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A SIMPLE DEVICE FOR DEMONSTRATING THE TEMPERED SCALE.

L. B. SPINNEY.

The diatomic 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.

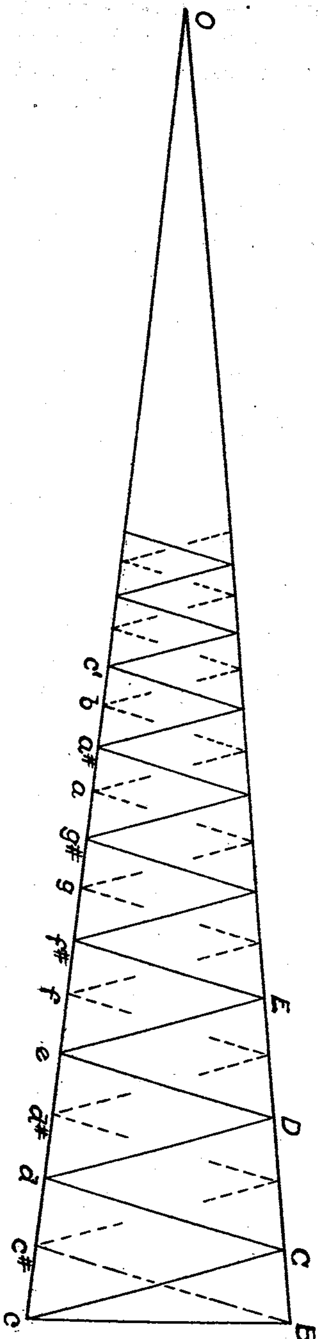

FIG. 26.—Diagram for demonstrating the tempered scale.

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, figure 26). From the point of intersection lay off on one line any convenient length Oc=L, on the other a length OC=L÷1.05946. Join the points Cc by a straight line. Locate the corresponding points B and c# and join by a dotted straight line. Now draw the series Cd, dD, De, etc., and the dotted series, parallel to Bc# and cC. By this means the points c#, d, d#, e, etc., are detemined 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.

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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