Classics of Science: Effects of Relativity

Physics

Lorentz was one of the small group of mathematical physicists whose work led up to the Einstein theory. He, with Fitzgerald, in 1892 interpreted the negative result of the famous Michaelson-Morley experiment by the hypothesis that the apparatus contracts in the direction of the earth's motion. Lorentz' biography appears on page 146 of this issue of the SCIENCE NEWS-LETTER. While most of us will not be able to understand in all its details the following quotation, it will give some idea of the fields in which Lorentz did his work.

PROBLEMS OF MODERN PHYSICS, A Course of lectures Delivered in the California Institute of Technology, by H. A. Lorentz, Professor in the University of Leiden, edited by H. Bateman, Professor in the California Institute of Technology. Boston, 1927.

The Rotation of the Earth

This rotation, which has been established by Foucault's pendulum experiment and by the phenomena of falling bodies, can also conceivably be proved by electromagnetic or optical phenomena. Diurnal aberration has not been observed with certainty, but an interference experiment has been planned by Professor Michelson in which light is to be sent by means of reflecting mirrors round a triangle in two opposite directions, in order to see whether any difference in the time of propagation is produced by the earth's rotation. (Since this was written, the experiment has been performed with the expected result.)

Consider an ideal experiment in which electric waves travel around two parallel wires, as in Lecher's system, except that the wires are supposed to be placed round the earth's equator, each forming a closed circle. The theory of relativity, as well as the old theory of a stationary ether, would require that the velocities of propagation in the two directions relative to the earth be unequal. There will then be standing waves whose nodes and loops move round the earth, making a complete circuit in a sidereal day. The earth may be said to rotate relative to these nodes and loops. (In this discussion we need not speak of the gravitational field of the earth; the phenomena would be the same if the earth exerted no gravitation at all.)

Now choose a system of coördinates. We can do this in two ways:

1. So that the loops and nodes are stationary; that is, so that the velocity of electric waves is the same in both directions. In this system we have the normal values of the potentials g_{ab}, and the earth appears to rotate.

2. So that the axes are fixed to the earth. We now have different values of the g_{ab}'s that can be found by means of the transformation formulæ. The new g_{ab}'s also occur in the equations of electromagnetism, and these show that the nodes and loops are rotating and that the velocities in the two directions are unequal.

Thus when we are asked *with respect to what* the earth rotates, we may say that it is rotating in a system of coördinates in which the g_{ab}'s have their normal values. Foucault's experiment leads to the same conclusion.

But we may wish to think of the earth's motion as motion relative to something that is more substantial than a mere system of axes of coördinates. Here there are two alternative views.

Physicists of former days would say that the nodes and loops have their seat in the ether—that the earth rotates relative to this medium and that the g_{ab}'s have their normal values in a system of axes that is at rest in the ether. We have no longer to account for these normal values, the properties (if we may call them so) of the ether being responsible for them.

On the other hand, according to Einstein there is no such thing as the ether of which we have just spoken. If there is some medium, it has not sufficient substantiability to enable us to use it as a framework of reference with respect to which the position of bodies can be determined. Einstein thinks that in our experiment the nodes and loops are fixed in some way or other relative to the fixed stars, seen or pehaps unseen. This conception can be admitted because the stars are really seen rotating around the earth. Therefore we can admit that the nodes and loops are kept in their places by them, so that it is relative to them that the earth rotates.

Of course this implies that there is some kind of connection, or link, between the stars and the earth. Indeed, if there is nothing of the kind between them, the conception of relative motion is wholly clear. We cannot, without further explanation, even draw a straight line toward some star. Now, according to Einstein, the system of coördinates in which the g_{ab}'s have their normal values is not determined by the fixed stars by some mysterious influence but (*Turn the page*)

Short-Wave Tube

Physics

A vacuum tube with a power of 15,000 watts, sending out radio waves of only six meters length, that can light electric lamps without wires or socket, produce a warmth in nearby spectators reminiscent of prohibited stimulants, and cook sausage in a glass tube without fire, is one of the latest radio wonders. It has just been demonstrated at the General Electric Company's research laboratory at Schenectady.

The new tube, known as the ZT-6, looks harmless enough. It is about five inches in diameter, and two feet long, set in a wooden cage and surrounded by a network of wires, condensers and meters. With its great power of 15 kilowatts, it is at least fifty times as powerful as any short-wave tube previously constructed. Through a coupling system it is connected to a copper bar about three meters, or ten feet, long, which acts as the tuned aerial circuit, radiating the full 15 kilowatts into space.

When an ordinary electric lamp is touched to the copper bar, it lights up brilliantlty. A loose copper rod, lying on the floor, is picked up, and, though cold, it blisters the hand. When a person approaches the apparatus, he first feels a warm glow, then pain in the limbs and joints. Artificial fever, as much as 100 degrees Fahrenheit, is induced after standing close to it for 15 minutes.

This may indicate one of the future applications of the tube, says Dr. W. R. Whitney, director of the laboratory. "If we had a perfectly harmless method for warming the blood it might have (*Turn the page*)

Physics of the Bowling Ball

Physics

Bowling enthusiasts will now have available a scientific study of their favorite pastime. At a meeting of the American Physical Society recently, Dr. L. W. Taylor, of Oberlin College, told of apparatus that he has developed to study the motion of the ball in a bowling alley. A recording device registers to the hundredth of a second the passage of the ball at half meter (about 20 inch) intervals. Instead of rolling the ball by hand, a catapult is used, so that the force used can accurately be controlled. Studies already made with the device indicate that the accepted theories of the ball's motion are not quite correct, but that the friction seems to vary with the ball's speed.