

Oliver Heaviside

Oliver Heaviside (May 18, 1850 – February 3, 1925), an outstanding self-taught physicist, electrical engineer and mathematician, predicted the existence of the ionosphere and developed much of the mathematics behind the theory of telegraphy and electric circuits. He adapted complex numbers to the study of electrical circuits and applied Laplace transforms to the solution of differential equations.



Heaviside was born in the slums of London and as a young child he was afflicted with scarlet fever, which forever affected his hearing. His increasing deafness may partly explain his combative nature and his being constantly embroiled in controversy. He ended his schooling at the age of 16, and although a top student in almost every way, he failed geometry. Heaviside took work as a telegrapher, which drew him to an independent study of electricity. When he read James Clerk Maxwell's new *Treatise on Electricity and Magnetism* it changed his life and he enthusiastically took up his own researches in electricity. He published two papers in 1872 and 1873, which Maxwell found so interesting he mentioned their results in the second edition of his book. Heaviside quit his job and in a flash of intuition reformulated and reduced Maxwell's cumbersome 20 equations in 20 variables of his field theory to two equations in two variables.

Heaviside stumbled on the radical new idea of vector analysis, and between 1880 and 1887, armed with this theory he developed a strange new and powerful tool called operational calculus. It is a method for efficiently solving differential equations, which is now employed in various different branches of pure mathematics. Heaviside was never much interested in rigor or proof and it showed in his methods. He was contemptuous of what he called the "logic-choppers" and cared nothing for the opinions of other scientists. His techniques seemed to pure mathematicians to be unjustified and outlandish. It would take other physicists and mathematicians to put his theory in order, but Heaviside's intuition about the importance of his work was on target. Heaviside stated his opinion on the matter as follows:

"The prevalent idea of mathematical works is that you must understand the reason why first, before you proceed to practice. That is fudge and fiddlesticks. I know mathematical processes that I have used with success for a very long time, of which neither I nor anyone else understands the scholastic logic. I have grown into them, and so understand them that way. "

In 1901 Guglielmo Marconi transmitted radio signals across the Atlantic Ocean, though he was not able to explain why they were not stopped by the curvature of the Earth. A year later, independently and almost simultaneously, American electrical engineer Arthur E.

Kennelly and Heaviside predicted the existence of an electrically conducting gaseous layer (the ionosphere) in the atmosphere, by means of which radio signals are transmitted around the earth's curvature. Heaviside made his prediction in an article he contributed to the tenth edition of the *Encyclopedia Britannica*. In 1925 British scientists Sir Edward Appleton and M.A.F. Barnett experimentally demonstrated the existence of the Heaviside layer in the upper atmosphere.

The ionosphere is the part of the Earth's upper atmosphere where ions and electrons are present in sufficient quantities to affect the propagation of radio waves. In his 1887 paper, "Electromagnetic induction and its propagation," Heaviside became the first to give the conditions necessary to transmit a signal without distortion. When his idea for an induction coil to increase induction didn't excite much interest in Great Britain, he dropped the idea, but Michael Pupin of Columbia University, who read Heaviside's papers, patented the idea in the U.S. in 1904.

While Heaviside received many honors, including being elected a Fellow of the Royal Society in 1891, he became more and more bitter as the years went by. Sick of fighting for the recognition he and his work deserved he moved to Torquay in Southwest England where he showed increasing evidence of a persecution complex. He lived as a virtual hermit in his lodgings for 25 years. He signed the initials W.O.R.M. after his name, for worm was all he felt he was in other people's eyes. Burglars destroyed the last, unpublished, volume of his *Electromagnetic Theory* a few days after his death from jaundice. It was known to have described a unified field theory combining electromagnetism and gravitation.

Andrew Lloyd Webber's famous musical *CATS* (1981) is based on T.S. Eliot's book of children's verses, *Old Possum's Book of Practical Cats* (1969). In the musical Old Deuteronomy is the oldest and most respected of the Jellicoe cats. Each year he shows up at the annual Jellicoe Ball where he chooses one of the flawed felines to ascend to the "heaviside layer" (the feline version of heaven), where she will be reborn and come back to a different life. One of Webber's songs is "Journey to the Heaviside Layer," featuring the line: "Up, up, up, up to the Heaviside Layer."

Quotation of the Day: "Mathematics is an experimental science, and definitions do not come first, but later on." – Oliver Heaviside