

2. The remedy lies in developing as much of the practical side as possible.
3. Economic problems relating to seeds, stems, leaves, flowers, fruits and some of the lower forms are life problems for both ourselves and the plant and should be more fully developed than they usually are.
4. Many of the lower forms are not connected with our ordinary experience and they should be emphasized less.
5. In general the course should be based on the idea of utility to the pupil, rather than upon a broad philosophy of plant life.

VELOCITY OF SOUND IN SOLIDS.

BY R. M. BARRUS,

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In answer to requests for explanation of the method used in our laboratory to determine the velocity of sound in solids, I give the following:

Materials required: Tuning fork. C," Small adjustable iron vice. Bench or board at least eight feet long, arranged for attaching the vice anywhere along the edge. About three metres each of wires of different materials.

The pitch of a tone produced by longitudinal vibrations does not depend upon the tension or the diameter of the wire, hence any common size and sufficient tension to hold the wire straight will answer the purpose.

Fasten a wire securely at one end of the bench or board and secure the other end of the wire with the vice in order to vary the length. Stroke the wire lengthwise with a small cloth well dusted with resin by pinching the wire lightly in the cloth with the fingers. This will cause the wire to give a loud tone from its longitudinal vibrations. By varying the length of the wire carefully determine the exact length necessary to give a tone having the same pitch (number of vibrations per second) that the tuning fork, C" has.

C" has 1024 vibrations per second. 342.5 m is the velocity of sound in air; therefore 332.5 divided by 1024 equals the length of each vibration, that is the distance between condensations in air, .3246 m. This bears the same ratio to the distance between the condensations in the material as velocity in air bears to velocity in the material. Double the length of the wire is the distance be-

tween condensations in the material, because the mass makes a complete or double vibration for each condensation sent forward, therefore;

Length of wire multiplied by two is to the length of air wave as velocity in wire is to velocity in air.

Piano wire giving same tone as fork C'' measures 2.495 m, then $4.99 : .3246 :: X : 332.5$. Whence X equals 5112 m, the velocity in piano wire iron.

Apply same process to find velocity in other materials.

Note—To consider the influence of temperature upon velocity of sound in different materials requires the application of Newton's formula that velocity varies directly as the square root of the coefficient of elasticity and inversely as the square root of the density of the medium.

Approximate method: A small rod of the material to be tested, two or three metres in length and $\frac{2}{10}$ to $\frac{6}{10}$ cm. in diameter.

Hold the rod at its center and stroke towards one end with resined cloth and secure a tone from longitudinal vibrations. Find the tone of a piano which has the same pitch as the tone produced by the rod. Use the number of vibrations of such piano tone in the above proportion in place of the number of vibrations of C," also double the length of the rod. This will give approximate velocity of sound in the material of the rod.

110 VOLT ALTERNATING CURRENT FOR BELLS.

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In practice we have found the 60 cycle alternating electric light current quite successful for our school signal bells, thus saving the trouble and expense of a large battery for the system. The 15 bells are connected in series and each bell is short circuited across the interrupter contact with a small piece of wire. The bell circuit which is a part of the electric light circuit includes in it a 32 c. p. lamp used as a resistance, and is connected and disconnected by a telegraphic relay instrument. The relay is connected with the signal clock and worked by a small dry cell. Thus the clock controls the relay and through it the whole system of bells. Some form of resistance is necessary, and for a system of 15 bells the 32 c. p. lamp gives satisfactory results.