

The Straggling of Alpha Particles by Matter. G. H. HENDERSON. (*Phil. Mag.*, July, 1922.)—When a beam of parallel alpha rays traverses matter, the several particles meet different experiences in passing through the atoms encountered. As a result of any cross-section of the beam there exist particles having quite different velocities, though Geiger has shown that at the start the alpha particles from radioactive material do not vary in velocity by as much as $\frac{1}{2}$ per cent. Moreover, at the cross-section considered the ranges of the particles are different, that is, the distances the particles will proceed before they cease to be observable. "The alpha particles may be said to be straggled out, and hence the term straggling has been applied to this phenomenon by Darwin."

The Rutherford atom with its positively charged nucleus and its negatively charged satellite electrons lends itself to the calculation of the amount of straggling and accordingly theoretical computations have been made. On the other hand there are two experimental methods of measuring the same quantity. The first is somewhat indirect and depends on the ionization caused by the alpha rays at different sections of their path. The second is based upon direct counts of the number of particles at different parts of their path, and it is of necessity a laborious process since many particles must be counted.

The two results obtained from the experimental methods agree none too well, differing as they do by 50 per cent. or less, yet they do agree in furnishing values three or four times as great as those deduced by theory. "Furthermore the calculated straggling increases steadily with increase of range, while that observed is constant within the limit of error." This constancy the author interprets thus: "This can only mean that the excess straggling takes place only in the last two or three centimetres of the range. From experiments with gold foils which will be discussed later, it appears probable that the straggling is confined to the last few millimetres of the range." A group of gold leaves was located at different parts of the beam. It was found to cause more straggling near the end of the range than elsewhere. The significant feature in this investigation is that experiment brings to light certain features of straggling that the present theory is incompetent to explain. It is at the end of the range that the new effects are noted and it is just there that Shimizu, working on the paths of alpha particles made visible by cloud condensation, encountered still another departure from the behavior predicted by theory. "It is noteworthy that this anomalous behavior of the alpha particle occurs at low velocities, where practically no investigation of the scattering alpha particles has been carried out on account of the experimental difficulties of dealing with slow alpha particles." It may be well to keep in mind that the Rutherford atom was devised to account for a certain effect inexplicable by the views of atomic structure current at that time. If, after mature proving both of the experimental processes and of the theoretical deductions, they persist in remaining in contradiction, then our conception of the atom must be modified.

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