

## **XLV. THE PHONELOSCOPE FOR SOUND INTENSITIES.**

**J. H. Cloud, Physics Department,  
Oklahoma Agricultural and Mechanical College.**

Practically all the points I have to present in this paper have already been reported. In my last report before the Academy, I discussed sound intensities as measured by means of a Rayleigh disc and a Webster Phonometer. I now wish to report that these measurements have been repeated with a phonelescope, and that they agree fairly well with the conclusions already given.

The essential parts of the phonelescope are a mirror attached to a spindle which is supported on jewelled bearings. Around this spindle is wound a ribbon, one end of which is attached to the diaphragm of a mouthpiece. Any motion of the diaphragm is communicated to the spindle, as in the ordinary bow drill. Light from an arc is reflected at the lower mirror on to the vibrating mirror, and from there to the screen; the lens carried by the instrument being so placed that the source and the screen are conjugate foci. Since light is deviated through twice the angle through which the mirror is rotated, and since the screen may be placed a long distance from the mirror, the sensitiveness may be increased almost without limit.

Some of the conclusions already reported are:

1. That the Rayleigh disc may be used for measuring sound intensities, and that its sensitiveness may be made as great as we please by using lighter mirrors and longer and finer fibres. From the description just given of the phonelescope, it is obvious that the same statements may be made regarding that instrument.

2. Both the intensity and the quality of sound indoors depend upon the position of the source and that of the hearer.

3. The inverse square law does not hold either indoors or out-of-doors.

4. The efficiency of sound sources is surprisingly low. In some cases it is less than one part in twenty thousand.

5. Continuous, unchanging sounds produce stationary waves, giving rise to nodes and loops, which account for conclusions 2 and 3.

6. Selectivity of pitch of Webster's Phonometer makes its range and usefulness very narrow. Precisely the same limitations

with regard to selectivity to pitch apply to the phoneloscope. Both instruments may be used either with or without a resonator. But whether a resonator be used or not, the vibrating system has a definite frequency of its own, and when the frequency of the source agrees with the frequency of the vibrating system, the amplitude of vibration is maximum.

In the case of the Rayleigh disc or the Webster Phonometer, there is no friction and therefore the energy of the wave may be proportional to the deflection. In the phoneloscope and Miller's phonodeik, there is friction at the bearings. Hence the deflection is not strictly proportional to the energy of the wave. However, the limited observations I have been able to make indicate that this friction factor is constant and that energy plotted against deflections gives a straight line with a negative intercept on the Y-axis. Fortunately, the diaphragm of the phoneloscope may be operated by an electro magnet excited by an alternating current. Again, observations indicate that this Y intercept is constant and that the slope of the line depends upon the frequency of the alternating current; being maximum when the vibrations of the diaphragm and those of the spindle are isochronous.