and for other assistance and to Mr. H. C. Rentschler of the Westinghouse Lamp Co., for furnishing the thorium wire.