justed by increasing or decreasing the wattage of the bulb, changing its position with respect to the eggs, or by drawing apart the top panes of glass to allow greater circulation of air. To hold the eggs in an upright position, a sheet of $\frac{1}{4}''$ mesh hardware cloth, with $1\frac{1}{2}''$ holes cut to receive the eggs, may be placed as a horizontal shelf across the box above its center.

Given favorable conditions of temperature, humidity and circulation of air, fertile eggs should develop successfully and be observable throughout their incubation period when the eggshell caps are used as described above.

HATCHING CHICKENS IN A LABORATORY

The course of study for high school biology in Washington includes these units: All Life Comes from Life, and Improvement in Plant and Animal Life Depends upon Variations and Heredity. Each unit is given approximately two weeks. During the study of these units eggs are hatched in an electric incubator costing less than $10.00, purchased from a local mail order house. The incubator holds at least five dozen eggs.

Eggs are opened every day or so in order that the development of the embryo may be observed. It is best, but not necessary, to plan to use an egg for each class as each group prefers watching its own egg opened.

To open, an egg is placed in a pan of lukewarm water. The surface which rights itself above the water bears the embryo. With scissors, the shell is punctured at the large end, then cut lengthwise around the shell, taking care not to cut deeper than the underlying membrane. The upper portion of the shell is then removed.

The embryo of the opened egg may be kept alive for at least four hours by keeping it in a warm, moistened compartment. This is prepared by placing a small shallow container in warm water and inverting a large glass dish over all as cover. The small container supports the egg, and all is set in the incubator until the next class.

General directions for setting of the eggs and care of the incubator as well as early care of the chicks come with the incubator. However, all eggs should be set at the same time, for the incubator should not be opened from the eighteenth day to the time of hatching; escape of moisture is thus prevented. It is well to have the eighteenth day come on Saturday so that the class will not miss steps in the development of the embryo. Everyone wants to see a pipped egg. By all means, have enough eggs so that some will be sure to hatch. Candling is recommended so that odors from infertile eggs may be eliminated. Light eggs may be tested on the third or fourth day, dark eggs on the sixth or seventh. After the first day until the eighteenth, the eggs should be turned daily to keep the chick from sticking to the shell. After the eighteenth, the embryo is so large that it cannot change position easily in the shell and besides, moisture must be conserved.

Soon after the egg is placed in the incubator, the embryo, which is already in the early stages of germ-layer formation at the time of laying, resumes its growth. On the second day the heart beats, sending blood through a fine network of arteries and veins. By the third day, the gill clefts on the side of the neck reveal the fish-like plan of body. Limb buds, developing into miniature wings and legs, show well by the fifth day.

Feathers appear on the eighth day. Two weeks are necessary for formation

of the hard beak and claws. Twenty-one days after setting, from the pip, a partial ring is broken around the shell. The chick by pushing its feet against the small end, with its head against the large end, bursts the shell all around and is free.

Our incubator was easily converted into a brooder. A few chicks lived in the class room for two weeks. As long as plenty of food was kept before them and there was sufficient heat, they demanded no attention. For night protection, they were tucked into a well ventilated box and placed under the cover of the hood.

Since the claiming of chicks was apt to become a problem, ownership was arranged before the eggs were set. Even then, the owner did not gain them until he had promised to return them for periodical visits.

The few minutes given every day or so to observation of the developing embryo made no break in the remainder of the lesson period. References were made frequently to the human or mammalian embryos at such a particular stage of development. Many textbooks carry a page of comparative embryos.

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AN AIR TIGHT BALANCED AQUARIUM

This technique is a variation of the Spallanzani tube (to disprove spontaneous generation) and originated at a session of the "Laboratory Techniques in Biology" in-service course.

A balanced aquarium is prepared by making a Spallanzani tube and putting in it several snails such as Physa, an alga such as Hydrodictyon or Nitella, and some natural or artificial pond water.[1] The tube is prepared by heating and drawing out a soft glass test tube over a Bunsen flame so that there is a constriction near the center of the tube. After putting in the plants and animals the tube is sealed by applying the Bunsen flame to the constricted portion until it is molten and then pulling and twisting the tube. The top portion of the test tube is discarded.

The writer has prepared such tubes which are maintaining themselves very well. The aquarium water remains very clear in the tube. In some tubes there were definite signs of growth and in one tube where hydrodictyon was introduced, the hydrodictyon reproduced, forming many cylindrical nets or colonies.

Another way of checking on the balance within the aquarium tube is to add some Brom-Thymol Blue to the water before sealing the tube. If decay goes on due to death of plant or animal material, the water will become slightly acid which condition will cause a change in the color of the water from blue to yellow. (Brom-Thymol Blue is yellow in the presence of an acid and blue in the presence of a base. It operates on a pH range of from 6 to 7.6.)

When studying the balanced aquarium in class, enough of these tubes can be made up so that each student can have one for individual study to observe and take notes on. Better still—each student can easily make one himself by following simple mimeographed or verbal directions or watching a demonstration at first by the teacher. The experience of working with glass under a flame and

[1] Artificial pond water can easily be made in the laboratory by using the following formula:

NaCl, 1.20 g.; KCl, 0.30 g.; $CaCl_2$, 0.04 g.; $NaH \cdot CO_3$, 0.02 g.

Phosphate buffer, with pH of 6.9–7.0: 50 c.c.

Distilled water to 1000 c.c.

This is a stock solution. For use, dilute this by adding 900 cc. of distilled water to 100 cc. of the solution.