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STUDIES OF ATOMIC NUCLEI[1]

IT is well known that a study of the single scattering of α particles by the elements led to the nuclear theory of the atom, and has provided us with a direct method of measuring the nuclear charge of the elements. The pioneer experiments in this field were made by Geiger and Marsden in 1913, who showed that the number of particles scattered at different angles was in close accord with the nuclear theory, assuming an inverse square law for the forces between the α particle and the nucleus. The variation of scattering with velocity of the α particle was in close accord with this law. Their results were subsequently extended by the experiments of Chadwick, who made direct measurements of the nuclear charge. Most of the experiments of Geiger and Marsden were made with silver and gold. Using α particles of average range about 4 cms of air, they found that the law of inverse square held, at any rate approximately, for the closest distance of approach of the α particle, *viz.,* about 4×10^{-12} cms for gold. These results suggested that the nuclei of even the heavy elements must be of radius less than this small distance.

In a collision of an α particle with a light atom the distance of approach in a close collision is much smaller than the above, and direct evidence has been obtained that the law of the inverse square breaks down completely in the case of a close collision between an α particle and a hydrogen nucleus. More recently Bieer compared the scattering of α particles by aluminium and gold, and found the relative number of particles scattered by aluminium and gold to decrease as the angle of scattering was increased. Assuming that the scattering by gold was normal—*i.e.,* in agreement with an inverse square law—he suggested that the discrepancy in aluminium might be due to the combined action of an attractive force superimposed on a normal repulsive force. From calculation he concluded that an attractive force varying as r^{-4} fitted in best with his experimental results. In the light of these conclusions it became of importance to re-examine the question whether the law of inverse square holds accurately for the heavy elements for the closest possible distances of approach, and to determine as accurately as possible the variation of the scattering with velocity for the lighter elements.

[1] Abstract of a lecture given before the Royal Institution of Great Britain, March 27, 1925.