expanded, and hence are produced alternations in the length of the flame, which are, however, scarcely perceptible when the flame is observed directly. But to render them distinct they are received on a mirror with four faces, which is rotated on a vertical axis. As long as the flame burns steadily there appears in the mirror, when turned, a continuous band of light. But if the capsule is connected with a sounding

tube for example, yielding the fundamental note, the image of the flame takes the form represented in Fig. 4, and that of Fig. 5 if the sound yields the octave. For different sounds produced before the capsule the flame assumes widely differing appearances. It would not be impossible to photograph the representation of the flame in the mirror, and thus permanent graphic records of sounds might be obtained.

We now come to purely mechanical means of registering sound, to which class belong the Edison and other phonographs. In Fig. 6 is represented Leon Scott's phonautograph, which consists of an ellipsoidal cask, A, of plaster of Paris, and about 1½ feet long. The end, A, is open; that at B is closed by a solid bottom having an orifice, in

which is a bent brass tube, a, which carries a ring on which is affixed a thin membrane. Near the center of the latter is a very light style; and in order that this style may not be at a node, the membrane stretching ring carries a movable piece, i, which is termed a subdivide, and which, being made to touch the membrane first at one point and then at another, enables the experimenter to alter the arrangements of the nodal lines at will. It follows that, when a sound is produced near the apparatus, the air in the ellipsoid, the membrane and the style will vibrate in unison with it, and it only remains to trace on a sensitive surface the vibrations of the style and to fix them. For this purpose a rotating copper cylinder, c is covered with lampblacked paper and the style is brought in contact with the latter, so that, when the cylinder is rotating and the style vibrating, a sinuous line is produced, the nature of which depends upon the sound. Thus in Fig. 7 is represented the trace of the sound produced jointly by two pipes, whose notes differ by an octave. This arrangement of rotating cylinder is also employed in connection with tuning forks, a style being arranged on one arm of the fork. On a note being sounded in unison with which the fork is tuned, the fork vibrates and consequently a sinuous line showing the nature and velocity of the vibrations is made upon the paper of the cylinder.

In April, 1873, Mr. W. H. Barlow read before the Royal Society a paper on the "Logograph," an invention of his own for recording sound, which consists of a small speaking trumpet about 4 inches long, having an ordinary mouthpiece connected to one end of a tube of $\frac{1}{2}$ an inch in diameter, whose other end is broadened out so as to form an aperture of $2\frac{1}{4}$ inches diameter, which aperture is



