Relation between electricity, magnetism, and the speed of light

The relation between electricity, magnetism, and the speed of light can be summarized by the modern equation:

$$c = 1/\mathrm{sqrt}\{\mu_0\ \varepsilon\}.$$

The left-hand side is the speed of light, and the right-hand side is a quantity related to the equations governing electricity and magnetism. Although the right-hand side has units of velocity, it can be inferred from measurements of electric and magnetic forces, which involve no physical velocities. Therefore, establishing this relationship provided convincing evidence that light is an electromagnetic phenomenon.

The discovery of this relationship started in 1855, when Wilhelm Eduard Weber and Rudolf Kohlrausch determined that there was a quantity related to electricity and magnetism, "the ratio of the absolute electromagnetic unit of charge to the absolute electrostatic unit of charge" (in modern language, the value $1/\mathrm{sqrt}\{\mu_0\ \varepsilon\}$., and determined that it should have units of velocity. They then measured this ratio by an experiment which involved charging and discharging a Leyden jar and measuring the magnetic force from the discharge current, and found a value 3.107 $x10^8$ m/s remarkably close to the speed of light, which had recently been measured at 3.14 $x10^8$ by Hippolyte Fizeau in 1848 and at 2.98 $x10^8$ m/s by LÈon Foucault in 1850. However, Weber and Kohlrausch did not make the connection to the speed of light Towards the end of 1861 while working on part III of his paper On Physical Lines of Force, Maxwell travelled from Scotland to London and looked up Weber and Kohlrausch's results. He converted them into a format which was compatible with his own writings, and in doing so he established the connection to the speed of light and concluded that light is a form of electromagnetic radiation

The concept of fields was introduced by, among others, Faraday. Albert Einstein wrote:

> The precise formulation of the time-space laws was the work of Maxwell. Imagine his feelings when the differential equations he had formulated proved to him that electromagnetic fields spread in the form of polarised waves, and at the speed of light! To few men in the world has such an experience been vouchsafed ... it took physicists some decades to grasp the full significance of Maxwell's discovery, so bold was the leap that his genius forced upon the conceptions of his fellow-workers
> —(Science, May 24, 1940)