Research & Reviews: Journal of Pure and Applied Physics ISSN: 2320-2459

Historical Development of Electricity and Magnetism in Applied Physics

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Opinion Article

Received: 25-May-2022 Manuscript No. JPAP-22-52065; **Editor assigned:** 27-May-2022 Pre QC No. JPAP-22-52065(PQ); **Reviewed:** 10-Jun-2022, QC No. JPAP-22-52065; **Revised:** 17-Jun-2022, Manuscript No. JPAP-22-52065(R) **Published:** 24-Jun-2022, DOI:10.4172/2320-2459.10.S2.001.

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ABOUT THE STUDY

The electricity and magnetism were considered to be two separate forces. This view changed with the publication of James Clerk Maxwell's 1873 a treatises on electricity and magnetism in which the interactions of positive and negative charges were shown to be mediated by one force. There are four main effects resulting from these interactions, all of which have been clearly demonstrated by experiments; Electric charges attract or repel one another with a force inversely proportional to the square of the distance between them; unlike charges attract, like ones repel.

Magnetic poles (or states of polarization at individual points) attract or repel one another in a manner similar to positive and negative charges and always exist as pairs: every north pole is yoked to a south pole.

An electric current inside a wire creates a corresponding circumferential magnetic field outside the wire. Its direction (clockwise or counter-clockwise) depends on the direction of the current in the wire. A current is induced in a loop of wire when it is moved toward or away from a magnetic field, or a magnet is moved towards or away from it; the direction of current depends on that of the movement.

In April 1820, Hans Christian Ørsted observed that an electrical current in a wire caused a nearby compass needle to move. At the time of discovery, Ørsted did not suggest any satisfactory explanation of the phenomenon, nor did he try to represent the phenomenon in a mathematical framework. However, three months later he began more intensive investigations. Soon thereafter he published his findings, proving that an electric current produces a magnetic field as it flows through a wire. The CGS unit of magnetic induction (oersted) is named in honor of his contributions to the field of electromagnetism. His findings resulted in intensive research throughout the scientific community in electrodynamics. They influenced French physicist André-Marie Ampère's developments of a single

mathematical form to represent the magnetic forces between current-carrying conductors. Ørsted's discovery also represented a major step toward a unified concept of energy.

This unification, which was observed by Michael Faraday, extended by James Clerk Maxwell, and partially reformulated, by Oliver Heaviside and Heinrich Hertz, is one of the key accomplishments of 19th century mathematical physics. It has had far-reaching consequences, one of which was the understanding of the nature of light. Unlike what was proposed by the electromagnetic theory of that time, light and other electromagnetic waves are at present seen as taking the form of quantized, self-propagating oscillatory electromagnetic field disturbances called photons. Different frequencies of oscillation give rise to the different forms of electromagnetic radiation, from radio waves at the lowest frequencies, to visible light at intermediate frequencies, to gamma rays at the highest frequencies. Ørsted was not the only person to examine the relationship between electricity and magnetism. In 1802, Gian Domenico Romagnosi, an Italian legal scholar, deflected a magnetic needle using a Voltaic pile. The factual setup of the experiment is not completely clear, nor if current flowed across the needle or not. An account of the discovery was published in 1802 in an Italian newspaper, but it was largely overlooked by the contemporary scientific community, because Romagnosi seemingly did not belong to this community. An earlier (1735), and often neglected, connection between electricity and magnetism was reported by a Dr. Cookson.

CONCLUSION

A tradesman at Wakefield in Yorkshire, having put up a great number of knives and forks in a large box and having placed the box in the corner of a large room, there happened a sudden storm of thunder, lightning, &c. The owner emptying the box on a counter where some nails lay, the persons who took up the knives, which lay on the nails, observed that the knives took up the nails. On this the whole number was tried, and found to do the same, and that, to such a degree as to take up large nails, packing needles, and other iron things of considerable weight. E. T. Whittaker suggested in 1910 that this particular event was responsible for lightning to be "credited with the power of magnetizing steel; and it was doubtless this which led Franklin in 1751 to attempt to magnetize a sewing-needle by means of the discharge of Leyden jars.