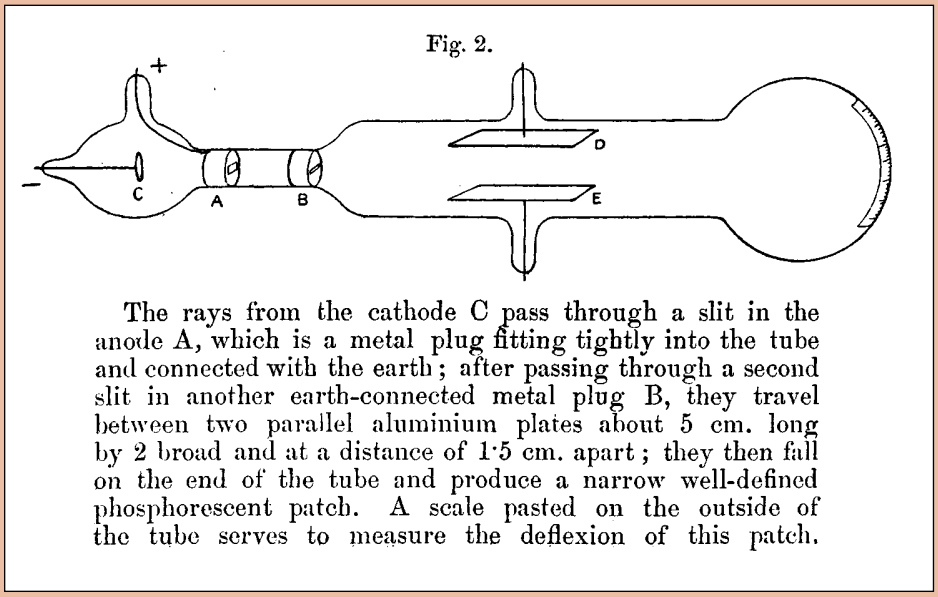

Figure from Thomson's first paper (together with explanatory text) illustrating the apparatus he used to measure e/m.

to envision atoms as made of "primordial atoms, which we shall for brevity call corpuscles." He went on:

> The smallness of the value of *m/e* is, I think, due to the largeness of *e* as well as the smallness of *m*. There seems to me to be some evidence that the charges carried by the corpuscles in the atom are large compared with those carried by the ions of an electrolyte.

Over the next two years, Thomson determined the mass and charge of his corpuscles, but it took additional experiments culminating in a second paper, "On the Masses of the Ions in Gases at Low Pressures," [*Phil. Mag.*, Ser. 5, Vol. 48, No. 295 (1899), p. 547]. Using a novel technique developed by his student C. T. R. Wilson, he measured both *m/e* and *e* for the negatively charged particles created by dissociation of atoms in ultraviolet light. He found *m/e* to be the same as for cathode rays and *e* to have the same absolute value as the hydrogen ion in electrolysis. Thus he concluded:

> The experiments just described, taken in conjunction with the previous ones on the value of *m/e* for the cathode rays . . . show that in gases at low pressures negative electrification, though it may be produced by very different means, is made up of units each having a charge of electricity of a definite size; the magnitude of this negative charge is about 6×10^{-10} electrostatic units, and is equal to the positive charge carried by the hydrogen atom in the electrolysis of solutions.
>
> In gases at low pressures these units of negative electric charge are always associated with carriers of a definite mass. This mass is exceedingly small, being only about 1.4×10^{-3} of that of the hydrogen ion, the smallest mass hitherto recognized as capable of a separate existence. The production of negative electrification thus involves the splitting up of an atom, as from a collection of atoms something is detached whose mass is less than that of a single atom.

Thus was the first elementary particle finally discovered and the field of particle physics born. Educated at Cambridge as a mathematical physicist, Thomson seems to have grasped the importance of his breakthrough almost immediately. For he ended his second paper with some bold speculations about its ultimate significance:

> From what we have seen, this negative ion must be a quantity of fundamental importance in any theory of electrical action; indeed, it seems not improbable that it is the fundamental quantity in terms of which all electrical processes can be expressed. For, as we have seen, its mass and its charge are invariable, independent both of the processes by which the electrification is produced and of the gas from which the ions are set free. It thus possesses the characteristics of being a fundamental conception in electricity; and it seems desirable to adopt some view of electrical action which brings this conception into prominence.

Within a few years most physicists recognized Thomson's new particle by the name "electron," the term George Stoney had coined for the fundamental unit of charge (see main text). But Thomson stuck resolutely by his beloved "corpuscle" and still refused to call it anything else upon receiving the 1906 Nobel Prize in Physics "in recognition of the great merits of his theoretical and experimental investigations on the conduction of electricity by gases."

—M.R.