A Brief History of c

When the Danish astronomer Olaf Roemer (Philosophical Transactions; June 25, 1677) announced to the Paris Academie des Sciences in September 1676 that the anomalous behavior of the eclipse times of Jupiter's inner moon, Io, could be accounted for by a finite speed of light, he ran counter to the current wisdom espoused by Descartes and Cassini. It took another quarter century for scientific opinion to accept the notion that the speed of light was not infinite. Until then, the majority point of view was that the velocity of light was infinite.

The Greek philosophers generally followed Aristotle's belief that the speed of light was infinite. However, there were exceptions such as Empedocles of Acragas (c.450 B.C.) who spoke of light, "travelling or being at any given moment between the earth and its envelope, its movement being unobservable to us," (The Works of Aristotle translated into English, W.D. Ross, Ed.; Vol. III; Oxford Press, 1931: De Anima, p. 418b and De Sensu, pp. 446a-447b). Around 1000 A.D., the Moslem scientists Avicenna and Alhazen both believed in a finite speed for light (George Sarton, Introduction to the History of Science Vol. I; Baltimore, 1927; pp. 709-12). Roger Bacon (1250 A.D.) and Francis Bacon (1600 A.D.) both accepted that the speed of light was finite though very rapid. The latter wrote, "Even in sight, whereof the action is most rapid, it appears that there are required certain moments of time for its accomplishment...things which by reason of the velocity of their motion cannot be seen-as when a ball is discharged from a musket" (Philosophical Works of Francis Bacon; J.M. Robertson, Ed.; London, 1905; p. 363). However, in 1600 A.D., Kepler maintained the majority view that light speed was instantaneous, since space could offer no resistance to its motion (Johann Kepler; Ad Vitellionem paralipomena astronomise pars optica traditur Frankfurt, 1804).

It was Galileo in his Discorsi..., published in Leyden in 1638, who proposed that the question might be settled in true scientific fashion by an experiment over a number of miles using lanterns, telescopes, and shutters. The Accademia del Cimento of Florence reported in 1667 that such an experiment over a distance of one mile was tried, "without any observable delay" (Essays of Natural Experiments made in the Academie del Cimento; translated by Richard Waler, London; 1684; p. 157). However, after reporting the experimental results, Salviati, by analogy with the rapid spread of light from lightning, maintained that light velocity was fast but finite.

Descartes (who died in 1650) strongly held to a belief in the instantaneous propagation of light and, accordingly, influenced Roemer's generation of scientists, who accepted his arguments. He pointed out that we never see the sun and moon eclipsed simultaneously. However, if light took, say, one hour to travel from earth to moon, the point of co-linearity of the sun, earth, and moon system causing the eclipse would be lost and visibly so (Christiaan Huygens, Traite de la Lumiere...; Leyden; 1690, pp. 4-6, presented in Paris to the Academie Royale des Sciences in 1678). In 1678 Christiaan Huygens demolished Descartes' argument by pointing out, using Roemer's measurements, that light took (of the order of) seconds to get from moon to earth, maintaining both the co-linearity and a finite speed.

However, only Bradley's independent confirmation published January 1, 1729 ended the opposition to a finite value for the speed of light. Roemer's work, which had split the scientific community, was at last vindicated. After 53 years of struggle, science accepted the observational fact that light traveled at a finite speed. Until recently, that finite speed has been generally been considered a fixed and immutable constant of the universe in which we live.

Scientifically speaking, the velocity of light is the highest known velocity in the physical universe. The present value has been fixed (by definition) since 1967 and is 299,792.458 kilometers per second. Almost everyone rounds this off to 3 X 10 (exp8) meters/second, or 186,000 miles/second. Electronics technicians often prefer to remember the approximate speed of light as one foot per nanosecond in air or vacuum-the distance light travels in one-billionth of a second. In dielectric media the velocity of light (electromagnetic waves) is slower than in the vacuum of space.

by Barry Setterfield
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