Science.

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SIMPLE HYGROSCOPE.

BY GEO. M. HOPKINS.

IN THE sultry days of summer we hear a great deal about humidity. This means great discomfort to almost every one.

To be really comfortable on a hot summer's day we do not need shade, cooling drinks, and fans so much as dry air. When the air is dry, nature's method of cooling by spontaneous evaporation of moisture from the skin is carried on to the comfort and satisfaction of those who are compelled to spend the heated term in a warm climate; but when the air is overcharged with moisture nature's cooling process ceases and discomfort results.

To determine by observation how thermal and hygroscopic conditions are related to the enjoyment of existence in hot weather, it is necessary, in addition to a thermometer—which nearly every one possesses—to have a hygroscope or hygrometer of some kind that will either indicate the hygrometric state of the air or afford a means of actually measuring the percentage of moisture in the air.

The annexed engravings illustrate a hygroscope—which may be used for measuring the moisture in the air with tolerable accuracy, and which might therefore be called with equal propriety a hygrometer.

The instrument depends for its action on the expansion and contraction of a strip of cardboard (Bristol board), formed into a helix and rendered impervious to moisture on the outer surface. The helix is rigidly held at one end while the opposite end carries an index which moves over a graduated dial.

The simplest form of illustration is shown in Fig. 1. In this the upper end of the helix is glued to a cork which fits tightly on the wire projecting from the centre of the dial. The lower end of the helix is cemented to a paper index, which is perforated to receive the wire. To reduce friction, the hole in the index is blackleaded by twirling in it the point of a very soft lead pencil.

The form shown in Fig 2 (in which parts are broken away) is like that already described, except in the manner of supporting the helix and in the arrangement of the index. The index in this base is attached to a common needle or pin, which passes through a hole in the centre of the dial and is inserted in a cork in the end of the helix. In the end of the helix farthest from the dial is glued a cork, which is supported by an angled wire projecting from the back of the dial.

When the cardboard helix is as dry as it can be made, a zero mark is drawn opposite the point of the index, and on a very damp and sultry day the instrument is placed in a steamy

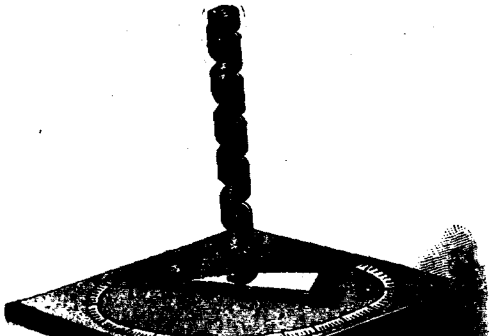

FIG. 1.—SIMPLE HYGROSCOPE.

atmosphere until the index has moved as far as it will go from the zero mark; the coil is then inserted in the mouth without bringing it in contact with the tongue or lips, when it is breathed upon until the index stops moving and a mark is made opposite the point of the index. This mark is numbered 100, as it is assumed that the atmosphere surrounding the helix at the time of making the 100 mark was saturated. The space between the 0 and 100 marks is now divided into 100 equal parts. The helix must be fixed so that it will not change its position relative to the scale, otherwise the adjustment may be lost.

The percentage of moisture in the air will be indicated by position of the index on the dial. If it points to 75, the air is within 25 per cent. of

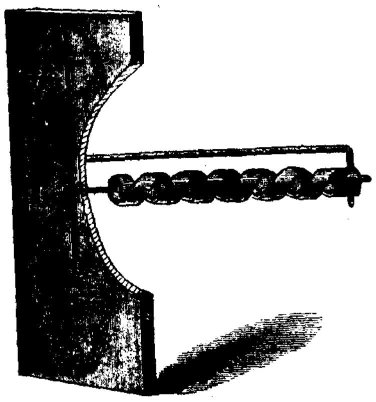

FIG. 2.—SENSITIVE HYGROSCOPE.

saturation. If 80, 20 per cent., and so on. The index makes something more than a half turn between 0 and 100

The important part of the instrument is the paper helix, but its preparation is very simple. A strip of thin Bristol board, ¾ inch wide and 6½ inches long, is wet on one side and wound on a lead pencil or similar object, with the dry side next the pencil. The ends are secured by winding a small rubber band several times around the pencil, as shown by Fig. 3.

When the paper helix thus formed is perfectly dry and before it is removed from the pencil the

FIG. 3.—FORMING THE HELIX.

outer surface only of the cardboard is covered with two coats of shellac varnish, the first coat being allowed to dry thoroughly before the second is applied.

The helix is now allowed to remain in a warm dry place for a week or more, to allow the varnish to become perfectly dry and hard. Neglect of this last precaution will insure failure, as the paper will not return to its original form after being expanded unless the varnish is hard.

PROBLEMS IN PHYSICS.

A correspondent asks for solutions of the following questions. As these questions are types the solutions are given here rather than in the correspondence column as they may be of use to general readers and experimenters.

1. Devise various arrangements of 30 cells in which

r = .8 ohm R = 10 ohms and E.M.F. 1 volt.

(a). Connected in series

$$C = \frac{30 \times 1}{(.8 \times 30) + 10} = .882 \text{ ampere.}$$

(b). Connected in 2 series of 15 cells each.

$$C = \frac{15}{\left(\frac{.8 \times 15}{2}\right) + 10} = .937 \text{ ampere.}$$

(c). 3 series of 10 cells each.

$$C = \frac{10}{\left(\frac{.8 \times 10}{3}\right) + 10} = .789 \text{ ampere.}$$

2. How many incandescent lamps requiring an E.M.F. of 60 volts and a current of 1.5 amperes each can be supplied by an engine giving 15 useful horsepowers, the loss of energy in the dynamo being 20 per cent.

Each lamp requires $1.5 \times 60 = 90$ volt-amperes or watts.

80 per cent. of 15 = 12 horsepowers of current

1 horsepower current = 746 watts

$$\therefore \text{ No. of lamps} = \frac{12 \times 746}{90} = \text{about 100 lamps.}$$

3. Why is a battery of 100 cells connected in series with no external resistance no better than 1 cell?

Ans. Consult textbook or answer to 1-a above.

EXCLUSIVE COMMUNITIES.

The number of ants dwelling together in a community, according to Sir John Lubbock, is sometimes as great as five hundred thousand. They are always friendly towards each other, no quarrels ever having been observed between two ants, members of the same community. They are, however, very exclusive, and regard an emigrant with horror. When an ant of the same species belonging to another nest appears among them, he is promptly taken by the leg or antenna and put out. It would naturally be surmised that this distinction was made by means of some communication. To test whether they could recognize each other without signs, attempts were made to render them insensible, first by chloroform and afterward by whiskey. "None of the ants would voluntarily degrade themselves by getting drunk." Finally fifty ants were taken, twenty-five from one community and twenty-five from another, and dipped into whisky until intoxicated. They were then appropriately marked with a spot of paint and placed on a table where the ants from one nest were feeding. The sober ones noticed the drunkards and seemed much perplexed. At length they took the interlopers to the edge of the moat surrounding the table and dropped each one into the water. Their comrades, however they carried home and placed in the nest, where they slept off the effects of the liquor.—*Popular Science Monthly.*

CORRESPONDENCE.

W.J.B., Priceville.—Question.—How to "describe accurately the plant submitted."

Ans.—Suppose the plant submitted were the white Trillium. The following description would answer:

Root.—Fibrous from a rootstock, primary.

Stem.—from 8 to 18 inches long, herbaceous, smooth, round, bearing a whorl of 3 leaves near the summit.

Leaf.—Three near the summit of the stem, sessile, broad, net-veined, entire, apex acute, base ovoid.

Flower.—Perianth of 3 outer green sepals and 3 inner white petals. Petals oborate, all polyphyllous. Stamens six opposite the petals and sepals, monandrous, anthers elongated, pistil compound 3 celled syncarpous styles 3. Superior-Perianth inferior. Flower solitary, regular, symmetrical.

Locality.—Rich woods in Spring.

R. J.—Question.—What are the "Laws of the Electro Magnet?"

Ans.—1. The resistance of the helix of an E.M. should be equal to that of the rest of the circuit.

2. The thickness of the helix should be equal to the diameter of the core.

3. The attractive force of an E.M. is proportional to the diameter of the core and to the square root of its length. It is also proportional to the square of the current strength for a like number of convolutions and to the square of the number of convolutions for like strength of current.

4. The attractive force is proportional to the square of the current strength multiplied by the square of the number of convolutions.

5. The maximum of saturation depends solely upon the mass of iron in the core.

HE who most prizes the science of education, and who most carefully studies the subjects which it embraces will likely do the best work. —*Bishop J. H. Vincent.*

School-Room Methods.

FRACTIONS.—The first step will be to show that fractions may have different forms; that $\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$, etc. The same must be done with $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$, $\frac{1}{10}$. Let it be noted that this equivalence must be *shown.* Some teachers teach this solely by figures, they say $\frac{1}{3} = \frac{2}{6}$, etc. This throws the learning of the fact on the memory; it is a matter for the understanding. It makes little difference whether the boy is ten or fifteen years of age; give him a circle and let