separation is much faster. The volume of the centrifuge is, of course, decreased, which decreases the time that the material is in the centrifuge, but a simple calculation shows that this decrease in time is much more than compensated for by the increase of the average centrifugal field. Experimental tests also show a large increase in efficiency.

In addition to the purification of materials by the continuous flow vacuum-type tubular centrifuge, it is possible at the same time to determine the sedimentation constant s from a knowledge of the dimensions of the centrifuge, rate of flow of material, the ratio of the amounts of the light and heavy fractions and the ratio of the concentrations of the original material and the light and heavy fractions. From a knowledge of s and the diffusion constant, the molecular weight may be obtained.[2] As yet extremely high accuracy has not been obtained, but the results are reproducible with precision. Since the molecular weights of substances from about 40 up to 20,000,000 have previously been measured with precision principally by Svedberg and his collaborators,[3] these materials with known molecular weights can be used to calibrate a particular vacuum-type tubular centrifuge. After once calibrated, the apparatus should give comparatively precise results, especially for high molecular weight substances.

It is a pleasure to record my indebtedness to the Division of Natural Sciences of the Rockefeller Foundation for a grant that has made possible the development of the tubular vacuum-type centrifuge.

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## THE VELOCITY OF SOUND

THE velocity of sound has usually been measured over long distances (one to twenty miles) by means of guns and stop watches. With the invention of the oscilloscope, it is possible accurately to measure intervals of time as short as one millionth of a second. Therefore, the velocity of sound may be measured with a baseline less than one foot. As a base line so short can not be determined accurately, a longer base line should be used. Since the standard current alternates sixty times per second, one complete cycle of the current represents one sixtieth of a second. The horizontal plates of a standard oscilloscope are connected to the alternating current, which at the same time causes a loud speaker to emit sixty pulses per second. These sound pulses are received on a microphone which is connected through an amplifier to the vertical deflection plates of the same oscilloscope. The electric impulses received by all four plates must be in synchronism; hence a single line appears on the oscilloscopic screen. If the microphone is moved through approximately twenty feet, the line on the oscilloscope will move through one cycle or one sixtieth of a second. The product of 20 and 60 gives 1,200 feet for the velocity. Careful measurements give the actual velocity 331.57 meters per second at 0° C.

This method may be improved by receiving the impulses alternately upon two microphones through the use of a double pole switch. This obviates the necessity of moving a single microphone twenty feet for each observation.

Accurate measurements can be made over shorter distances by using a continuous sound source instead of a succession of impulses. The sound received in the microphone then sets up a series of sinusoidal waves upon the oscilloscope screen. The microphone is moved until one wave passes across the reference line. In this way both the wave-length and the velocity are determined at the same time.

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[3] Svedberg, *Ind. and Eng. Chem.*, 10: 113, 1938; *Nature*, 139, 1051, 1937.

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