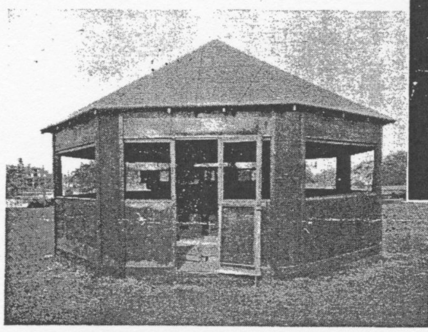
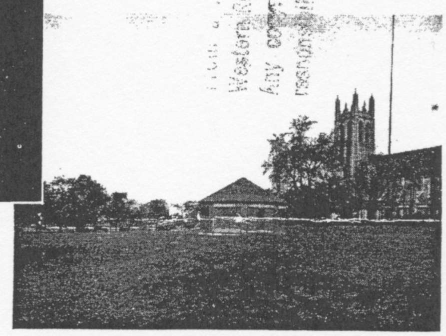
DR. DAYTON C. MILLER
"By George, I never could get zero!"





The temporary interferometer house which has been erected on the Case campus

MILLER CHALLENGES EINSTEIN

Explains Ether Drift Research and Function of Interferometer

FOR twenty-nine years Dr. Dayton C. Miller, has tried to find zero in an attempt to prove or disprove the fundamental scientific theory of "ether drift."

But whether or not he has proved that "ether drift" does exist he has focused the eyes of all scientists upon his work and has received hundreds of column inches of interesting publicity in this country and abroad. He has made the front page of most of the large papers of this country because of his manuscript delivered before the National Academy of Sciences at Princeton, November eighteenth.

Dr. Miller is a small man physically to be measuring such gigantic things in space. Standing about five feet four, he greets one with a quizzical smile that makes one immediately at ease. At the mere mention of writing for the ALUMNUS he turns to his files to locate an article written six years ago. He failed to locate the same but I am confident the precision and painstaking care with which he cares for his business would not often so fail him.

It is also significant that the great interferometer located in a small, green painted octagon building on the front campus is but about 300 feet from the site of the original Michelson and Morley instrument. However, Dr. Miller has made hundreds of thousands of observations while Morley and Michelson in 1887 made only 36.

The following description of the Ether Drift research explains in some length and detail the functions of the interferometer, Dr. Miller's pride and joy.

Sinct the time of the ancient Greeks, scientists and philosophers have been wondering what light is and how it gets from place to place. The first assumption, proposed by Newton, was that light is a stream of minute particles, shot from the object of the eye. This gave place to the more modern theory, which says that light consists of waves in the ether. Nothing is known of the ether, except that radiations, such as light, heat, and radio waves, travel through it. It is assumed to penetrate all substances freely and to fill all space. The question was soon raised as to whether a body in motion would drag the ether with it, or merely slip through it. The ether drift experiment is an attempt to detect and measure this slip of the earth through the ether.

Now if the ether is stationary, there should be a measurable relation motion between the moving earth, and the stationary ether. Suppose a ray of light started out from some point of the earth. If it were traveling in the direction of the apparent motion of the ether, it would be like an airplane, flying with the wind; that is, it would get to its destination quicker. If, on the other hand, it went against the direction of drift, it would be slowed down. No effect should be produced in a direction at right angles. It is this speeding up and slowing down which is to be measured.

The interferometer, which is used to measure this quantity, was developed by Professor Michelson in 1881. The essential part of the apparatus is a thin film of silver deposited on a sheet of glass. The film is just thick enough so that it will reflect half of the light which falls upon it and transmit the rest. A ray of light is allowed to fall on this film and so is built up into two equal parts, one going through the film the other being reflected. These two parts are sent off at right angles to each other, and are later brought together again by a system of mirrors, after which they enter an observing telescope. When they meet in the telescope, a phenomenon known as interference takes place, as a result of which, parts of the field of view are dark, and the rest is light. The filed resembles a set of vertical bars, called fringes, whose edges are somewhat indistinct. This is explained by saying that one ray destroys the other in the dark spots, and aids it in the light areas. If anything happens to one of the rays in its passage, such as a slight slowing down or speeding up, the fringes will move sideways past a pointer in the telescope. We saw above, that if there is any relative motion of the earth and ether, there might be a slight effect on the velocity of light in that direction. Now as the interferometer is turned about a vertical axis, first one path, then the other, will occupy the direction of drift, and the fringes would be expected to shift from one position to another.

It is possible to calculate just how great a drift would produce any given shift in the fringes.

The first experiments were carried out at Case School of Applied Science, in 1887, by Professor Michelson of Case, and Professor Morley of Western Reserve University. These experiments did not show a drift anywhere near as large as was then expected from the known velocity of the earth in its orbit. Their instrument was not capable of measuring the quantity with sufficient accuracy, so in 1902 Professor Dayton C. Miller of Case, and Professor Morley of Reserve, constructed a new and much more sensitive interferometer. Measurements were made with this instrument in the basement of the Administration Building at Case. These showed a drift of about the same magnitude as that obtained by Michelson and Morley.

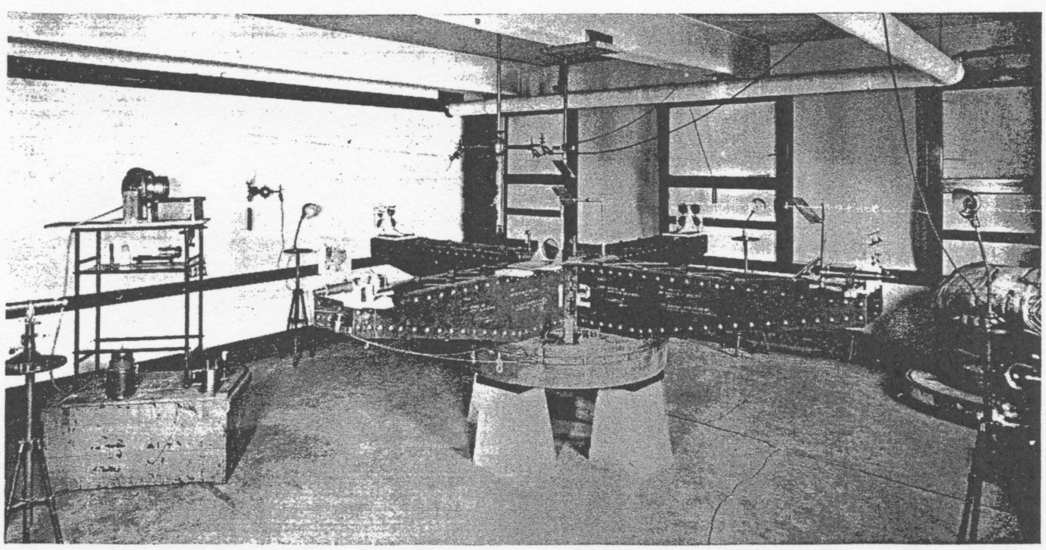
In 1925 and 1926, a very complete set of observations were made at Mount Wilson, upon which Dr. Miller bases his claims. Within the past year, another set of observations has been made on the campus at Case, which supports those at Mount Wilson in every detail.

The interferometer is about fourteen feet square, and about six feet high. It floats on a large pool of mercury, so that it will move very freely. During the course of an observation, it is rotating steadily, at the rate of about one turn per minute. The observer must follow it around, keeping his eye at the telescope constantly, and not touching the apparatus in any way. To add to the difficulties, the room in which the observations are being made must be darkened. Readings are taken at sixteen points around the circle.

Twenty turns of the interferometer, taking about fifteen minutes, are usually considered one observation. The mean of these readings will give a value which is fairly free from accidental errors of observation. It is possible to plot a curve showing the variation in the amount of drift throughout the day. It is also possible to determine the exact direction of the drift, since the fringes will have their maximum displacement when one light path occupies that direction.

Several groups of these ten day observations are made at different times of the year. Now if the observed shift were due to anything on the earth, such as the variation of temperature between night and day, it would be reasonable to expect that the curves for different times of the year would agree for corresponding times of the day. But this is not the case. If instead of the time of day we take the position of the earth with respect to the stars, the curves agree very

(Continued on page 12)



This shows the Ether-Drift interferometer as mounted in the Physical Laboratory. It consists of a steel cross-shaped frame which floats in a basin of mercury. On the upper surface of this frame are mounted the optical parts of the apparatus.

well. The only logical inference from this is that the effect is due to something outside of the earth.

Curiously enough, it is found that the motion of the earth in its orbit does not have any effect. This is shown by taking two sets of observations six months apart. When the second set is taken, the earth will be moving in the opposite direction to that in which the earth was moving during the first readings. Therefore, a difference in the direction and magnitude of the effect would be expected for different times of the year. But no such effect is found, so we are compelled to assume that the orbital motion of the earth has no effect on the drift.

While not confirming Einstein's theory, the results obtained also fail to agree with those expected from the classical theories of Physics. One of the great difficulties in establishing either theory has been that the relativity theory would predict one effect, while the old theory would predict an effect only slightly different. Therefore measurements necessarily inaccurate might be regarded as confirming either theory. This applied more to the other experiments which have been tried in an effort to establish the relativity theory than to the ether-drift experiments. The present situation, then, would seem to be that no single theory explains all observed facts, and that, until new methods of measurement have been developed, the prospect of finding such a theory are not so good.