

When the velocity of the source was less than the velocity of propagation of the waves, the waves were crowded together in front of the moving source thus giving an increase in the frequency, whereas behind the source, the waves were spread out corresponding to a fall in pitch. If the source was moved more rapidly than the waves, an overlapping resulted so that a tangent drawn to the contiguous crests gave a resultant similar to the wave set up by a bullet in flight.

Photographs were taken of a number of type cases with (1) the velocity of the source less than the wave velocity, (2) the velocity of the source greater than the waves, (3) the velocity of the source approximately equal to that of the waves, (4) various intermediate conditions.

Since these waves appear to move slowly, data may be obtained with comparative ease and thus yield information that will assist in explaining the phenomena of bullets in flight as well as other examples of Doppler's principle.

By photographing a scale with the waves, the wave-length may be found, so that, if the frequency of the puffs of air is known, the velocity of the source v may be calculated. By measuring the angle θ , between the median line and the wave front, the velocity V of the waves may be found according to the formula

$$V/v = \sin \theta.$$

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EINSTEIN'S RELATIVITY AND GRAVITATION.

BY JOHN MILLIS.

NOTE is made of certain errors and misapprehensions found in publications relating to the relativity theories as indicated by the recently published book "Einstein's Theories of Relativity and Gravitation" by J. Malcolm Bird, associate editor, Scientific American. Considerable lack of clearness is found as to the real purpose and significance of the famous Michelson-Morley experiment. This, in a few words, was undertaken to test the relative movement of the apparatus used and the supposed medium which transmits light, the ether. No such relative movement has ever been detected either by this or by a number of other similar tests that have been carried out. The Lorentz-Fitzgerald explanation of this failure which is that the dimensions of all matter are affected by motions relative to the ether and that therefore no such relative movement can ever be detected by man, is not only highly improbable but is fallacious in the assumption that an ether could exist without its being possible to detect its presence by similar tests. It is shown that if an ether does exist and that if it affects matter as assumed, an apparatus could be constructed that would reverse this effect and therefore disclose it.

Some writers appear to assume that there is some relation between the so-called Lorentz-Fitzgerald effect in connection with the ether and the discrepancies that arise in certain measurements because of the time required to

convey intelligence from sensible distances. The velocity of light appears in both, but there is no real connection between them; the first is a mere speculation while the second is a reality.

It is demonstrated that there cannot be any superior limit to possible relative velocities; in other words, that the velocity of light is not such a limit, as has been assumed. The assumption that there can be a change of mass with change of velocity is also fallacious. Since all velocity is relative and a body may have an indefinite number of velocities at the same time, this assumption of a relation between mass and velocity would require that a body could have an indefinite number of masses simultaneously. Energy has been regarded as something definite or fixed, but a body may have an indefinite number of energies at the same time, depending on relative velocity.

There can be no special significance in the velocity of light as such as a fundamental physical principle. Such an assumption would be attaching to one of the sense organs of human beings who have had a comparatively recent career in the universe, an importance in connection with a general physical theory that facts do not warrant.

It is shown that certain ideas connected with centrifugal force in a relative sense are erroneous and it is also pointed out that the celebrated Foucault pendulum experiment and the behavior of the gyroscope do not establish the persistence of motion of a body "in space." These only show a tendency to preserve motion or position respecting the axis of the earth. Reference is made to the "Shadow-bands" which have been observed during a total eclipse near the edge of the moon's shadow as it passes over the earth and it is suggested that there may be some relation between the cause of these bands, whatever it is, and the displacement of stars observed during a total eclipse which has been regarded as confirming the Einstein theories.

The non-existence of any universal medium like ether is more comprehensible and consistent with the general structure of nature than would be such a medium as a demonstrated fact—this, notwithstanding the difficulty of understanding how gravitation and other so-called forces can be transmitted without any medium.

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SOME ASPECTS OF THE THEORY OF RELATIVITY.

BY A. C. LUNN.

THE Einstein theory may be considered as based on a combined differential geometry of space and time measurements but amplified into a comprehensive physical theory by the addition of various notions and postulates consistently interpretable in connection with the geometry but at least not known to be definable or deducible from it. Since particular contacts with experiment are concerned with these additional assumptions as well as with the main geometric basis it is conceivable that adaptation to results of observation may require,