THE EFFICIENCY OF ARTIFICIAL AIDS TO HEARING.

BY PAUL E. SABINE.

MEASUREMENTS were made to determine the amplification of sound by eleven different instruments commonly employed for the aid of the deaf. The measurements were made by timing the duration of sound, after the source of sound had ceased in a sound chamber, audible to a deaf person, with and without the instrument held to the ear. From the difference of time with and without the instrument and the known rate of decrease of intensity as the sound dies away in the room, the ratio of the intensities at the ear of the observer under the two conditions was computed by the equation

$$\log_e \frac{I_1}{I_2} = A(t_1 - t_2).$$

A being defined by the equation

$$\frac{dI}{dt} = -AI.$$

The experiments covered the range of pitch from 128 to 4096 d.v.

The amplifications produced by different instruments of the trumpet type were found to follow order of size of these instruments. The effect of the natural frequencies of the air columns enclosed by the trumpets were shown by increased amplifications for these frequencies. Instruments in which the vibrations of diaphragms held in contact with the teeth are supposed to be conducted to the auditory nerve by the bones of the skull were found to produce positive, though small amplifications. Telephonic devices showed relatively large amplifications for tones in the neighborhood of the natural frequencies of the diaphragms of the transmitter and receiver.

By comparison with the duration of sound audible to normal ears, the sensitivity of the ears of the deaf observer was determined in terms of norma sensitivity. The ratio of sensitivities so determined was of the order of 10^5 in the middle register. The maximum amplification produced by any of the trumpets was approximately $10^{1.3}$, while that for the telephone at the natural frequency of the receiver was $10^{2.5}$. The inadequacy of any of the instruments tested in the relief of cases of extreme deafness is thus shown.

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DOPPLER'S PRINCIPLE ILLUSTRATED BY RIPPLE WAVES.

BY F. R. WATSON AND W. B. WORSHAM.

THE Doppler effect was observed when a source of ripple waves on water was made to move. The waves were generated by a jet of air directed against the surface of the water. For some cases, the stream of air was made to come in periodic puffs and the resulting waves were observed by means of a stroboscopic device so that they appeared to move slowly.[1]

[1] "A Study of Ripple Wave Motion," PHYS. REV., Vol. 7, pp. 226–228, 1916.

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

$$V/v = \text{Sin } \theta.$$

UNIVERSITY OF ILLINOIS,
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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