When was it realized magnetism circles the cable, electric rays shoot out

It was first realised that magnetism circles a wire in **1820**, when Danish physicist Hans Christian Ørsted discovered that an electric current creates a circular magnetic field.

The Circular Magnetic Field (1820)

While preparing for a lecture in April 1820, Ørsted noticed that a compass needle deflected when placed near a wire carrying an electric current.

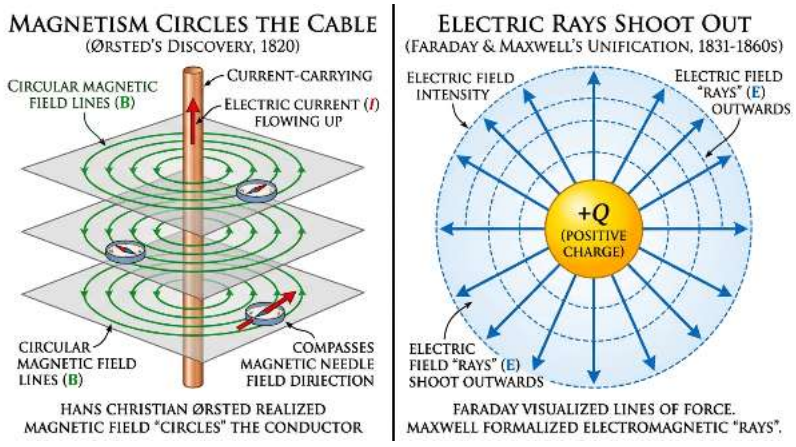
- **Initial Observation**: He initially thought the magnetic effect might radiate straight out like light or heat.
- **The "Circular" Realisation**: After months of intensive investigation, he published his findings in **July 1820**, proving that the magnetic field actually **circles around the wire** in a closed loop.
- **Impact**: This discovery, known as **Oersted's Law**, provided the first experimental proof that electricity and magnetism were linked, founding the field of **electromagnetism**.

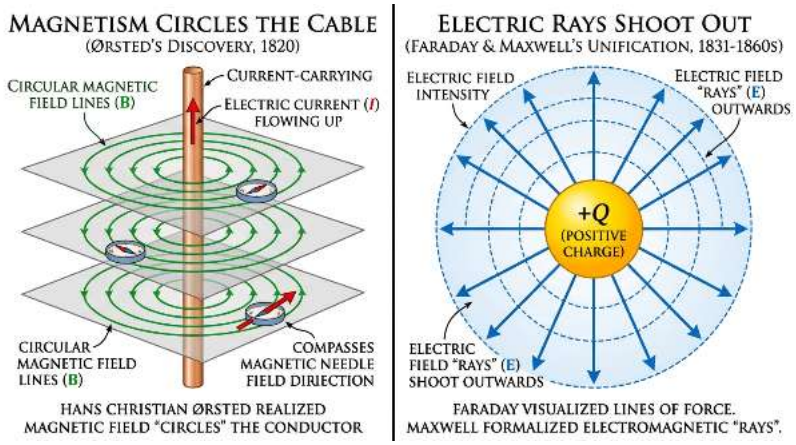
"Electric Rays" and Lines of Force (1831–1860s)

The concept of "rays" or "lines" of force shooting out was later developed primarily by Michael Faraday **and** James Clerk Maxwell.

- **Faraday's Visualisation (1831)**: Michael Faraday introduced the concept of **lines of force** to describe how magnetic and electric fields extend into the space around a conductor. He visualised these fields as physical "lines" or "rays" that push or pull objects.
- **Maxwell's Unification (1861–1865)**: James Clerk Maxwell formalised these ideas mathematically. He showed that changing electric fields produce magnetic fields and vice versa, which travel through space as **electromagnetic waves** (often described as "rays" of light or radiation).

Below is a **diagram** of how the magnetic field circles a wire versus how electric field lines radiate from a charge?





The difference between these fields comes down to how they originate:

1. Magnetic Field (Circles)

When an electric current flows through a straight wire, it creates a magnetic field that forms **concentric circles** around the wire.

- **Rule**: You can find the direction of these circles using the Right-Hand Grip Rule. If you point your right thumb in the direction of the current, your fingers curl in the direction of the magnetic field lines.
- **Shape**: These lines form closed loops; they have no beginning or end.

2. Electric Field (Rays)

Electric fields originate from stationary charges (like an electron or proton) and radiate in straight lines, often called **"electric rays"** or lines of force.

- **Direction**: For a positive charge, the lines **radiate outward** in all directions. For a negative charge, they point inward.
- **Shape**: Unlike magnetic loops, these lines are radial and open—they start at a positive charge and end at a negative charge or extend to infinity.

When these two types of fields—the **circular** magnetic loops and the **radiating** electric "rays"—interact, they create **electromagnetic waves**, which is what light actually is.

How Light Is Made

If you "shake" or oscillate an electric charge, it creates a ripple effect:

1. **Changing Electric Field**: Moving the charge creates a changing electric field that "shoots out."
2. **Creating Magnetism**: This changing electric field automatically generates a magnetic field that "circles" it.
3. **The Chain Reaction**: These two fields regenerate each other in a continuous cycle, pushing the wave forward through space at the **speed of light**.

Key Differences at a Glance

Feature	Magnetic Field (B)	Electric Field (E)
Path	Closed loops (Circles)	Radial lines (Rays)
Source	Moving charges (Current)	Stationary charges
Start/End	No start or end point	Start at + and end at -

This synergy is what allowed Maxwell to prove that electricity, magnetism, and light are all manifestations of the same phenomenon.

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