

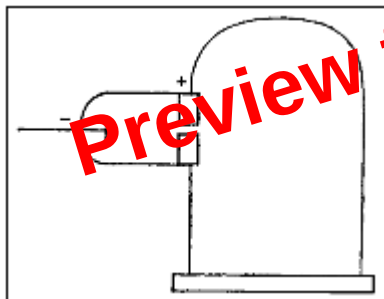
The cathode ray (blue line) was deflected by the electric field (yellow).

In his second experiment, he investigated whether or not the rays could be deflected by an electric field. Previous experimenters had failed to observe this, but Thomson believed their experiments were flawed because their tubes contained too much gas.

Thomson constructed a Crookes tube with a near-perfect vacuum. At the start of the tube was the cathode from which the rays projected. The rays were sharpened to a beam by two metal slits - the first of these slits doubled as the anode, the second was connected to the earth. The beam then passed between two parallel aluminium plates, which produced an electric field between them when they were connected to a battery. The end of the tube was a large sphere where the beam would impact on the glass, created a glowing patch. Thomson pasted a scale to the surface of this sphere to measure the deflection of the beam.

When the upper plate was connected to the negative pole of the battery and the lower plate to the positive pole, the glowing patch moved downwards, and when the polarity was reversed, the patch moved upwards.

Third experiment



Thomson's third experiment.

In his third experiment, Thomson measured the mass-to-charge ratio of the cathode rays by measuring how much they were deflected by a magnetic field and how much energy they carried. He found that the mass to charge ratio was over a thousand times lower than that of a hydrogen ion (H^+), suggesting either

that the particles were very light and/or very highly charged.

Conclusions

As the cathode rays carry a charge of negative electricity, are deflected by an electrostatic force as if they were negatively electrified, and are acted on by a magnetic force in just the way in which this force would act on a negatively electrified body moving along the path of these rays, I can see no escape from the conclusion that they are charges of negative electricity carried by particles of matter.

—J. J. Thomson

As to the source of these particles, Thomson believed they emerged from the molecules of gas in the vicinity of the cathode.