Experimental Arrangement.

The source of radiation was a small disk coated with polonium, which was placed inside an exhausted tube, closed at one end by a zinc sulphide screen. The scintillations were counted in the usual way by means of a microscope on an area of about one sq. mm. of screen. During the time of counting (5 days), in order to correct for the decay, the polonium was moved daily closer to the screen in order that the average number of α particles impinging on the screen should be nearly constant. The scintillations were recorded on a chronograph tape by closing an electric circuit by hand at the instant of each scintillation. Time-marks at intervals of one half-minute were also automatically recorded on the same tape.

After the eye was rested, scintillations were counted from 3 to 5 minutes. The motor running the tape was then stopped and the eye rested for several minutes; then another interval of counting, and so on. It was found possible to count 2000 scintillations a day, and in all 10,000 were recorded. The records on the tape were then systematically

* Kohlrausch, *Wiener Akad.* cxv. p. 673 (1906).

† Meyer and Regener, *Ann. d. Phys.* xxv. p. 757 (1907).

‡ Geiger, Phil. Mag. xv. p. 539 (1908).

§ Regener, *Verh. d. D. Phys. Ges.* x. p. 78 (1908); *Sitz. Ber. d. K. Preuss. Akad. Wiss.* xxxviii. p. 948 (1909).

‖ Rutherford and Geiger, Proc. Roy. Soc. A. lxxxi. p. 141 (1908).

examined. The length of tape corresponding to half-minute marks was subdivided into four equal parts by means of a celluloid film marked with five parallel lines at equal distances. By slanting the film at different angles, the outside lines were made to pass through the time-marks, and the number of scintillations between the lines corresponding to 1/8 minute intervals were counted through the film. By this method correction was made for slow variations in the speed of the motor during the long interval required by the observations.

In an experiment of this kind the probability variations are independent of the imperfections of the zinc sulphide screen. The main source of error is the possibility of missing some of the scintillations. The following example is an illustration of the result obtained. The numbers, given in the horizontal lines, correspond to the number of scintillations for successive intervals of 7·5 seconds.

									Total per minute.
1st minute:	3	7	4	4	2	3	2	0	25
2nd ,,	5	2	5	4	3	5	4	2	30
3rd ,,	5	4	1	3	3	1	5	2	24
4th ,,	8	2	2	2	3	4	2	6	31
5th ,,	7	4	2	6	4	5	10	4	42
Average for 5 minutes ...									30·4
True average									31·0

The length of tape was about 14 cms. for one minute interval. The average number of particles deduced from counting 10,000 scintillations was 31·0 per minute. It will be seen that for the 1/8 minute intervals the number of scintillations varied between 0 and 10; for one minute intervals between 25 and 42.

The distribution of α particles according to the law of probability was kindly worked out for us by Mr. Bateman. The mathematical theory is appended as a note to this paper. Mr. Bateman has shown that if x be the true average number of particles for any given interval falling on the screen from a constant source, the probability that n α particles are observed in the same interval is given by $\frac{x^n}{n!}e^{-x}$. n is here a whole number, which may have all positive values from 0 to ∞. The value of x is determined by counting a large number of scintillations and dividing by the number of intervals involved. The probability for n α particles in the given interval can then at once be calculated from the theory. The following table contains the results of an examination of the groups of α particles occurring in 1/8 minute interval.

For convenience the tape was measured up in four parts, the results of which are given separately in horizontal columns I. to IV.