GENERAL SCIENCE

Ether Drift Experiment Is Repeated With Success

Failure 40 Years Ago Started Einstein Studies; Positive Results Now Obtained With Canal Rays

THE ETHER drift experiment, whose failure more than forty years ago started Einstein on the investigations that led to the relativity theory, has at last been repeated in modified form with successful results, which were reported before the meeting of the National Academy of Sciences by Dr. Herbert E. Ives of the Bell Telephone Laboratories.

The secret of Dr. Ives' success was his use of streams of positively charged particles or ions, known as canal rays, instead of the beams of light originally tried in the classic Michelson-Morley experiment in 1887. This experiment undertook to find out to what extent light would be deflected from its straight path through the ether when it was made to take a course at right angles to the direction of the earth's motion through space. Light treated in this way might be considered scientifically as a clock, and the expectation was that a clock in motion should run slower than one at rest.

Slowing Down is Slight

So slight is the slowing-down that no speeds available to experimenters when the theory was announced were adequate for a crucial test. But by using as a "clock" the light-giving oscillation of a hydrogen ion, which can be shot down a vacuum tube at a thousand miles a second, it is possible to measure a definite change in the color of the light. That, of course, means a change in the rate of vibration of the atom.

Why the experiment is epochal is seen from the history of science. As the wave theory of light gained acceptance, people asked, "Is this 'ether,' which carries the waves, stationary in space, or is it dragged along with the observer?" The crucial experiment was rather simple—measure the velocity of light in the direction of motion of the earth and at right angles to it. Michelson and Morley tried it first, in 1887, and other experimenters repeated it with great refinement of technique. All the conclusions were that the ether appeared to move with the earth.

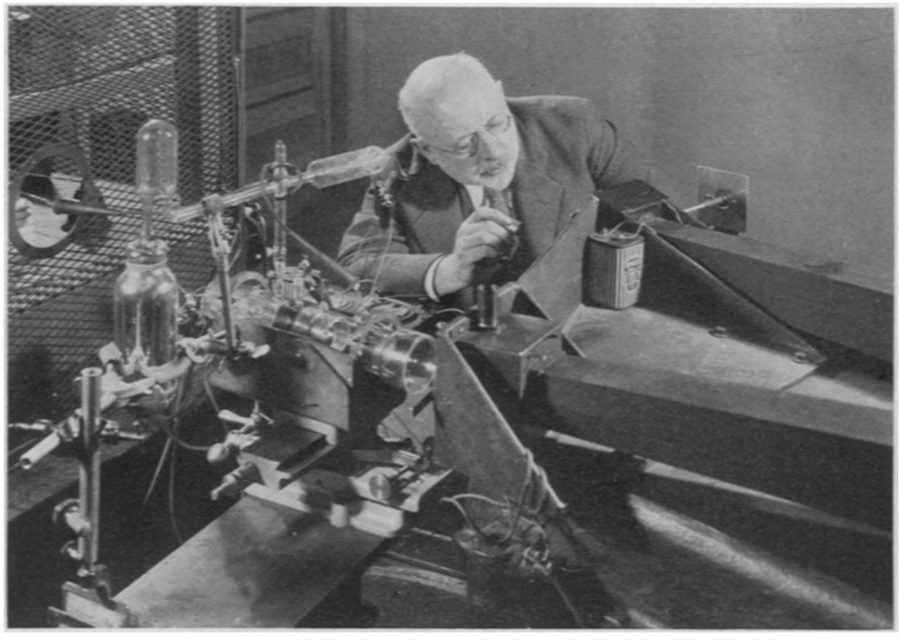
Did, then, each heavenly body drag along its own ether? This was hard to believe. Eventually, about the turn of the century, three scientists, Fitzgerald, Larmor and Lorentz, developed a theory according to which light could appear to have the same velocity across and with a stationary ether. This could occur, they found, if a clock would slow down and a rod would grow shorter when in motion by amounts related in a certain way to the velocity through the ether.

In 1907 Stark discovered that hydrogen ions, which emit light whose color tells their vibrating frequency, and so can be used as "clocks," could be brought up to sufficiently high speeds in a vacuum tube, to serve as means to test this theory. Because of experimental difficulties the experiment has been classed for thirty years as "hypothetical." Recently, due to experiments in the type of vacuum tube needed made by Dr. A. J. Dempster of the University of Chicago, actual performance of the experiment has become feasible.

Dr. Ives' apparatus uses a vacuum tube in which there is a small amount of hydrogen. An electric arc breaks down the hydrogen molecules into charged ions. These are picked up by a high-voltage electric field and brought up to the speeds of the order of a thousand miles a second. Looking into the end of the tube, the observer sees these ions approaching him, and by means of a mirror he also sees them apparently receding from him. If his eyes were sufficiently sensitive to color, he would notice that the receding ones were redder than the approaching ones. This is called the Doppler effect. But as compared with the color of stationary ions, those moving in either direction are redder. That is, they vibrate more slowly. And that is what Fitzgerald, Larmor and Lorentz proposed nearly forty years ago —atomic "clocks" oscillating more slowly as they move through a stationary medium called the ether.

Radium Cancer

Radium poisoning tragedies, that have created sensations in the news recently, have been paralleled in experiments on rats, as a means toward better understanding of the human cases and their more effectual prevention. The researches, conducted at the Massachusetts



NEW EVIDENCE ON OLD QUESTION

Dr. Herbert E. Ives, physicist of the Bell Telephone Laboratories, working with the apparatus with which he repeated the famous ether-drift experiment, this time successfully because he used canal rays instead of light beams.

Institute of Technology, were described by Drs. Robley D. Evans and Robert S. Harris.

The two scientists fed young rats three different amounts of radium chloride in daily doses of 20, 35, and 70 millionths of a gram, respectively. The rats got rid of most of this by excretion—at the highest dosage levels 98 to 99 per cent. of it. Yet the small amount remaining proved fatal.

Their growth appeared normal, yet after a short time the bones became very fragile, so that they would break when the rats were picked up and handled in the ordinary manner. After fifteen months they developed osteogenic sarcoma (bone cancer) that closely resembled the bone ailment in radium paint workers who had been exposed for from ten to fifteen years.

Rats seem to be much more resistant to radium poisoning than human beings. Dr. Evans stated that the average concentration of the element in their skeletons was several hundred times greater than the concentration required to produce osteogenic sarcoma in man.

New Chlorophyll

Something new under the sun, a definitely new kind of green coloring matter (chlorophyll) in plants, was presented for the consideration of the Academy by Prof. O. L. Inman of Antioch College and Dr. A. F. Blakeslee of the Carnegie Institution of Washington.

The new chlorophyll was obtained by manipulating one particular chromosome, the heredity-controlling structure within the cell, in a plant of the jimsonweed family. It resulted in the production of a strain of offspring with a different combination of the "a" and "b" chlorophyll components than that of all other known plants. It is the first case of its kind on record.

Medals Awarded

A British biologist and an American electrical engineer were honored with the presentation of two gold medals at the meeting.

The Agassiz Medal for Oceanography was awarded to Dr. Edgar Johnson Allen, director emeritus of the Plymouth Laboratory of the Marine Biological Association of the United Kingdom. Dr. Allen is noted for his researches on marine organisms, and he has also done much to encourage scientific work by others.

Dr. Allen was unable to be present in person to receive the medal, and in his absence it was handed to Leander McCormick-Goodheart of the British Embassy for transmission through diplomatic channels. Dr. E. G. Conklin of Princeton University, president of Science Service, made the speech of presentation.

The Academy's Public Welfare Medal was presented to Dr. Willis Rodney Whitney of the General Research Company research laboratories. The presentation address was made by Dr. Albert W. Hull, a colleague of Dr. Whitney.

Dr. Whitney's outstanding researches in the field of electrical engineering have been on electric lighting and in the use of high-frequency currents in the treatment of arthritis, paresis, and other diseases. He began the organization of General Electric's research laboratories in 1900, as a part-time diversion from his position as a professor at the Massachusetts Institute of Technology, and has seen their development to an institution with a full-time staff of 300 scientists.

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GEOPHYSICS

"Late" Artillery Reports Give Clues to Stratosphere

Minute Slow in Arriving, Sound Travelled Very High And Was Reflected From Warmer Stratospheric Layer

REPORTS of naval guns, arriving at distant sensitive instruments later than they should according to theory, give meteorologists clues to the temperatures high in the stratosphere, Dr. Beno Gutenberg, California Institute of Technology geophysicist, reported to the American Geophysical Union, meeting in Washington, D. C.

Using a special air-pressure-change instrument, resembling a radio loudspeaker, designed by Dr. H. Benioff, Dr. Gutenberg detected variations in air pressure that coincided with naval gunfire offshore.

Sound from the gunfire arrived at the sensitive instruments almost a minute later than it theoretically should have, indicating that it traveled into the stratosphere and was reflected from a layer of warm air high above the earth's surface. From time and distance studies, Dr. Gutenberg, assisted by the U. S. Navy, determined that sound in Southern California travels at the same speed as in Europe, suggesting similar upper-air conditions.

Hot Rock Destroys

Evidence that geological records of the earth's oldest happenings have been destroyed by molten rock masses rising to the surface of the earth in later times was reported by Dr. E. N. Goddard of the U. S. Geological Survey.

Starting more than 50,000,000 years ago during the eocene age when primitive mammals were displacing the great dinosaurs, a mass of molten rock rose up from the depths to break the billion-year-old crust of the earth at a point where today the mining camp of Jimtown, Colo., is located, Dr. Goddard declared.

In the intruded rock, he found fragments of these older rocks, some of them hardly changed by their submersion in the molten mass. Other fragments were greatly changed, and there is evidence that still others had been melted and dissolved in the rising mass, transformed into part of it.

These findings, Dr. Goddard pointed out, show on a small scale the cycle of rock changes that is going on everywhere. Molten rocks are washed away, deposited as sediments, then they are heated and squeezed into new forms, then are absorbed by intruding melted rocks, beginning the cycle all over again.

Roots of Volcanoes

Volcanoes' roots may go down to a molten earth-interior after all, despite the disrepute into which that theory, once universally held, has fallen during recent years. A picture of the roots of volcanoes, presenting the old theory in more acceptable modern form, was offered by Prof. Reginald A. Daly of Harvard University.

Prof. Daly likened the crust of the earth to a wrinkled layer of solid paraffin floating on an interior of melted paraffin. The actual materials of the earth's crust and deeper layers are, of course, stony. Solid stone floats on the molten stone. Connecting masses be-