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An Experiment in Hydrostatics

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with that of conifers. The conifers, through their possession of leaves, are able to manufacture some food but they do not suffer from excessive water loss because of the nature of their leaves. The small leaf size, the thickness of the cuticle and of the entire leaf, and the internal structure render the escape of moisture very difficult. The efficiency of the leaf in resisting water loss is readily shown by the fact that loss of water from conifers in winter is little more than that of deciduous trees in their defoliated condition. An important application of these principles is seen in the distribution of our coniferous forests. A vegetation map of North America will show that the forests typical of the drier and colder portions of the continent are coniferous rather than deciduous. (See Chapter 33 in Transeau's General Botany.)

The difference in the form or type of branching in deciduous and coniferous trees is most readily seen during the winter. The pyramidal form or "excurrent" branching with the characteristic whorls of branches is typical of most of our conifers. Our deciduous trees, on the other hand, usually show the type of branching known as "deliquescent," in which the main trunk soon dissolves into the branches of the crown. There are some exceptions to be noted in the case of the Lombardy Poplar, the Pin Oak and a few others. An interesting problem is to relate the difference in form and method of branching in the two types of trees to the relative development of the terminal and lateral buds. Another application can be made in a study of the relation of pruning practice to the form of the tree and to the development of wood or of fruit.

Twigs of such trees as the Shagbark Hickory or one of the varieties of Ash will show clearly series of marks or rings, known as terminal bud scars, at the base of each season's growth. These scars are produced by the falling away of the scales surrounding the terminal bud. Each season's growth begins just above such a ring and by counting the rings the age of the twig may be determined. Also by examining the portion between the rings we can tell how much growth was produced each season and the number of leaves borne by the branch. An interesting problem is to attempt to interpret the history of such a twig and to relate its growth to external conditions. The age of the twig can also be determined by making cross sections through each season's growth and counting the annual rings of growth shown. The age so determined should correspond with the figure previously obtained. An examination of such twigs will also reveal the origin of the lateral branches.

Identification of trees in the winter condition can very readily be made by reference to characters, such as the color; nature and texture of the "bark" on the trunk; the color and hairiness or smoothness of the "twigs"; the size, color, shape and outer covering of the "buds" and their arrangement or position on the twig; the size, shape and arrangement of the "leaf scars" and their "bundle scars"; the presence or absence of "stipule scars"; the size, shape and color of "lenticels" in the bark; and in some cases the "fruit". In order to proceed intelligently and make accurate determinations one should have access to some reliable, though simple, key. Some references which will prove valuable in work of this sort include: Michigan Trees by Otis, obtained from the Secretary, University of Michigan, Ann Arbor; Trees in Winter by Blakeslee and Jarvis, published by the Macmillan Company, Chicago; and Studies of Trees by Levison, published by John Wiley and Sons, New York City.

We plan to present suggestions for spring tree work in a later number of the Bulletin.

O. R. CLARK

AN EXPERIMENT IN HYDROSTATICS

Physics

Individual laboratory work in hydrostatics is not very essential if the teacher is properly equipped for classroom demonstration. However, it would be interesting and profitable in communities where gas is supplied to the laboratory, to have the student measure the gas pressure by means of a water column. All that is necessary for this problem is a bent U shaped tube containing a water column. This tube can be made from a straight glass tube thirty inches long and one-fourth inch internal diameter. Bend the tube at its middle point into a rounding U shaped form. Fill the two arms of the tube with water to a height of about eight inches and attach one arm to the gas jet with a piece of rubber tubing.

The difference in the height of the two columns of water when the gas is turned on will enable the pupils to calculate the gas pressure, using the principle of gravity pressure applied to a water column. Let us assume the difference in the height of the two water columns to be eight inches. Then the gas pressure would equal the weight of a column of water of one square inch cross section and eight inches high. The computation is simple. First convert the eight cubic inches of water column to cubic feet by dividing by 1728. Then multiply the quotient by 62.4, the weight in pounds of one cubic foot of water. If the pressure is to be determined in grams per square centimeter instead of pounds per square inch, we need only to measure in centimeters the difference in the heights of the two water columns. The result is the numerical answer, since one cubic centimeter of water weighs one gram.

L. BEGEMAN

ATMOSPHERIC PRESSURE

Physics

Having learned the meaning of "pressure" from the study of hydrostatics, the pupil is easily led to understand the striking phenomena of atmospheric pressure. He should readily appreciate that the term refers to the gravity pressure of the atmosphere. For example, an atmospheric pressure of 14.7 pounds per square inch refers to the weight of an average column of air resting on one square inch of the earth's surface at sea level. The first experiment should be one to demonstrate to the class that air has weight. This can be done by means of an air pump and an ordinary quart bottle. The bottle is fitted with a one hole rubber stopper carrying a short glass tube of quarter inch bore, and to the end of this is attached a rubber tube. The bottle with its connections is first weighed on an ordinary beam balance. The air is then partially exhausted and the tube closed with a pinch clamp. When it is again placed on the balance the original weights should over balance it. Thus it is shown that the air removed from the bottle has weight. In case the school does not possess an air pump, it is best to use a thin walled chemical flask and exhaust the air by means of steam pressure as explained in the General Science article of this issue.

The historical side of this interesting subject must not be neglected in class room discussions. The following instance may be discussed. Galileo had learned that air has weight through his oft repeated experiment similar to the one described above. He first weighed a container full of air under ordinary pressure, then when it was filled under high pressure and noted that the second weight was the greater. He did not, however, clearly understand the phenomena of atmospheric pressure, as shown by his incorrect explanation of the action of a siphon or a suction pump. The action of water in these devices was accounted for by the old Aristotelian statement that "Nature abhors a vacuum". It remained for Torricelli, an ardent disciple of Galileo, to associate atmospheric pressure and the height of the water column in a suction pump. He devised the famous experiment which bears his name and which is now practically applied in the mercurial barometer. He designed this apparatus to measure the weight of the atmosphere which in his words was "now heavier, now lighter". This experiment, known as Torricelli's experiment, is described in all high school physics texts and need not be discussed in detail here. The actual experiment was not performed by Torricelli but was first carried out by his pupil, Viviani, in Florence, Italy in 1643.

An account of the experiment reached Paris the next year and came to the notice of Pascal. He could not try the experiment until 1646 when glass tubes were available to him. Pascal reasoned that if the atmosphere supported the mercury column, the height of the column should

(To be continued)