a theoretical footing with the formulation of Maxwell's laws of electromagnetism in 1864. This Maxwell's laws contained a quantity constructed from physical constants which observers came to identify with the speed of light. Because it was constructed from physical constants it should be value invariant under transformation between inertial frames, but value invariant relations are incompatible with the Galilean transformation. Another problem was the Lorentz force law, $\underline{F} = q(\underline{E} + \underline{v} \times \underline{B})$, a velocity dependent force law, hence also incompatible with the Galilean transformation.

Einstein reconciled the principle of relativity and electromagnetism with his special theory of relativity but much of Newtonian mechanics had to be modified. His theory was based on two postulates.

1) The laws of physics take the same form in all inertial frames.

2) In particular the speed of light takes the same value for all observers.

The Galilean transformation was replaced by the Lorentz transformation

$$x' = \frac{x - Vt}{\sqrt{1 - V^2/c^2}}$$

$$t' = \frac{t - Vx/c^2}{\sqrt{1 - V^2/c^2}}$$

$$u' = \frac{u - V}{1 - uV/c^2}$$