A METHOD OF STUDYING THE FORM AND INTENSITY OF AN EXPLOSIVE SOUND WAVE.

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If a fine powder, such as lycopodium, is spread over a flat plate or contained in a glass tube and a sharp explosive sound allowed to set the air in motion, the dust will be left in fine striae, of a fairly constant pattern for any given conditions.

It is the purpose of this paper to call attention to two principles that seem to hold concerning these striae.

1. The striae represent the form of the air waves.
2. The distance between striae is a function of the intensity of the concussion.

1. Form of Waves. The apparatus used in studying these striae was a static machine arranged with leyden jars and spark gaps as shown in figure 1. The spark gap at S is the source of the sound waves studied, although a toy cap gun produced quite as good striae.
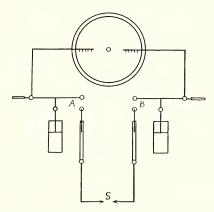

Fig. 1—Apparatus used in studying striae of air waves produced by explosions.

Figures 2 to 7 inclusive, which are explained in the legends, show convincingly that the striae mark the form of the sound waves and the above method of studying them is offered as a substitute for photographing sound waves when studying their form.

2. Intensity of Sound. A number of glass tubes all of the same size and containing lycopodium were placed radially about the spark gap at increasing distances from the gap. The average distance between striae was then measured for each tube and plotted against the reciprocal
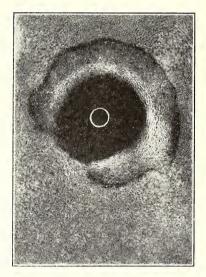
Fig. 2—Striae arranged in concentric circles about a spark which was passed through a hole in a glass plate covered with lycopodium.
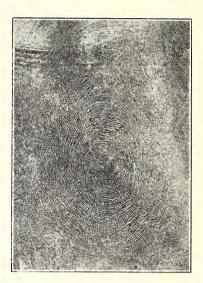

Fig. 3—Striae marking the image of a spark which was reflected from a cylindrical mirror made of tin.
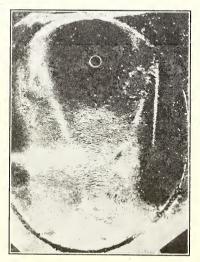

Fig. 4—Striae marking one focus of an elliptic mirror when the spark gap is at the other focus.
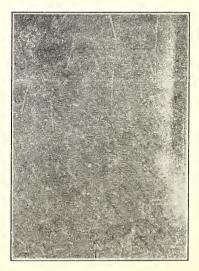

Fig. 5—Striae marking the plane wave form which has been reflected from a spark gap at the focus of a parabolic cylindrical mirror.
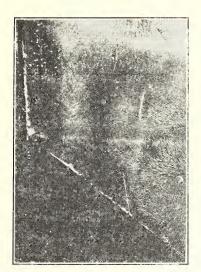
Fig. 6—A distinct interference band caused by a double reflection of the spark wave between two plane mirrors placed at an angle.
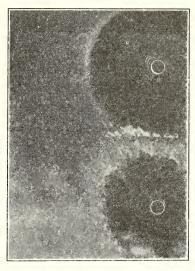

Fig. 7—Three interference bands caused by placing two spark gaps in series, one at each of the two holes in the glass plate.
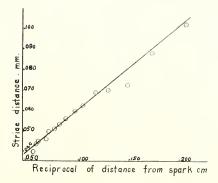

Fig. 8—Curve showing relation of width of striae to distance from source of sound wave.

of the distance of each tube away from the spark gap. The curve shown
in figure 8 indicates that the striae distance is a linear function of the
reciprocal of the distance from the source.

Since the intensity of sound varies inversely as the square of the
distance from the source and directly as the square of the amplitude of
the vibrating medium, these data show that the striae distance is a
linear function of the amplitude of the vibrating air, a conclusion which
seems reasonable after all, since it must be the to and fro movement
of the air which causes them to form.

The above method is therefore suggested as a means of comparing
sound intensities, as it can be worked within a few centimeters of the
source.

As a practical application, two types of telephone mouthpieces, one
the ordinary flared horn and the other of the parabolic type developed
by Prof. A. L. Foley, were set up facing a spark gap. A powdered
tube was placed at the diaphragm position of each horn. The striae
were measured for each horn and the vibration amplitude ratios com-
puted from the linear equation $Y = M X + P$. The amplitude ratio when
squared gave the relative intensities of the sound collected by each
type of horn. The resulting ratio of 1.3 in favor of the parabolic horn
is exactly the same as obtained by Prof. J. E. Brock[1] by an electrical
method.

My thanks are due to Prof. A. L. Foley who suggested the above
problem and to the other members of the Indiana University Physics
Staff and the graduate students for many helpful suggestions.

[1] Proc. Ind. Acad. Sci. 1922 (1923), p. 199.