

LXXVI. *The Probability Variations in the Distribution of α Particles.* By Professor E. RUTHERFORD, F.R.S., and H. GEIGER, Ph.D. With a Note by H. BATEMAN*.

IN counting the α particles emitted from radioactive substances either by the scintillation or electric method, it is observed that, while the average number of particles from a steady source is nearly constant, when a large number is counted, the number appearing in a given short interval is subject to wide fluctuations. These variations are especially noticeable when only a few scintillations appear per minute. For example, during a considerable interval it may happen that no α particle appears; then follows a group of α particles in rapid succession; then an occasional α particle, and so on. It is of importance to settle whether these variations in distribution are in agreement with the laws of probability, *i. e.* whether the distribution of α particles on an average is that to be anticipated if the α particles are expelled at random both in regard to space and time. It might be conceived, for example, that the emission of an α particle might precipitate the disintegration of neighbouring atoms, and so lead to a distribution of α particles at variance with the simple probability law.

The magnitude of the probability variations in the number of α particles was first drawn attention to by E. v. Schweidler †. He showed that the average error from the mean number of α particles was $\sqrt{N} \cdot t$, where N was the number of particles emitted per second and t the interval under consideration. This conclusion has been experimentally verified by several

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† v. Schweidler, Congrès Internationale de Radiologie, Liège, 1905.

observers, including Kohlrausch *, Meyer and Regener †, and H. Geiger ‡, by noticing the fluctuations when the ionization currents due to two sources of α rays were balanced against each other. The results obtained have been shown to be in good agreement with the theoretical predictions of von Schweidler.

The development of the scintillation method of counting α particles by Regener, and of the electric method by Rutherford and Geiger, has afforded a more direct method of testing the probability variations. Examples of the distribution of α particles in time have been given by Regener § and also by Rutherford and Geiger ||. It was the intention of the authors initially to determine the distribution of α particles in time by the electric method, using a string electrometer of quick period as the detecting instrument. Experiments were made in this direction, and photographs of the throws of the instrument were readily obtained on a revolving film; but it was found to be a long and tedious matter to obtain records of the large number of α particles required. It was considered simpler, if not quite so accurate, to count the α particles by the scintillation method.