We now turn to consider the question of atomic structure. In 1895 Lennard made a famous experiment in which he passed electrons through a thin window in the discharge tube where they were made, and was able to observe them outside the tube. Since the electrons could penetrate the windows so easily he concluded that the atoms in the window must have a very open structure and have comparatively large spaces between them. He suggested that the atoms might contain spheres of positive electricity associated somehow with negative charges. A year or two later J. J. Thomson elaborated this idea and calculated how negative electrons would distribute themselves throughout a sphere of positive charge. He was able to explain in this way the fundamental nature of the periodic table.

Now I myself was very interested in the next stage, so I will give you it in some detail, and I would like to use this example to show how you often stumble upon facts by accident. In the early days I had observed the scattering of α-particles, and Dr Geiger in my laboratory had examined it in detail. He found, in thin pieces of heavy metal, that the scattering was usually small, of the order of one degree. One day Geiger came to me and said, "Don't you think that young Marsden, whom I am training in radioactive methods, ought to begin a small research?" Now I had thought that too, so I said, "Why not let him see if any α-particles can be scattered through a large angle?" I may tell you in confidence that I did not believe that they would be, since we knew that the α-particle was a very fast massive particle, with a great deal of energy, and you could show that if the scattering was due to the accumulated effect of a number of small scatterings the chance of an α-particle's being scattered backwards was very small. Then I remember two or three days later Geiger coming to me in great excitement and saying, "We have been able to get some of the α-particles coming backwards . . .". It was quite the most incredible event that has ever happened to me in my life. It was almost as incredible as if you fired a 15-inch shell at a piece of tissue paper and it came back and hit you. On consideration I realized that this scattering backwards must be the result of a single collision, and when I made calculations

discharge tube - Entladungsröhre: Eine Glasröhre zur Erzeugung von Elektronen.

to penetrate – durchdringen

sphere - Bereich

to elaborate - ausarbeiten

to stumble upon sth. - auf etw. stoßen

scattering - Streuung

ought to do sth. - sollte etw. tun

angle - Winkel

accumulated - angehäuft

15 inch = 38,1 cm

tissue paper - Seidenpapier

I saw that it was impossible to get anything of that order of magnitude unless you took a system in which the greater part of the mass of the atom was concentrated in a minute nucleus. It was then that I had the idea of an atom with a minute massive centre carrying a charge. I worked out mathematically what laws the scattering should obey, and I found that the number of particles scattered through a given angle should be proportional to the thickness of the scattering foil, the square of the nuclear charge, and inversely proportional to the fourth power of the velocity. These deductions were later verified by Geiger and Marsden in a series of beautiful experiments.

Now let us consider what deductions could be made at that stage. By considering how close to the nucleus the α-particles could go, and yet be scattered normally, I could show that the size of the nucleus must be very small. I also estimated the magnitude of the charge and made it about a hundred times as great as the electronic charge e. It was not possible to make an accurate estimate, but general evidence indicated that the nucleus of hydrogen must have a charge e, helium $2e$, and so on. Geiger and Marsden examined the scattering in different elements and found that the amount of scattering varied as the square of the atomic weight. This result was rough but quite sufficient: it indicated that the charge on a nucleus was roughly proportional to the atomic weight.

magnitude - Größe

minute - winzig

charge - Ladung

velocity - Geschwindigkeit

deduction - Schlussfolgerung

to estimate - abschätzen

to examine - untersuchen

rough - grob

sufficient - ausreichend

Aus: Rutherford, E. & Ratcliffe, J. A. (1938). Forty Years of Physics. In J. Needham & W. Pagel (Hrsg.), *Background to Modern Science* (S. 47–74). Cambridge: Cambridge University Press.

“In order to account for this large angle scattering of α particles, I supposed that the atom consisted of a positively charged nucleus of small dimensions in which practically all the mass of the atom was concentrated. The nucleus was supposed to be surrounded by a distribution of electrons to make the atom electrically neutral, and extending to distances from the nucleus comparable with the ordinary accepted radius of the atom. Some of the swift α particles passed through the atoms in their path and entered the intense electric field in the neighbourhood of the nucleus and were deflected from their rectilinear path.”

in order to account for sth. - um etw. zu erklären

distribution - Verteilung
to extend - ausdehnen
ordinary - allgemein
swift - schnell

to deflect - ablenken
rectilinear - geradlinig

Aus: Rutherford, E. (1914). The structure of the atom. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, *27*(159), 488–498. https://doi.org/10.1080/14786440308635117