The Scattering of the α-Particles by Matter.

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In a preliminary note ('Roy. Soc. Proc.,' A, vol. 81, p. 174, 1908) on the above subject, experiments were described which gave direct evidence of the scattering of the α-particles.* In those experiments a strong source of α-radiation was placed at one end of a long exhausted tube, and the α-particles, after passing through a narrow slit, fell upon a zinc sulphide screen sealed to the other end of the tube. When the pressure inside the tube was very low, the narrow line of scintillations which marked the place of incidence of the α-particles on the screen was well defined, but when the rays on their way to the screen passed through gas or through thin metal foils the edges of this line of scintillations became indistinct. The amount of scattering could be estimated for different foils by placing them in the path of the rays and noting the distribution of the scintillations on the screen.

The present investigation was undertaken with a view to obtain a quantitative measurement of the scattering by determining the most probable angle through which an α-particle of definite range is turned by passing through a given thickness of matter. The following are the chief points investigated:—

(1) Determination of the amount of scattering produced in different thicknesses of the same material.
(2) Comparison of the amounts of scattering produced in different materials.
(3) Relation between the velocity of the α-particles and the amount of their scattering.

Experimental Arrangements.

Since the amount by which the α-particles are scattered is comparatively small, accurate measurements could only be obtained in the way outlined above by the use of a very narrow beam of α-particles. In consequence it was necessary to employ a very small and intense source. In the earlier experiments the radiating source consisted of a short glass tube drawn down

* The phenomenon of the scattering of the α-particles was first observed by Rutherford ('Phil. Mag.,' vol. 12, p. 143, 1906), and discussed later by Kucera and Masek, by W. H. Bragg, L. Meitner, and E. Meyer.

conically at one end and closed tightly at the other end by a very thin sheet of mica. The tube was filled with radium emanation and the α-particles expelled from it and its active deposit, could easily pass through the mica window. Although this source fulfilled the conditions of being intense and narrow, it was not suitable for quantitative measurements, as its radiation was not homogeneous, firstly, on account of the different α-ray products present, and, secondly, owing to the absorption by the gas inside the tube. For these reasons the radiating source was modified in a way which will be understood from fig. 1. The conical glass tube A (of less than 2 mm.

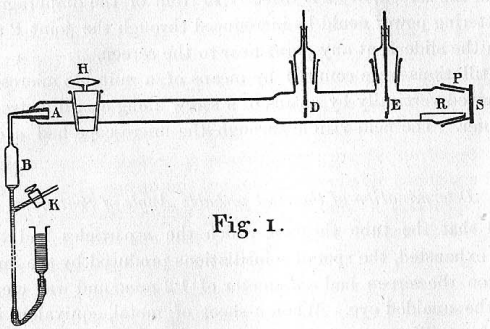

Fig. 1.

diameter at its wider end) was sealed by its narrow end to a glass tube, of very fine bore, leading to the bulb B. A quantity of radium emanation corresponding to about 50 milligrammes $RaBr_2$, which had been partially purified by the methods developed by Prof. Rutherford ('Phil. Mag.,' vol. 16, p. 300, 1908), was introduced into the exhausted bulb B through the stop-cock K. The whole emanation was then compressed into the conical tube by means of mercury. During this process the pressure increased, usually becoming nearly atmospheric. After three hours the active deposit formed from the emanation on the walls of the conical tube had reached nearly its maximum value. At this stage the emanation was expanded again into the bulb B.

On account of the volume of the bulb B being about 200 times that of the conical tube, the pressure on expanding decreased to less than 4 mm., and the amount of α-radiation from the emanation remaining in A was negligible compared with that from the active deposit present on the walls.

Fifteen minutes after the expansion of the emanation, the first product of the active deposit, viz., Radium A, had decayed to an inappreciable value, and