brightens (they are usually barely luminous), while that on the other side becomes entirely dark. For most physiological purposes a sufficient current is obtained if $C$ and $C'$ are 80-watt carbon filament lamps and $D$ is a 50-watt lamp. For some physiological induction coils (*e. g.*, the Harvard coil) it is necessary, however, to use larger lamps (120 watts) in $C$ and $C'$. If still more current is wanted two or more sockets can be screwed to the board on each side, connected in parallel and filled with lamps until the needed current is obtained. Fig. 3 shows the arrangement of the sockets on the board.

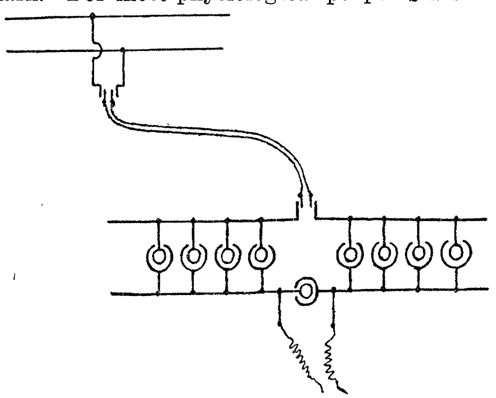

FIG. 3

In Fig. 4 is shown a convenient method of wiring the entire student laboratory for recording time. The figure shows at the left the lamp battery and the clock. The latter may be placed either in series with the signal magnets or so as to short-circuit the current, as it is in the diagram. The signal magnets must all be arranged on the line in series, each with a short-circuiting key to be closed when the time record at that place is to be discontinued or the signal magnet disconnected. With this arrangement it is not easy for one careless student to upset the entire system, and he is easily located if he does. One lamp battery operates effectively a large number of signal magnets in series.

When, as in work with the graphic method, it is desired to have an automatic record on the smoked paper of the instant at which some nerve was stimulated, the arrangement shown at the right in Fig. 4 is convenient. It consists merely of another lamp battery, induction coil and a double knife-edge switch. One blade of the switch is connected as a making and breaking key in the coil circuit, and the other as a short-circuiting key in the time circuit. Thus the interval of stimulation when the key is closed is indicated on the graphic record by the cessation of the movements of the signal magnet, and the time record recommences the instant the stimulation is ended by the reopening of the key.

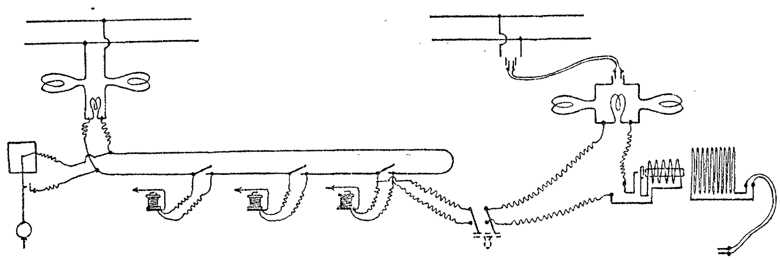

FIG. 4

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### A SIMPLE DEVICE FOR DEMONSTRATING THE TEMPERED SCALE

THE diatonic scale, consisting of a succession of eight tones and containing three intervals known as "major second intervals," two known as "minor second intervals" and two "half-tones," is not adapted to musical instruments of "fixed pitch" (*e. g.*, the piano, harp, etc.) for the reason that it does not without a multiplicity of keys (strings) allow of transposition or change of keys.

For fixed-pitch instruments, therefore, the scale is modified in the following manner. First, an additional tone is inserted in each of the larger intervals (major and minor seconds) of the scale—thus breaking the octave into twelve instead of seven intervals, and second, the pitches of the various tones are so altered as to make the interval between any two successive tones the same. This scale is known as the scale of "equal temperament" or briefly, the tempered scale.

The "interval" between two tones, as the term is here used, is the ratio of the pitch of the higher tone to that of the lower. It follows that on the tempered scale this ratio is the same for any two adjacent tones. The numerical value of this interval is 1.05946, since the sum of twelve such intervals is 2, the numerical value of the octave interval.

These considerations coupled with the fundamental law of string vibrations, to the effect that, for a string of given weight and tension, the frequency of a vibrating segment is inversely proportional to its length, suggest a simple method of finding those string lengths which will give the successive tones of the tempered scale.

Draw two intersecting straight lines including any convenient angle (see accompanying diagram). From the point of intersection lay off on one line any convenient length $Oc = L$, on the other a length $OC = L \div 1.05946$. Join the points $Cc$ by a straight line.

Locate the corresponding points $B$ and $c\sharp$ and join by a dotted straight line. Now draw the series $Cd$, $dD$, $De$, etc., and the dotted series, parallel to $Bc\sharp$ and $cC$. By this means the points $c\sharp$, $d$, $d\sharp$, $e$, etc., are determined at which a string of length $L$ $(= Oc)$ must be stopped to give the successive tones of the tempered (chromatic) scale. This will be evident from the construction of the figure in which $Oc/OC = OC/Od = Od/OD =$ etc., the value of this ratio being 1.05946 by construction.

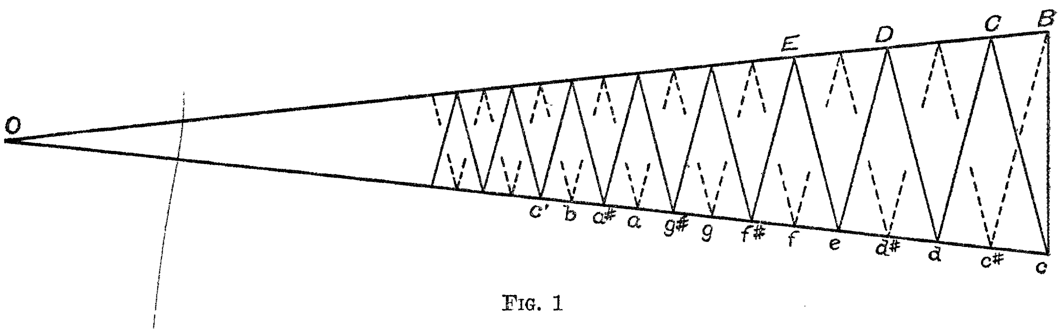


Fig. 1

If this diagram is drawn on the top of a sonometer, or a table-top across which a string is stretched, and bridges are placed under the string opposite $O$ and $c$, it forms a complete finger board for running the major, minor and chromatic scales.

The device lends itself to the demonstration of the following relations:

(1) Comparison of the major and minor scales. (2) Comparison of the major and minor chords. (3) To show that on the tempered scale any note may be taken as key note, and all scales are equally good. For this purpose choose any point as starting point, calling it point 1. Number the points from point 1 upward. Sound in succession the tones given by the string when stopped at points 1, 3, 5, 6, 8, 10, 12 and 13. (4) Comparison of just and tempered scales. Lay off from $O$ on $Oc$ lengths equal to 8/9, 4/5, 3/4, 2/3, 3/5 and 8/15 of $L$. The points so determined are those at which the string should be stopped to give the tones of the just scale. A glance at the board will now show to what extent each interval of the tempered scale is falsified.

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### THREE STRAWBERRY FUNGI WHICH CAUSE FRUIT ROTS

In my investigation of strawberry troubles in Louisiana last year,[1] and later in a study of market berries in this state, I frequently found upon spotted berries the fungi described be-

[1] Science, N. S., 39: 949, 1914.