Magnetic Field Encyclopedia Article

Magnetic Field

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William Gilbert, who experimented with navigational compasses, suggested that the Earth itself was a great spherical magnet. This implied that Earth had a magnetic field which caused compass needles to point north, but this magnetic field was more an object of theory than actual fact.

In 1819 Hans Christian Oersted discovered that electric current passing through a wire affected the direction in which a compass needle pointed. This remarkable discovery showed that it did not involve a magnet as much as it involved electricity; it also implied that a magnetic field was responsible. The discovery linking magnetism with electricity set off a flurry of experimentation, however the magnetic field itself still remained an object of theory.

One scientist seized on Oersted's discovery and set about to reverse the procedure--if electricity could produce a magnetic attraction, reasoned Michael Faraday, then it should be possible to produce electricity from magnetism. In 1821 Faraday succeeded in his attempt, creating the first transformer. The results were not as Faraday had expected. In an attempt to visualize how the magnet and electricity were interacting with each other, Faraday sprinkled iron filings on a paper and held it over the apparatus. When the paper was tapped he saw the filings line themselves up along the "magnetic lines of force," a term he coined. Here was definite proof of the existence of the magnetic field.

Faraday's discovery had far-reaching implications. The magnetic field established a new picture of the universe, one that consisted of energy fields of various types, magnetic and electric, interacting with each other.

James Clerk Maxwell played a major role in the field of magnetic research. A brilliant mathematician, Maxwell established precise equations that covered all the various forms of electricity and magnetism and linked them together. He showed that the two forces could not exist alone; where there was one, there was the other. His work became known as the electromagnetic theory.

Maxwell's equations, developed from 1864 through 1873, showed that magnetic (and electric) fields radiated outward in a wave motion, linking them with light waves. He went on to conclude (correctly) that there was a vast range of electromagnetic radiation of which visible light was just a small part. It has been well over a century since Maxwell undertook his work with magnetic fields, but his equations are as valid today as when they were first derived.