colloidal suspension in the soil solution. In addition, iron and aluminum are found adsorbed by this organic material to the extent of about 40 p.p.m. and 20 p.p.m. of the soil, respectively. These soils and soil solutions with this treatment remain acid between values of pH 6.1 and 6.7.

Iron toxicity, due to increase in soluble iron after liming, has been claimed for the Louisiana soils, but the evidence that we possess indicates that the presence of the soluble sesquioxides in small amounts after sodium alkali treatment does not inhibit production from these Quebec soils but permits positive increases.

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THE ATTRACTION OF SPHERES

IT is appropriate that some warning should be given the inexperienced reader of Mr. Thaddeus Merriman's article in SCIENCE for April 14 (p. 371). His method of calculating the attraction of a homogeneous sphere upon a neighboring body involves assumptions inconsistent with the generally accepted methods of the integral calculus, as well as with the Newtonian law of gravitation. Newton's beautiful geometrical proof that the net attraction of such a sphere is exactly the same as if all the mass was concentrated at its center is, of course, fully confirmed by the rigorous analytical discussion which may be found in any standard treatise on mechanics, and so need not be reproduced here.

Mr. Merriman's proposed substitute law is inconsistent not only with theory but with the fact. For a small sphere near the earth's surface, it reduces to $F = G \frac{M, \cos \alpha}{d^2}$, when M is the earth's mass, d its radius, and α the angle between a line drawn to the earth's center and one tangent to a circle of radius 0.424 times the earth's. The factor $\cos \alpha$, which is omitted in Newton's equation, has the value 0.911 for a point on the earth's surface. Without it the attraction at the surface is known to be in complete agreement with that inferred from the orbital motion of the moon. To introduce it destroys the agreement, which provided Newton with the first conclusive test of his theory.

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PRINCETON
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

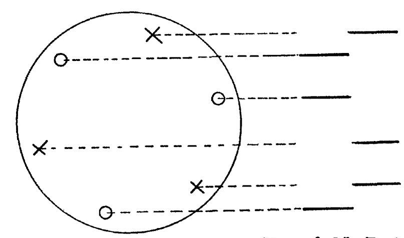
A TWO-FIELD STROBOSCOPE

IN stroboscopic observation of vibrating strings for measurement of frequency, no use seems to have been made of a two-field illumination. The two fields are contiguous and are alternately illuminated. The two-field method removes some ambiguities of the one-field method. But more important is the fact that a feeble resonance of the string to a tuning-fork or other source is more easily detected.

For the laboratory, the simplest device is the type of Neon bulb built for a. c. lighting circuits and having semi-cylindrical electrodes. Such a bulb can be held behind a string in such a manner that half of each electrode is visible. The two electrodes light up in alternation, the flash frequency of either side being equal to the frequency of the current.

For lecture demonstration, one can take a siren disk with an even number of holes. Alternate holes are half covered on the half nearest the center of the disk; the remaining holes are half covered on the side next the edge of the disk. The disk is set as closely as possible to the string, with the center of the disk level with the string. When a hole is level with the string, a strong beam of light is made convergent by means of a condenser, and is arranged to just cover either type of hole. On the other side, an objective focusses the string on a screen. When the disk is rotated and the string made to vibrate, a two-field stroboscopic view of the string is obtained. (Many other methods may be used.)

To understand the patterns seen, the procedure is to construct in advance the patterns to be expected. To do this, imagine a stroboscope disk with a single spot; rotate this at S revolutions per second, S being the string frequency; and illuminate the disk by F flashes per second. When the pattern has been worked out, project the spots of the pattern on a vertical line in the plane of the disk. Then repeat the process for a series of flashes beginning one half flash-period later. The projections of this second pattern gives the string pattern in the other field. The figure herewith illustrates the case when the flash frequency is 3/5 of the string frequency. Small circles give the first disk pattern, and crosses give the second.



Disk Pattern Two-field Pattern

Figure illustrating the construction of the two-field pattern for $F = S.3/5$.