

Historical background electrophorus

The electrophorus was initially developed by the Swedish researcher Wilcke who in 1761 described a resin cake that can be used for producing electrical charges. However, most researchers in the field of electricity remained ignorant of Wilcke's work; and the electrophorus was particularly made known by the Italian Alessandro Volta (who is best known for his invention of the battery). Volta also claimed to have invented the device. However, it is unclear whether he had been familiar with Wilcke's work or whether his work serves as an example of an independent development.

The operations with the electrophorus are fairly straightforward: The instrument consists (simplified speaking) of a resin cake which is placed inside a bowl that has a metallic bottom which is grounded. At the beginning of the experiment, the electrophorus is rubbed and charges are separated. A metallic plate which is suspended from insulating fibers is placed on the resin cake and grounded. When the grounding is removed, the metal plate is lifted, and the experimenter can draw a spark from it. This can be repeated almost forever (realistically speaking for a day or so) without having to rub the resin cake ever again. This ability to produce sparks without being recharged again is the reason why Volta called the instrument *elettroforo perpetuo* (permanent electricity producer). From a modern point of view, the instrument can be described as an electrostatic generator which is based on induction.



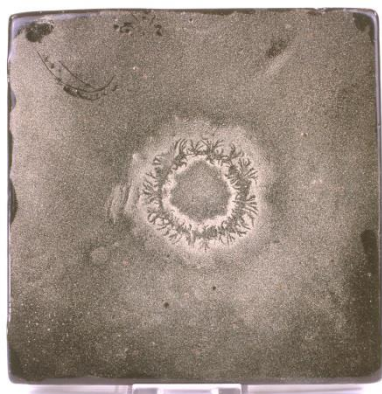
Reconstruction of Volta's electrophorus

Even though Volta tried to use the instrument as an argument in the dispute whether electrical phenomena are the result of one electrical fluid or of two electrical fluids, it turned out that the device was not suitable for this purpose and could (like all the other electrical phenomena) be explained with both conceptual ideas. However, another researcher worked with the electrophorus, and he seemingly made an observation that could be used as evidence for the two fluid theory. The name of this researcher was Georg Christoph Lichtenberg.

Lichtenberg was physics professor in Göttingen and was extremely well known for his experimental lectures on natural philosophy. When he learned about the electrophorus, he decided that this was a device that would be useful to have another attraction in his demonstrations. Lichtenberg started making several electrophori, the largest with a diameter of approximately 2m. One of the things he needed to do to improve the performance of the electrophorus was to smoothen the surface. As a result, the workshop was full of dust, and this enabled Lichtenberg to make a remarkable observation: At places in the resin cake where discharges had taken place, the dust formed specific figures: Actually, there were two types of figures, one representing the discharge of one type of electricity, the other occurring when the discharge took place with the other type of electricity. The advocates of the two fluid theory quickly pointed out that this was an evidence for their theory. However, Lichtenberg himself took a completely different, and in some respect new, perspective: He explained that the result could also be explained with a one fluid theory, and thus the instrument's behavior was inconclusive in this respect. However, Lichtenberg made two more points: He stated that the controversy had become ineffective with respect to research in natural philosophy, and thus should be postponed until further evidence would be produced by new experiments. Moreover, Lichtenberg argued that one could use the mathematical signs '+' and '-' to distinguish both kinds of electricity – either meaning surplus or lack of electrical fluid compared to the natural state, or indicating with which of the two different types of electricity an object has been charged.



Positive Lichtenberg-figure



Negative Lichtenberg-figure

References

Heilbron, J. L. (1979). *Electricity in the 17th and 18th Centuries*. Berkeley, Los Angeles, London: University of California Press.

Lichtenberg, G. C. (1778). *De nova methodo naturam ac motum fluidi electrici investigandi commentatio posterior*. Gottingae: Dieterich.

Meya, J., & Sibum, H. O. (1987). *Das fünfte Element*. Reinbek bei Hamburg.

Verrecchia, A. (1967). Lichtenberg und Volta. *In: Sudhoffs Archiv Band 51*, S. 349 - 360.

Background electrophorus was written by P. Heering with the support of the European Commission (project 518094-LLP-1-2011-1-GR-COMENIUS-CMP) and University of Flensburg, Germany. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.