faint turbidity in 24 hours. When the concentration of whole serum was reduced to 1.36 per cent. protein during urea treatment, the resulting material showed an activity of 89 per cent. of the activity shown by untreated serum. When the protein concentration was reduced to 0.58 per cent., the activity of the resulting material was approximately the same as the untreated control. The partially purified antibody showed the greatest effect of protein concentration—the 5 per cent. solution giving 28 per cent. more precipitate than the untreated control. Increases of 20 to 40 per cent. have been obtained with most systems of this type or where small amounts of serum albumin were added to purified antibody preparations. The third preparation, which consisted of highly purified antibody, showed essentially no effect from the urea treatment. In no case was there any significant change in the equivalence zone. However, the zones were usually much sharper for the urea-treated preparations.

These results indicate that when there is a large excess of non-antibody protein, optimum conditions for complexing of proteins will tend to eliminate precipitating activity due to masking of combining sites. When there is a relatively large amount of antibody protein present, complexing tends to increase the apparent precipitability of the antibody preparation because of complexing with non-antibody protein but with sufficient combining sites exposed to afford the formation of a precipitating framework. When the antibody is essentially pure, complexing has little or no effect on the resulting preparation. It is apparent, therefore, that considerable care should be exercised in the interpretation of data obtained for denaturation of antibodies, not only with urea but also any denaturing agent which causes the formation of protein complexes.

DAN H. CAMPBELL
JOHN E. CUSHING
CALIFORNIA INSTITUTE OF TECHNOLOGY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE TECHNIQUE OF INDUCING SPAWNING IN HALIOTIS RUFESCENS SWAINSON

IN April, 1940, an investigation into the life history of *Haliotis rufescens,* the commercial abalone of California, was initiated at the Hopkins Marine Station of Stanford University. In September of the same year the program was interrupted when the writer accepted temporary employment with the California State Division of Fish and Game. Due to subsequent enlistment in the armed forces, resumption of the work has been indefinitely postponed. It is, therefore, deemed advisable to present the following brief notes on the solution of one difficult problem, lest all results be lost.

Haliotis rufescens is a dioecious gastropod mollusk. Tide-pool and shallow-water observations made in the spring of 1940 revealed that the expulsion of sexual products by the male was of common occurrence, usually easily induced by disturbing the specimen. During any period of desiccation following removal of specimens from their habitat, large quantities of sperm were liberated. Similar treatment, however, never resulted in the liberation of eggs by the females.

Although the difficulty of inducing ovulation in this species has caused the abandonment of at least two previous attempts at an embryological investigation, numerous means were tried in an effort to solve the problem. Methods as drastic as the injection of KCl isotonic with sea water, a technique employed successfully by Dr. Albert Taylor,[1] of the California Institute of Technology on various mollusks, failed. After various methods had been tried with negative results, the following technique was arrived at as a successful method to induce spawning and fertilization.

For each experiment 15 to 20 specimens of both sexes were taken in the littoral waters, varying in depth from four to 18 feet. Since exposure to air was found to be necessary for the success of induced spawning, these animals were brought to the laboratory dry in large tubs. A period of desiccation totalling one hour and fifteen minutes was finally found to represent the optimum time for exposure to air. During this period large quantities of sperm were given off by all male specimens. This sperm was thoroughly washed over the entire body of each female; then all individuals of both sexes were placed in well-aerated salt-water tanks. These concrete tanks were out of doors and simulated quite well the natural environment of the species under discussion. Sperm continued to issue from the males until the water became cloudy and, in successful experiments, spawning of the females occurred within six to eight hours after placing the animals in the tanks.

Fertilization resulted in obtaining of typical mollusk cleavage stages. Development continued until trochophore larvae appeared, each still enclosed in a thin membrane. These membranes were finally ruptured and the trochophores became extremely active free-swimming larvae. Changes continued through the veliger stage, paralleling somewhat the develop-

[1] Personal communication.

ment of *Patella* as described by Patten.[2] The shell first appeared on the second day, and by the seventh day resembled closely the shell of small metamorphosed specimens collected in the field.

Considerable material and data are at hand and it is hoped that the work may be resumed, and that a full report on the embryology and larval development of this species can be presented at a later date.

JOHN G. CARLISLE, JR.,
1st Lieut., Army Air Corps

A BOX TRAP FOR COTTON RATS[1]

THE demand for wild caught cotton rats of the genus *Sigmodon* for research on the chemotherapy of filariasis has stimulated the trapping of these animals in various southern localities. The box trap shown in Fig. 1 has proved sufficiently successful in practice as

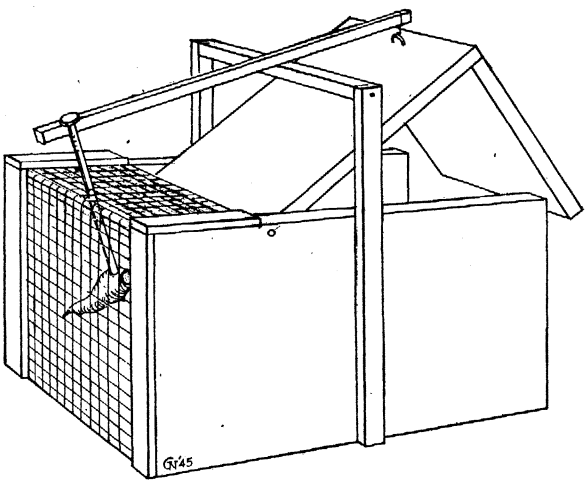

FIG. 1

to warrant making its description available to others. Made of $\frac{3}{4}$ inch lumber, its outside dimensions are $12 \times 6\frac{1}{2} \times 6\frac{1}{2}$ inches. The handle, which also serves to support the trigger mechanism, increases the overall width by 1 inch and makes the total height $9\frac{1}{4}$ inches. The door is made of two pieces of wood nailed together so as to comprise the front and two thirds of the top of the box. Two nails are passed through holes drilled in the sides of the box, and driven into the top of the door near the back edge to form a hinge. A cross piece just behind the door gives rigidity to the box in addition to that supplied by the handle, and furnishes a support for the edge of the galvanized hardware cloth (one-third inch mesh) covering the balance of the top as well as the back of the cage. This wire, the edges of which are covered with wood strips so as to protect the operator's hands, makes it possible to see what is in the trap, and also provides a base for the trigger, which consists of a 20d nail and a piece of wood $\frac{1}{2} \times \frac{1}{2} \times 11$ inches, the latter loosely wired to a staple driven into the front edge of the top of the door. A notch, one-sixteenth inch deep, is cut into the nail with a hacksaw $1\frac{1}{2}$ inch from the head, and is filed to a taper on the upper side only. Since the nail head under which the lever supporting the door is placed, is slightly curved and the notch in the nail shallow, the mechanism releases at the slightest touch, but is not too sensitive to jarring. The bait, such as a piece of carrot or bread crust, is placed on the point of the nail. The possibility of hooking the nail to either side of any one of the squares of the wire mesh is of great convenience when the effect of the weight and varying center of gravity of the bait is considered.

Trapping on the mainland of Galveston County, Texas, has proved best in fields which have neither been plowed, burned nor pastured for several years. The labyrinthine runs can be located under the lodged dead grass of a previous year. Those in current use are easily recognized by the absence of green growth or debris in the center of the run. Traps are set to the side of the run with the door facing the run, a convenient location being where the run crosses a rabbit trail. In carefully chosen fields about one trap in five can be expected to yield a rat each night of trapping.

J. ALLEN SCOTT

MEDICAL BRANCH,
UNIVERSITY OF TEXAS,
GALVESTON, TEXAS

DISCUSSION

THE SUPPORT OF EDUCATION IN A DEMOCRACY

IN an article in the June 22, 1945, issue of SCIENCE Dr. E. V. Cowdry points out that private institutions of higher learning are finding it increasingly difficult to survive because of financial difficulties engendered by a number of causes. Among these causes may be listed a diminution of donations, decrease of income from investments and dependency of private institutions upon students' fees.

Dr. Cowdry offers three reasons for the support of private institutions: their training of leaders in business, in the professions and in science and letters;

[2] W. Patten, *Arb. aus d. Zool. Instit. der Univ. Wien*, Bd. 6, 1885, pp. 149–174.

[1] The work which formed the basis of this paper has been supported in part by a grant from the John and Mary R. Markle Foundation for the study of filariasis.