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SOUND WAVES

The subject of sound falls naturally into two divisions: sound vibrators and sound waves. Every sound wave is originated by a sound vibrator of some kind.

The vibrators used in the production of musical sounds are of four kinds: strings, air columns, membranes and rods. The first of these is practically illustrated by the violin, the piano and the harp. The second is found in the pipe organ and the various kinds of wind instruments used in the band and orchestra. The third is found in our drums, cymbals and the vocal chords, or membranes, of the human voice. Rod vibrators are found in such instruments as the xylophone and the triangle. However, these are not the only vibrators that produce sound waves. Any kind of a mass vibration, be it solid, liquid or gas, which oscillates within a certain range of frequency and with sufficient intensity may originate sound waves. An earthquake sound is due to the vibration of certain sections of the earth's crust. The sounds of a babbling brook are largely due to the irregular vibrations of definite masses of water. Even a flame inclosed in a pipe will vibrate and often produce a loud musical tone when reinforced by the upper air column of the pipe.

The relation between a vibrator and the waves it produces can be shown by a simple experiment. Take a light stick and immerse one end of it below the surface of a quiet pool of water, holding the other end in the hand. Then shake the end in the water rapidly back and forth and a train of waves will at once proceed in all directions from the point of disturbance. If the stick is vibrated back and forth twenty times per second then there will be just twenty complete waves produced in that time.

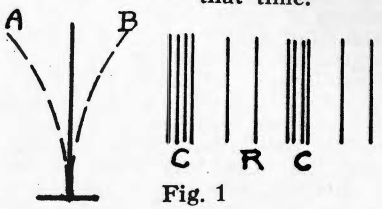

Fig. 1

In a similar manner a sounding elastic steel rod (Fig. 1) produces sound waves in the air which move away in spherical forms and at a definite speed. The number of vibrations of the rod per second determines exactly the number of waves proceeding from it in a second.

Now what is the nature of the wave (Fig. 1) that comes from the rod vibrator? In the first place we should note carefully that its form is nothing like that of a water wave. A water wave consists of crest and a trough whereas the wave from the rod consists of a compression and a rarefaction. As the end of the rod moves from A to B a compression is sent out into the surrounding air. When the end moves back to A it leaves a rarefaction behind it which immediately follows after the preceding compression. A complete sound wave then consists of a compression, frequently called a condensation, and a rarefaction. A sound wave is said to be longitudinal wave because the vibrations of the air particles, or the particles of any medium through which it is traveling, take place in the line of direction in which the wave form is traveling. In figure 2 is shown a series of sound waves proceeding

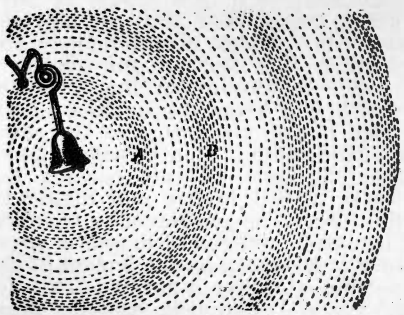

Fig. 2