

# The Conceptual History of the Classical Electron

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## Summary

This work examines the notion of the "Scientific Revolution" as it may be applied to the development of a single concept: that of the electron. It spans a period of approximately 400 years and traces the development of both the theoretical as well as the experimental work which finally led to the concept of the electron.

The concept of the "Scientific Revolution" as developed by Thomas Kuhn will be examined and discussed with respect to whether it may be directly applied to the areas of electricity and electromagnetism. It will become apparent that each significant series of new discoveries in this area was preceded by the development of various devices which allowed these discoveries to be made. Specifically the development of vacuum pumps, vacuum tubes, reliable sources of electricity and the cloud chamber will be discussed in some detail.

The discussion will start with the early documented discoveries and speculations on the nature of static electricity and magnetism. The development of Volta's pile allowed work to commence on the effects of a continuous current of electricity and later into the electromagnetic nature of this current. This will be followed by the work on electrical discharges in evacuated glass tubes which ultimately led to the discovery of the particle nature of cathode rays.

The focus of this thesis will be on the work carried out in the later part of the Nineteenth Century, much of it in the Cavendish Laboratory at Cambridge. A detailed discussion of the work of J.J.Thomson and his students C.T.R.Wilson, J.Townsend, H.A.Wilson and E.Rutherford will be made. The work of the Dutchman, P.Zeeman will also be considered since the discovery of the Zeeman Effect and its subsequent explanation supported the existence of a negatively charged subatomic particle.

The experimental determination of the magnitude of the unit electric charge on the electron will also be discussed from the early work at the Cavendish to R.A.Millikan's successful oil drop experiment and the later X-ray diffraction methods. This section will conclude with a description of T.H.Laby's work in Melbourne around 1940.

This work will conclude with a brief exposition of the theoretical development of the electron theory of matter. Specifically the work of J.C.Maxwell and H.A.Lorentz will be examined against the background of the concepts of the aether and force at a distance. Since this is a history of the classical electron the vast history of the development of quantum ideas is not a part of this story consequently the final chapter will very briefly mention the developments of quantum mechanics and the development of modern atomic theory.

## **Certificate of Submission**

This is to certify that this thesis had not been submitted for a higher degree to any other university or institution.

Anna-Eugenia Binnie

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