Stories of Science: Georg Ohm

The story of Ohm's difficult rise to success

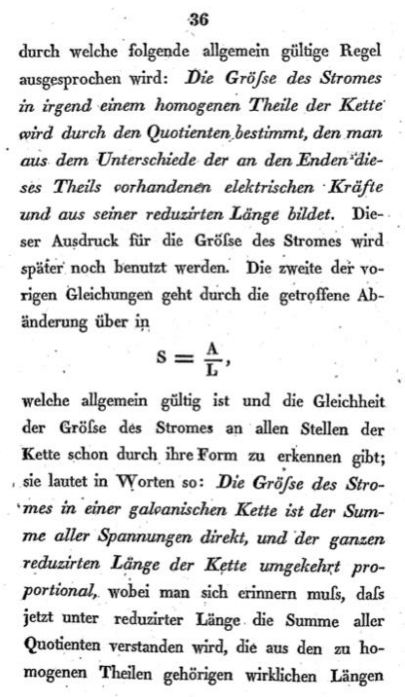
There are few scientific laws that are as well known as Ohm's law. One might imagine that Georg Ohm's contribution to physics would have secured him fame and academic approval but his story reveals that scientific ideas, even very good ones, sometimes take time to be accepted.

Dancing, ice-skating and billiards

Ohm was born in Erlangen in modern day Germany to parents who had no formal education. His father worked as a locksmith and this background, it is reported, helped develop the young scientist's technical skills. Despite his lack of academic schooling, Georg's father had taught himself mathematics, philosophy and science and passed his knowledge on to Georg and his brother Martin (who would become a professor of mathematics). After school, Georg went on to study at the University of Erlangen. After three terms at university, Georg's father found out that his son was spending his time dancing, ice-skating and playing billiards, and Georg was made to leave his course.

The struggling teacher

Ohm's father sent Georg to Swtizerland to work as a school mathematics teacher. In order to have more time to prusue his own reading, Ohm left full-time teaching to become a private tutor, before returning to the university of Erlangen to continue his studies. After getting his PhD, Georg became a lecturer, but couldn't afford to live on the small salary and took a post as a science and mathematics teacher at a challenging school in Bamberg. Whilst working as a teacher, Ohm wrote a textbook on geometry which he sent to the King of Prussia. The King was pleased with the book and offered Ohm a role in a better school where Ohm finally had time to continue his scientific research.



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durch welche folgende allgemein gültige Regel ausgesprochen wird: *Die Gröfse des Stromes in irgend einem homogenen Theile der Kette wird durch den Quotienten bestimmt, den man aus dem Unterschiede der an den Enden dieses Theils vorhandenen elektrischen Kräfte und aus seiner reduzirten Länge bildet.* Dieser Ausdruck für die Gröfse des Stromes wird später noch benutzt werden. Die zweite der vorigen Gleichungen geht durch die getroffene Abänderung über in

$$s = \frac{A}{L},$$

welche allgemein gültig ist und die Gleichheit der Gröfse des Stromes an allen Stellen der Kette schon durch ihre Form zu erkennen gibt; sie lautet in Worten so: *Die Gröfse des Stromes in einer galvanischen Kette ist der Summe aller Spannungen direkt, und der ganzen reduzirten Länge der Kette umgekehrt proportional,* wobei man sich erinnern mufs, dafs jetzt unter reduzirter Länge die Summe aller Quotienten verstanden wird, die aus den zu homogenen Theilen gehörigen wirklichen Längen

Ohm alone – getting accepted

Ohm's new school was known to have excellent practical equipment. At that time, it had been assumed that the current that flowed in a circuit was unrelated to the voltage applied. Ohm doubted this claim and set about trying to show it was wrong. To measure currents, he used an early form of ammeter consisting of a magnetised needle (like in a compass) and measured its deflection to indicate the size of the current flowing. He recorded the deflection of the needle with different lengths of wire placed alongside the needle. The data he collected allowed him to propose the relationship S=A/L where S represented the strength of current; A, the sum of all the tensions; and L the 'Reduzirten Lange' or the resistance. Ohm wasn't the first person to propose this relationship, it had been suggested some seventy years earlier by Cavendish whose work had remained unpublished. It is worth noting that scientists think of Ohm's law as a *ceteris paribus* law, meaning one that is not universally true but only holds if certain conditions are met, for example if temperature is kept constant. Ohm also produced a second law, his acoustic law, that states that musical sounds can be broken down into a series of pure notes.

Unfortunately for Ohm, his writing was difficult for other scientists to read and they found it difficult to understand his argument. Nowhere in his book did Ohm make clear what his central argument was and his now famous relationship is buried amongst many other mathematical equations. One of his critics commented that his work was: '…a web of naked fancies, which can never find the semblance of support from even the most superficial observation of facts'. The minister of education read his work and commented that a teacher who could produce such writing was unworthy to teach science. The negative reception of Ohm's work meant he had to resign his teaching post. However, his luck finally changed and he was appointed Professor of Physics at the University of Munich, though he was only to hold the post for two years before his death. It was only through the intervention of other scientists, including Gustav Kirchhoff and Charles Wheatstone, who correctly interpreted Ohm's abstract language, that the value of Ohm's electrical law finally began to be appreciated by his fellow scientists.

Comprehension and Reflection Questions

1. What experiment did Ohm carry out as he was developing his law?

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2. Why was his law not accepted quickly?

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3. What modern electrical concept would be used form the letter A, the sum of the tensions, in Ohm's formula?

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4. What is Ohm's Law?

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5. Why is Ohm's law a *ceteris paribus* law?

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6. Can you name a scientific law that is universally true?

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Extension Activities

Ideas for things to do next:

Several other well-known scientific ideas have taken a long time to get accepted. For example, Ignaz Semmelweis' notion that doctors should wash their hands before treating patients.

Research other scientific ideas that were slow to be accepted. What prevented those ideas from being adopted by other scientists?

If you could go back in time and advise Georg Ohm on making his research more likely to be accepted, what would you say? What guidelines could you write for scientists to clearly communicate their work?

Further Reading

Ideas for things to read next:
You can read more detail about Georg Ohm's life here:
http://www-history.mcs.st-andrews.ac.uk/Biographies/Ohm.html

Watch this clip about Ohm's life:
https://www.youtube.com/watch?v=mB1z_x7J5Aw