

were of a very sensitive type. The records were made by an especially constructed moving-film camera in connection with a string-galvanometer capable of recording from six stations simultaneously, of the type used by our army for sound-ranging. Stations were located at the muzzle of the gun, and at points in front of the guns at distances of about 100, 200, 300, 400, 500, 600, 1,000, 2,000, 7,300 and 21,000 feet, six of these stations being used at one time. The locations were determined with precision. Meteorological observations were made by special observers in the distant stations and on the field near the guns, at the time of the experiments and continuous records were made at the Proving Ground Headquarters and at the United States Weather Bureau Station. These observations covered temperature, barometric height, humidity, wind velocity and wind direction. Measurements were also made of the velocity of the sound at a series of stations located on a line at right angles to the line of fire, and on a line at 45° to one side of the line of fire. In all, seventy-two sets of velocity determinations were made, eleven sets extending to the most distant stations at 21,000 feet from the gun, while the other sets relate to various groups of stations within 2,000 feet of the gun. Heretofore there has been a general impression that explosive sounds travel much farther than do ordinary sounds, the velocity being perhaps several times the normal velocity. These experiments show conclusively that the velocity at a distance of one hundred feet from a 10-inch gun is about 1,240 feet per second, or 22 per cent. above normal; at two hundred feet from the gun the velocity is only about 5 per cent. above normal. For all distances above five hundred feet from the gun the velocity of the explosive sound from the largest sized gun is practically normal. The value of the velocity of sound over the long range of 21,000 feet has not yet been calculated with all corrections applied, the preliminary value is in entire agreement with other determinations, and is about 1,089 feet per second at the freezing temperature. It is expected that the final value will be of a precision equalling the best heretofore obtained.

The U. S. navy MV-type of hydrophone as an aid and safeguard to navigation: HARVEY C. HAYES, Ph.D., U. S. Naval Engineering Experiment Station, Annapolis. (Introduced by Professor John A. Miller.)

The transient process of establishing a steady alternating electric current on a long line from

laboratory measurements on an artificial line: A. E. KENNELLY, A.M., Sc.D., director, Research Division, Electrical Engineering Department, Massachusetts Institute of Technology, and U. NABESHIMA. When a power-transmission electric conducting line is switched on to the generator at the power house, the alternating-current on that line settles down to a final state, under steady load, in a time which is theoretically indefinitely long, but which is usually practically covered in a small fraction of a second. The paper discusses the transient phenomena which occur along the line during this process of upbuilding the final current and voltage. The subject has been studied theoretically by a number of writers; but very few practical observations have been published concerning this transient state. It is known that the current and voltage do not build up steadily and continuously, but advance by little jumps which occur at regular short intervals of time, accompanying successive reflections of electromagnetic waves from one end of the line to the other. The authors present in the paper a number of observations which have been secured photographically, of the rise of voltage and current on a long artificial electric power-transmission line in the laboratory, and have compared the observed rates of growth with those which are indicated by theory, with a fairly satisfactory agreement. The observed results indicate the manner and mechanism by which electric power may be conceived of as being transmitted along such a line.

The strephoscope: N. W. AKIMOFF. (Introduced by Professor Eric Doolittle.)

New features in the eclipsing variable U Cephei: R. S. DUGAN, professor of astronomy, Princeton University. (Introduced by Professor H. N. Russell.)

ARTHUR W. GOODSPEED
(To be concluded)

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS
LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter