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Cockroaches for Laboratory Study

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ft. above the water level in the dish. This value is obtained by multiplying the average barometric reading at sea level, or thirty inches, by the relative density of mercury, or 13.6. The pupils should be led to solve this problem.

4. Pour a pint of water into an empty gallon varnish can and boil for about five minutes. Immediately cork the can tightly and cool it either by pouring cold water on it or by allowing it to stand. The can will soon collapse. Require the pupils to calculate the total amount of force exerted on one side of the can, assuming a total vacuum inside. The experiment is striking and is admirably adapted to demonstrate the difference between the concepts of "pressure" and "force" as used in applied mechanics. Atmospheric pressure is 14.7 pounds per square inch.

5. Repeat (2) through the boiling process, then quickly insert a solid rubber stopper. After it has cooled for about fifteen minutes balance the flask on a beam balance. Then remove the stopper to admit air, replace the stopper, and notice which side of the balance is the heavier. This experiment strikingly shows that the weight of even as small a volume of air as the flask holds is sufficient to register itself on a common beam balance. Since a cubic foot of air weighs approximately one thirteenth of a pound, have the pupils calculate the weight of air in the school room. They will be surprised at its great weight and will then appreciate why a moving mass of air such as a high wind or a tornado can be so destructive.

L. BEGEMAN

COCKROACHES FOR LABORATORY STUDY

Biology

Teachers of high school biology are often handicapped by a lack of living material. This is particularly true in the teaching of insects. Most texts in biology use the grasshopper as a type of insect, largely, I suppose, because of its familiarity to the average pupil. In this latitude, however, grasshoppers do not commonly hatch until late in May and are then too small for favorable study. Plenty of adult specimens may be obtained in September, but they are then nearing the end of their life-cycle, and do not thrive well under laboratory conditions.

I have found the Australian roach, Periplaneta australasiae, to be superior to the grasshopper as a laboratory type for insect study. It is hardy in captivity and may easily be kept alive and active in the laboratory throughout the year. No particular effort is required to take care of this animal, it will eat almost anything, especially starches and sugars, and will endure starvation for long periods. The females in particular are voracious feeders; the males will eat but little in captivity even after prolonged starvation.

For laboratory study each student should be given a pair of the roaches, male and female, in a clean, quart Mason jar, The females may be distinguished by their broad abdomens and more robust appearance. The lid of the jar should be perforated to supply air, and a bit of paper placed in the jar for the animals to hide under. I usually place a small stick slantwise in the jar as the female likes to fasten her egg-cases to this support. The eggs are then easily accessible by simply removing the stick.

Sufficient water may be supplied to the roaches by letting a few drops fall inside the edge of the jar each day. Do not place any receptacle containing water in the cage, as the roaches drown easily even in shallow water. The animals should be transferred to a clean jar about every two weeks.

Each pupil should be required to keep a record of his observations on the animals throughout the semester. These notes should include general behavior of the animals, amount and kind of food eaten, response to stimuli such as is shown for example by the antennae, number of egg-cases laid in a given time and any other thing which may catch the pupil's interest. One of my captive females laid thirteen egg-cases in ninety days.

The young roaches usually hatch from the egg-capsule about forty or fifty days after laying. If the pupil succeeds in hatching some of the eggs, much interesting information

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ens. Long ironing and repeated paraffin treatments are essential. Tops so treated will last many years, especially if given a light paraffin coat occasionally. No surface paraffin should be left on the desk edges to soil the clothing of the pupil.

Another treatment and one to be recommended especially for new desks before use is the "aniline black" finish. The solutions contain aniline, copper sulphate, hydrochloric acid, potassium chlorate and water. The final finish is a satiny jet black. An authority claims that ten square yards can be coated at a cost of fifty cents. Details of the method can be obtained from the Editor.

Neglect of the plumbing often brings the chemistry teacher to grief. Pupils should be instructed to use acids sparingly and to run at least a gallon of water into the sink for each spoonful of acid discarded. If sinks are constructed to hold standing water, try keeping in each one a slab of marble or even limestone of fifteen to thirty square inches surface. It is surprising how much acid they neutralize. If sinks are of the bottom drain type it is desirable to keep water constantly flowing into them during laboratory periods. Their outlets should also be provided with a filter cap to retain matches and other floating material which might otherwise clog traps and sewer pipes. Supplement this precaution with a careful check to discover the pupil who carelessly throws such waste into the sink.

The comments in this article are based on the assumption that the teacher has inherited an equipped laboratory and is merely (?) confronted with the task of keeping it in first class condition. If, on the other hand, he is to assist in selecting plans and specifications for a new laboratory, the responsibility and satisfaction are increased many fold. Plans for a modern chemical laboratory require greater skill than for almost any other part of a new school building. Few architects, even, are conversant with the latest and best in modern laboratory arrangement and construction. If the rare privilege is yours of building a new laboratory, seek the very best advice, both from those who design them and from those who use them.

R. W. GETCHELL

COCKROACHES FOR LABORATORY STUDY

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may be obtained by watching the behavior of the nymphs or roachlings. As soon as they appear they should be removed from the jar and kept by themselves; ordinary Petri dishes serve very well as cages. The nymphs eat the same kinds of food as the adults.

Watch for the first moult which will occur in a day or so after hatching. Although the newly moulted roach may usually be distinguished by its increased size and improved complexion it is unsafe to depend upon these criteria for determining the number of moults. Since the young roaches always eat their cast skins, it is necessary to mark them as soon as hatched and after each moult. This may be done by touching each upon the back with a small camel's hair brush dipped in some white material such as wet chalk or temperine.

Large, freshly moulted nymphs are nearly transparent for a few hours after moulting and therefore make excellent material for the study of the heart and circulation in the living insect. If one of these specimens can be obtained, fasten the animal firmly to a bit of wax or cork by thrusting pins through the outer edges of the exoskeleton. By the use of a binocular or the low power of an ordinary microscope, the pulsating heart may be distinctly seen through the transparent covering of the back of the abdomen. Roaches also make excellent material for introducing various phases of general biology. For example, the Protozoon Gregarina is usually present in the intestine and may easily be demonstrated by the instructor. When a live roach is picked up in the fingers it almost invariably expectorates two or three large drops of clear saliva. This saliva may be used to demonstrate why roaches are such excellent starch transformers. I usually collect a few drops in the depression of a ground-glass slide, and then add a drop of dilute starch solution. An hour's incubation even at room temperature, is usually sufficient to demonstrate by the iodine test that the starch has been transformed into some other

product. It is not easy to show with such small quantities of material that the starch has been changed to maltose.

If you wish to create a real interest in the study of insects, try the cockroach for a semester.

ROY L. ABBOTT

Note: Live roaches may be obtained from N. P. Frye and Son, St. Petersburg, Fla.

HYDROSTATICS (Concluded)

Physics

The classroom apparatus necessary for an effective, interesting presentation of hydrostatics includes: pressure tubes, manometer tubes, pressure syringe, Pascal's vases and equilibrium tubes. All of these are listed in the apparatus catalogs found in every high school. The total cost of such equipment need not exceed six or seven dollars. Some pieces can be made by the instructor. We use a pressure syringe made from the float of a toilet closet. Drill a number of small holes in the sphere, cut off the rod, solder on a tube six inches long and one inch in diameter, opening into the sphere. For a plunger wrap enough cord around a wooden rod to fit the cylinder tightly. As an interesting lecture demonstration of Pascal's principle completely fill a thin-walled bottle with water and insert a close-fitting stopper. A sharp downward blow upon the stopper will completely shatter the bottle.

The instructor should avail himself of every opportunity to enliven the subject of Hydrostatics by discussing the various devices in which the principles are practically applied. These would include the hydraulic press, hydraulic jacks, hydraulic brakes of an automobile, barber's chair, city water distributing systems, devices used to neutralize the pressure on divers, and those used on engineering projects to enable men to work in caissons subjected to water pressure.

He may also profitably discuss the principles and applications of pressure of flowing liquids. Take up Bernouilli's principle as illustrated in the common laboratory filter pump and also in the curving of a pitched ball. The principle of Torricelli, which deals with the flow of a liquid from an orifice when subjected to gravity pressure, may be studied. Some years ago the writer was consulted by a group of men as to whether the doubling of the height of the city water tank would double the flow of the water from a faucet. When he stated that, theoretically, the tank would have to be four times as high to double the flow, the group were almost incredulous. The writer doubts that in the minds of those men, this statement added to his reputation as a teacher of physics.

L. BEGEMAN

WINTER STUDY OF TREES

Botany

One often hears the idea expressed that there is little to be done during the winter months in the way of field or laboratory studies of trees. In reality there is a wealth of material available and the following suggestions are offered in the hope that they will be helpful in calling attention to the possibilities of winter tree study.

The annual shedding of leaves by our deciduous trees is familiar to all but the importance of this phenomenon is not always recognized. The twigs of trees common to your locality can be collected, or studied in the field if the weather permits. Attention should be directed to the corky covering of the twigs and to the dry, waterproof covering of the buds. The scars left by the dropping of the leaves are also covered by a corky tissue known as the abscission layer, which caused the severing of the leaf from the twig. The tree which during the summer showed a high evaporation rate due to its enormous leaf surface, now exposes a much smaller surface that is protected by corky tissue through which the escape of water is difficult. The importance of this protection is realized when we think of the frozen condition of the soil. The waterproof nature of bud scales is readily illustrated by buds of Boxelder, Cottonwood, Shagbark Hickory and Horse Chestnut. It is instructive to note that leaves were borne only on the portion of the twigs produced during the last season and also to notice the position of the buds with reference to the leaf scars.

It is interesting to compare the winter condition of deciduous trees