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.

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.

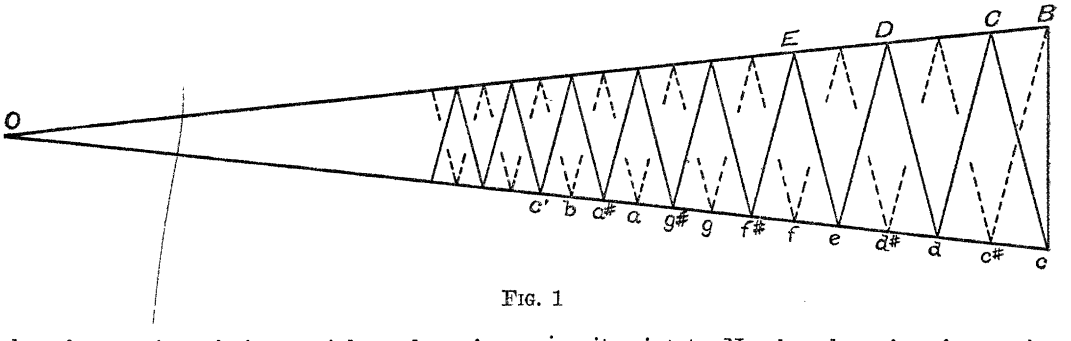

FIG. 1

L. B. SPINNEY

IOWA STATE COLLEGE

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.

low. The diseases were present in so large a percentage of the market berries as to make it apparent that they are real economic factors. In a recent trip to the Louisiana strawberry fields (April, 1915), I found the same fungi present upon berries still in the fields. The fungi have been isolated in pure culture and inoculations made. It seems desirable therefore to call attention to them at this time. A complete presentation of their study will be made later.

Strawberry Fruit Rot Due to Patellina Sp.

This rot begins either on green or ripe berries as a microscopic spot which enlarges slowly in green berries and more rapidly in ripe ones. In ripe berries the spot becomes sunken, the area tan colored. The margin is quite definite. The surface is soon studded thickly with sporodochia which vary from globular to patelliform to saucer-shaped, usually with a distinct, often wrinkled sterile margin. In color they vary from hyaline to tan, or when resting on the ripe berry they may take on completely the color of the berry.

The core of the diseased spot is completely occupied by the mycelium, rendering it of spongy tenacious texture. The host cells along a narrow line separating the diseased from the normal area are softened and separated from each other, evidently by enzyme action. It is therefore possible to lift out in its entirety the diseased tissue. The spot in a ripe berry increases in size sufficiently fast to involve the whole of a large berry in about four days. The fungus has been isolated and positive inoculations have been made. It clearly belongs to the genus *Patellina* and appears to be as yet undescribed.

Strawberry Fruit Rot Due to Sphæronemella Sp.

THIS rot occurs with or separate from the one above described. It differs distinctly in character of spot and is much less rapid in its effects. The spot is not definitely bounded nor is there such evidence of enzyme action as described above. The affected berry soon becomes completely covered with the *pycnidia,* which are tan-colored to black, distinctly rostrate and are of such peculiar gelatinous texture that berries affected with this disease can be distinguished by feeling of them.

The causal fungus has been isolated and positive inoculations have been made. It is a *Sphæronemella* apparently quite distinct from *Zythia fragariæ* Laib. and seems to be undescribed.

Each of the above fungi has been found repeatedly on market berries and they are clearly present in sufficient frequency to render them of considerable economic significance.

Strawberry Black Rot Due to Sphæropsis

LAST year both in Louisiana and in the market here, I frequently found berries which showed a very peculiar blackening or a bronzed appearance. Such berries rotted down dry and eventually shrivelled. Examination showed the presence of abundant dark coarse mycelium similar to that of *Sphæropsis malorum* and of pycnidia and spores also, as yet indistinguishable from that fungus. This disease was not nearly so abundant as the two above described and is not of much economic significance.

F. L. STEVENS

URBANA, ILL.,
May 3, 1915

SOCIETIES AND ACADEMIES

THE BOTANICAL SOCIETY OF WASHINGTON

THE 105th regular meeting of the Botanical Society of Washington was held in the Assembly Hall of the Cosmos Club, at 8 P.M., Tuesday, May 4, 1915. Thirty-three members and four guests were present. Dr. George R. Lyman was elected to membership. Dr. Camillo Schneider, general secretary of the Dendrologischen Gesellschaft of Austria-Hungary, was present as a guest of the society. The scientific program was as follows:

The Botany of Western Yunna (China): DR. CAMILLO SCHNEIDER.

Dr. Schneider has just returned from a year's journey in the high mountains of western Yunna. He has carried on in the region of the upper Yangtze investigations in botany, zoology and ethnology. He obtained a great number of colored photographs taken from nature (Lumiere, autochromes) of which he exhibited 25 with the lan-