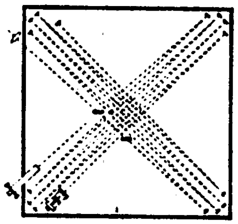
Michelson/Morley

The Great Experiment in Plain Terms

(or: A Layman's Guide through the Luminiferous Ether)

It was the end of the 19th century, the "Classical Age" of science. Physicists were secure in their understanding of the nature of the world. The interrelationships of matter and light, space, and time were known, if not fully understood or measured.



Scientific dogma at the time held that light consisted of waves, and these waves moved through a medium called luminiferous (or light-carrying) ether. The nature of ether had been a persistent problem for scientists since the early 1800s. Since it couldn't be seen or measured with instruments of the day, ether must be an ultra-fine gas. But observations on the properties of light indicated that the waves moved in a manner that could be accommodated only by a very dense solid ether. Explanatory theories were worked out, but each only raised still more problems.

Albert A. Michelson, professor at the Case School of Applied Science, and Edward W. Morley, professor of chemistry at neighboring Western Reserve University, were the latest scientists to tackle the mystery of the ether. Michelson was interested in the effect of the movement of the earth on the speed of light. The ether was assumed to be motionless, and the earth, in its passage through it, would face a "wind." It was plausible, then, to theorize that light waves moving "with" the ether "wind" would have a different speed than light traveling "against" the path of the ether.

To detect the effect the earth's motion had on the speed of light, Michelson constructed a device called an "interferometer." The interferometer split a beam of light in two. (One beam would be traveling with the ether current, the other across it.) Each beam was reflected at right angles to each other and then the beams were reunited. The hypothesis reasoned that the beam "halves" traveling at different speeds would "interfere" with each other. This interference would show up as bands of light and dark when the beams were combined. Measurement of the bands (or interference fringes, as they were called) as the interferometer was rotated, would enable Michelson and Morley to calculate the degree to which the earth's motion affected the speed of light.

The interferometer was mounted on a two-ton stone slab which, in turn, floated in a pool of mercury—this was Morley's idea to combat vibrations which would hinder the workings of the ultra-sensitive interferometer. The apparatus was set up in a building on the site of what is now the Millis Science Center.

Despite repeated tries, Michelson and Morley couldn't detect any change in the interference fringes when their instrument was rotated. There appeared to be no variation in the velocity of light under any circumstances. The scientific community was baffled by the results of the Michelson-Morley Experiment, but the ether theory eventually had to be abandoned.

Albert A. Michelson

Albert A. Michelson was the first American scientist to win a Nobel prize. He was born in 1852 in German-occupied Poland and came to the United States as a young child. A graduate of the U.S. Naval Academy, Michelson was named the first professor of physics at Case School of Applied Science, later to be known as Case Institute of Technology.

Michelson's scientific reputation extends beyond his collaboration with Morley. He was a pioneer in the measurement of the speed of light and proposed standardizing the length of the meter in terms of light. The interferometer, made famous in the Michelson-Morley experiment, was also put to practical use in 1920, when Michelson used the first stellar interferometer to measure the diameter of the star Betelgeuse.

He received numerous honorary doctorates and awards, but perhaps the highest honor came from Albert Einstein, who said, "It was you who led physicists in new paths and through your marvelous experimental work paved the way for the development of the theory of relativity."

Edward W. Morley

Edward Williams Morley was among the best of the scholar-scientists found on college campuses during the turn of the century. Essentially a self-taught scientist, he became one of the greatest chemists of his era. His most important contribution to the field was his determination of the atomic weight of oxygen, along with the proportions of hydrogen and oxygen that make up water. His work set a new standard of accuracy and reliability among chemists of the era.

Morley was born in New Jersey, the son of a Congregational minister. He followed his father into the clergy, accepting a pulpit in Twinsburg, Ohio. Almost immediately, he joined the faculty of Western Reserve College, then located in nearby Hudson. In addition to his scientific work, he was devoted to the study of Greek, Latin, Hebrew, French, and German, as well as Chaldean and Russian. Morley received seven honorary degrees and three gold medal awards in the sciences.