for the very briefest times of charge, while a paraffine condenser may show a reduction in capacity of some sixty per cent. from a time of charge of 0.4 second to that of 0.001 second.

Derivation of Equation of Decaying Sound in a Room, and Definition of Open Window Equivalent of Absorbing Power of the Room: W. S. Franklin, Lehigh University.

1. The paper presents a derivation of the equation

$$i = I\varepsilon^{-\frac{86a}{v}\cdot t},$$

in which I is the initial intensity of sound in a room, i is the intensity t seconds after the source has ceased, v is the volume of the room, a is the open window area which is equivalent to the absorbing power of the wall and objects in the room, and ε is the Naperian base.

2. The paper then gives a definition of the open window equivalent of the absorbing power of the walls and objects in a room.

3. The paper then compares the theoretically derived equation for duration of reverberation, namely,

$$t_1 = 0.165\frac{v}{a},$$

with the equation used by Sabine in which the numerical factor is based upon experiment.

4. The paper then discusses briefly the physical actions involved in the absorption of sound by the walls and objects in a room.

On the Velocity of Light as affected by Motion through the Ether: Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science.

The theory of the Michelson-Morley experiment contained in their paper of 1887 was elaborated as far as seemed needful in view of the negative result of their experiment. This paper gives some account of a more detailed theory and announces some preliminary results of the more recent experiments.

Some Measures of the Speed of Photographic Shutters: Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science.

A stroboscopic electrically driven tuning-fork and a special camera containing a cylindrical sensitive film were arranged to obtain graphic representations of the behavior of shutters. The exact manner and time of opening and closing, as well as the aperture and duration of exposure, are recorded.

Of the better grade of shutters designed to give definite and adjustable exposures, it was found that they were fairly constant in operation, but that the actual duration of exposure is often not even approximately that indicated by the maker. Different shutters of the same make and form give widely different exposures when set for the same time. It was found in all the shutters tested that the times marked one seventy-fifth of a second or less were all of the same duration, and that this was much less than the shortest marked time, namely, from three to four thousandths of a second. If the time scale for each separate shutter of this grade were constructed upon tests of the shutter, it might then be used to give practically correct exposures.

With the best shutters of the diaphragm class the duration of exposure is nearly independent of the aperture of the opening.

Some shutters of the cheaper grades designed to give long, medium and short exposures were found to give equal exposures in the three cases. In general, shutters of this grade with timing devices are wholly unreliable.

On the Distribution of Pressure around Spheres in a Viscous Fluid: S. R. COOK, Case School of Applied Science.

When a single sphere is set in motion in a perfect fluid at rest at infinity, its motion is completely determined by the velocity potential due to the motion of the sphere; and the pressure around the sphere is given by

$$\frac{p}{\rho}=\frac{d\varphi}{d\tau}-\tfrac{1}{2}u^2+F(t) \qquad (1)$$

Where φ is the velocity potential and u is the velocity of the sphere at time t.

When u is constant (1) may be written in the form

$$\frac{p}{\rho}=u^2\left\{\tfrac{9}{8}\cos^2\theta-\tfrac{5}{8}\right\}, \qquad (2)$$

where θ is measured from the direction of motion.

The curve for the pressure of a perfect fluid around a sphere was given, and also the curve for the pressure of air, which was determined by measuring the pressure of the air around a glass sphere by means of a water manometer while the air is flowing with a constant velocity past the sphere. The two curves differ, in that, for a perfect fluid the curve is symmetrical with respect to both axes, as may be seen from (2), while for a viscous fluid, *i. e.*, air, the curve is symmetrical with respect to the axis parallel to the direction of flow, but not with respect to the axis at right angles, the pressure at the rear being less than that in front of the sphere.

The pressure was also determined for two spheres moving in line of centers and for two spheres moving perpendicular to the line of centers. The equations which represent the pressure for a perfect fluid were given and the curves of pressure around the spheres compared with the curves obtained by measurements of the pressure in air. It was found that two spheres moving in the line of their centers in a perfect fluid are repelled, but when moving in a viscous fluid are attracted. For spheres moving perpendicular to their line of centers in a perfect fluid they were attracted, and in a viscous fluid repelled.

These results agree with results given in a former paper on 'Flutings in a Sound Wave' and corroborate the theory there advanced as an explanation of the cause of the flutings in a Kundt-tube.

A Portable Apparatus for the Measurement of Sound: A. G. WEBSTER, Clark University.

An improved form of the instrument shown at the Boston meeting, 1898.

The apparatus consists of two parts, a 'phone,' or apparatus for emitting continuously a pure tone, whose intensity is measured in absolute units (watts), and of a 'phonometer,' or instrument which measures at any point the intensity of the sound emitted by the phone or other source of sound measuring the absolute compression of the air. The amplitude of a diaphragm forming the back of a resonator is measured by the displacement of fringes in an interferometer, observed stroboscopically. Both parts of the apparatus are portable, and suitable for field work.

The Mechanical Efficiency of Musical Instruments as Sound Producers: A. G. WEBSTER, Clark University.

The sound emitted was measured by the phonometer, by comparison with the phone placed in the same place where the instrument was. The input of energy was obtained by measurement of the pressure, and time rate of air consumption for wind instruments, and by the pull of the bow and velocity for stringed instruments. Preliminary results were given for the