History

The theory of relativity was not invented by Einstein. It evolved through the work of a number of men over about fifteen years. Anyone interested in the history should read the two volume edition of Whittaker's 'History Of The Theories Of The Aether And Electricity'[1]. The two leading men were Lorentz and Poincaré. All the elements were in place in early 1905 and available to Einstein when he wrote his 1905 paper. He took Poincaré's relativity principle and produced some neat mathematical fudges to derive the relativity equations from it. Whittaker points out that Einstein's only original contribution was the relativistic Doppler effect[1i].

The theory was developed in response to the failure of experiments to detect the earth's motion though what Maxwell had described as "the luminiferous medium" which he understood to be the seat of the electric and magnetic fields[2i]. Just what the 'luminiferous medium' was remains a mystery whatever name it is given. Maxwell proved that the speed of light depended on the electrical and magnetic properties of the æther (luminiferous medium) called permittivity and permeability and determined the speed of light from them. Some speculated it should be possible to detect the earth's motion through the æther by experiment but both electromagnetic and optical experiments had failed to detect anything. Most notable of these was the Michelson-Morley experiment which needs no further description. Fitzgerald had proposed that the null result could be explained if matter contracted in the direction of motion. The crucial development came with JJ Thompson's discovery of electrons and the identification of beta rays as high speed electrons. Experimental attempts to measure the charge and mass of beta ray electrons showed that they travelled at near light speed and appeared to increase in mass with speed. Lorentz attempted to tie these two factors together in a single theory which predicted the contraction in length and explained the increase in mass. By 1915, more accurate experimental data on the mass increase confirmed Lorentz's theory, but in 1905 the data favoured a rival theory of Abraham[3i].

By its self, Lorentz's theory is about a contraction in length and an increase in mass. Poincaré pointed out that these would result in a slowing of clocks[1iii]. He suggested that clocks could be synchronised by light pulses and showed that this resulted in synchronisation errors. Putting these factors together gave the Lorentz transform equations. These had originally been derived by others[1iv] and shown to preserve Maxwell's equations. It was Poincaré who first speculated that the effects of motion through the æther conspired to make any attempt to detect the motion impossible and described this as the relativity principle[1iii]. The question was how?

The Lorentz transforms were supposed to be valid from the stationary system of the æther to the laboratory. A proper explanation of the null results required the transforms to be universal. In early 1905, Poincaré published a proof based on "Group Theory"[1v]. Later in the year, Einstein published his own much simplified theory[4] based on the assumption that God would want the laws of physics to be the same for all observers. This leads to a very much simplified derivation of the equations of relativity, but it lacks mathematical rigor and its validity is still much debated.

The great mystery is as to why Lorentz acclaimed Einstein's theory and abandoned his own[1ii]. Perhaps he did not understand Poincaré's group theory, perhaps he saw it was flawed, perhaps the incorrect data on the mass increase decided the issue. (Einstein was "cleaver" enough to cover both the results of Lorentz and Abraham by stating that it all depends on the way mass is defined.[4i]) It was also the case that Lorentz's theory of the mass increase was flawed, but that is easily corrected.