

19th-Century Mathematical Physics

When a compass needle is placed near a wire that carries electrical current, it is deflected: this observation, relating electricity and magnetism, led to the scientific study of electromagnetism. The first mathematical physicist to apply advanced mathematics to magnetic and electrical phenomena was the Frenchman **André-Marie Ampère** (1775–1836), after whom the SI unit of current flow is named. Ampère's law relates the magnetic field between two wires to the product of the currents in them.

In 1851, **Léon Foucault** (1819–1868) presented his pendulum experiment, designed to illustrate the rotation of the earth. A heavy ball was suspended from the dome of the Panthéon in Paris by a long wire and allowed to swing. After a while, the path of **Foucault's pendulum** had shifted, showing that the earth must be rotating on its axis.

In Germany, **Friedrich Wilhelm Bessel** (1784–1846) made measurements on over 50,000 stars, and was the first to use the method of parallax to measure interstellar distances. In 1817, while investigating a problem of Kepler, he introduced the **Bessel functions** $J_n(x)$, which satisfy a certain second-order differential equation and have applications throughout physics; the German stamp shows the graphs of $J_0(x)$ and $J_1(x)$.

Bessel functions also arise in the solution of Helmholtz's wave equation when cylindrical or spherical symmetry is involved. **Hermann von Helmholtz** (1821–1894) was a German physicist, mathematician, and biologist who wrote on the mathematics of sound and electromagnetic waves, formulated the general law of conservation of energy, and invented the ophthalmoscope for viewing the eye.



André-Marie Ampère



Léon Foucault



Foucault's pendulum



Friedrich Bessel



Bessel functions



Hermann von Helmholtz

> Column editor's address: **Robin Wilson**, Mathematical Institute,
Andrew Wiles Building, University of Oxford, UK
e-mail: rj.wilson@open.ac.uk