XXXIV.—REPORT UPON APPARATUS AND FACILITIES NEEDED FOR HATCHING SPANISH MACKEREL.

By J. Alban Kite, M. D.

I have the honor to submit for your consideration a report upon the following topics:

1. The best apparatus for hatching the eggs of the Spanish mackerel, as shown by my personal experience.
2. The most suitable station for conducting such work.
3. The best locality for station.
4. The necessary help and apparatus for conducting the work.

I will first go over the list of appliances we have used on the Fish Hawk. In July, 1881, the United States steamer Fish Hawk, under command of Lieut. Z. L. Tanner, United States Navy, made her headquarters in Cherrystone Creek, Virginia. The first eggs received were put into the Ferguson cones, which had been previously nickel-plated, to, it was thought, prevent the action of salt water. It took but a few hours to prove this would not answer, for the sulphate of nickel was formed and the fish died; besides the eggs when healthy float, and the current carried them against the gauze sides and aided in the work of destruction. Next we tried the eggs in a cylinder with a flat bottom and an intermittent flow of water maintained by a syphon. The cylinder was coated on the inside with asphaltum. Then copper cylinders with gauze bottoms were used over the side of the ship, and a rise and fall obtained by means of machinery. But in neither instance did much success attend our efforts; in the case of the cylinders over the side the movement of the waves dashed the eggs against the metal sides, the membranes were ruptured, and death ensued; had these eggs been free they would have freely ridden the waves with no discomfort. Next, Captain Tanner had a large block-tin cylinder, open at both ends, set in a tub of water; the eggs were placed in the cylinder and the water was delivered into the tub; nothing was used on the bottom of the cylinder to prevent the escape of the eggs, their buoyancy being found sufficient.

Things were progressing to our satisfaction, when a white scum was noticed on the surface of the water; this on analysis was found to be antimony; the metal had been used to form an alloy with the tin and

increase its strength. Many of the fish died, but, notwithstanding the baneful effects of the salts of antimony held in the water, the apparatus was so efficient that we were enabled to hatch out 50 per cent. of the eggs, and to keep the young fish for several days. The experiment was left unfinished when orders came for our departure. Yet our experiment taught us (1) to have, if possible, no metal come in contact with the water containing eggs or fish; (2) to give plenty of light; (3) that the eggs would not hatch properly when the temperature was below 78° F., nor could they survive a rise or fall of several degrees, even though the temperature was high.

In the summer of 1883 the United States steamer Fish Hawk, commanded by Lieut. W. M. Wood, United States Navy, made a cruise in Chesapeake Bay to experiment with and devise an apparatus for hatching the eggs of the Spanish mackerel. A few eggs were obtained at New Point, but the larger part were taken on the eastern shore, at the mouth of Cherrystone Creek, near the light-house.

Mr. Smith and myself having had some experience, as related, requested that some half dozen glass aquaria be furnished, and we devised an apparatus of which an idea may be formd from Fig. 1. The aquaria

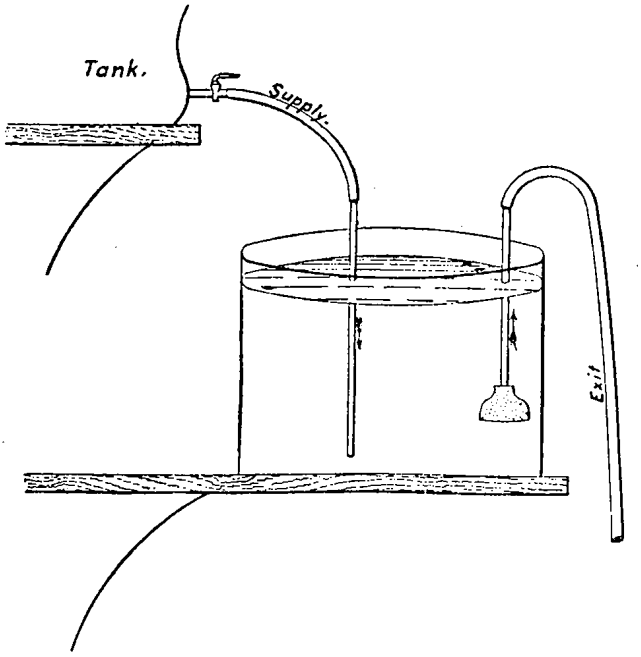

FIG. 1.—Aquarium for hatching Spanish mackerel.

gave us a large water surface with convenient depth, and into it from our tanks we allowed a flow of water; this was conducted from the tank to the aquaria by rubber tubing which passed over a piece of five-eighths-inch glass tube which in turn passed to the bottom of the

aquaria. The overflow was established by means of a syphon consisting of a glass tube that was inside the aquaria and a rubber tube that fell over the side and reached below the aquaria; to the lower end of the glass exit tube we affixed a strainer consisting of a wooden cone, and over the 3-inch opening fastened a plate of mica perforated by minute holes. We watched its operations with interest, and at first found it was all our crude ideas anticipated, and although we used a strong current of water, yet the floating eggs were not in the least disturbed. But after remaining in the water for some time the mica became very brittle and cracked. This would not do, so we substituted for the mica perforated tin coated with asphaltum, but the asphaltum did not coat the perforations, and these soon corroded, and the oxide of iron excluded the openings.

Later, at Mr. Smith's suggestion, we tried silk gauze, such as is used in making nets for surface towing, and by doubling this over the ends of the wooden cones prevented the escape of the eggs, but our trouble lay in the dead eggs rising and becoming entangled in the meshes of the gauze, thus preventing a free current, but this difficulty was easily overcome by occasionally freeing the surface with a feather.

The eggs hatched well, fully 60 per cent. of young fish appeared, and in 17½ hours after impregnation, with the temperature of the water at 80° F., a microscopic examination led me to believe had all the eggs placed in the aquaria been properly impregnated the percentage hatched would have been greater, but in taking the eggs it is impossible not to get some unripe ones. After hatching, the fish gradually died, and for a long time the cause was unexplained; finally we decided it must lay in the iron tanks used as receptacles for water. These tanks have been used to hold fresh and salt water for three years, and, though repeatedly scraped and painted, soon corrode; besides what now must have been suspended in the water we found large quantities, comparatively speaking, deposited in the bottom of a vessel where some of the water stood.

We had no good opportunity to test our conclusions, for later, when Captain Wood substituted a cypress tub as a receptacle, the cold nights destroyed both eggs and fish. Captain Wood also changed, in these later experiments, the form of apparatus by immersing into a vessel containing water a glass cylinder over whose lower end gauze was stretched; into this cylinder the eggs were placed. The entrance water either fell into the vessel outside the cylinder and fresh water was obtained by diffusion through the gauze or the water fell into the cylinder direct and passed out through the gauze; but in either case the eggs which settled caused much inconvenience by covering the gauze and preventing the free circulation of water. The cold, however, cut short our work.

This is a brief synopsis of my own observations, and although in the main our work was not a success, yet there appears to me evidence that with slight modifications our original apparatus will hatch the eggs of

C. maculata. I also believe the same design will work with cod or other floating eggs, and probably with much greater success, as the eggs are less delicate.

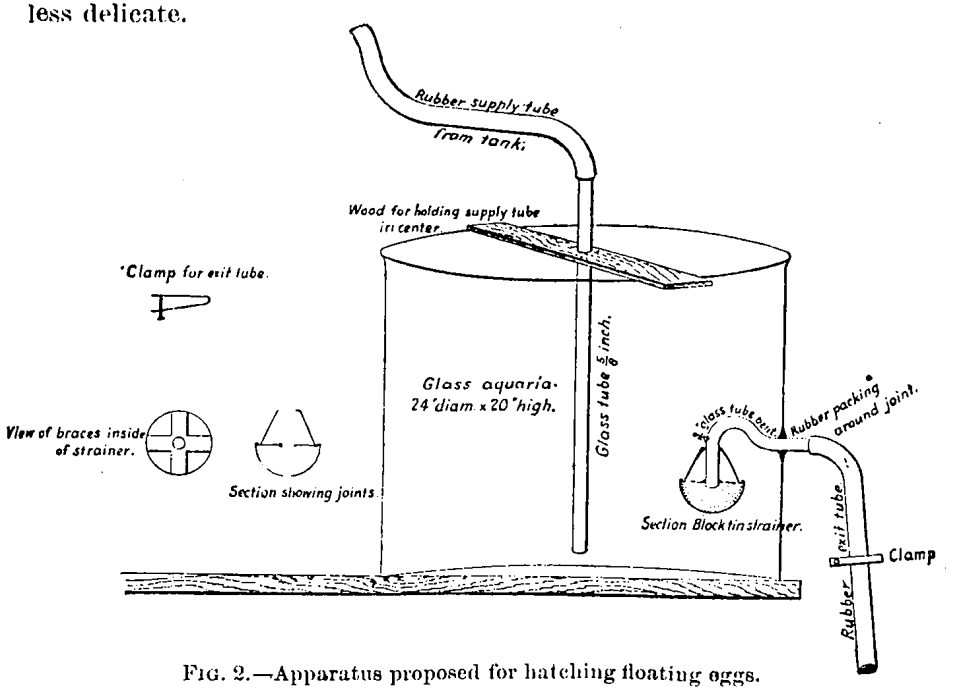

FIG. 2.—Apparatus proposed for hatching floating eggs.

As to the best apparatus I submit one shown in Fig. 2. I will describe the apparatus entire and name its advantages as they have appeared to me. It is drawn to a scale of 2 inches to the foot. The aquarium is to be of glass and 24 inches in diameter and 20 inches in height. A hole 1½ inches in diameter is to be made on one side of the aquarium, the center of which is to be 8 inches from bottom of aquaria. Through this is passed a five-eighths-inch piece of glass tubing, having a caliber of one-half inch; this to be bent in manner shown; over the inner extremity of this a block-tin strainer is passed and attached. The strainer, as shown, has a depth of 4 inches, the lower 2 inches convex, the upper 2 inches in shape of a truncated cone, the apex 1 inch across the base, with a diameter of 4 inches; the two pieces to be soldered together, and, to prevent separation, the upper lip of convex portion is to be bent inwards at a right angle, and directly rest upon the lower border of cone, which is bent outward at right angles to receive it.

To prevent collapsing, two pieces of block tin 1 inch in width and one-eighth inch in thickness cross each other and have their extremities firmly soldered to the junction of upper and lower half of strainer on the inside. These at their center are perforated to admit the extremity of three-fourths-inch glass exit tube. The truncated portion of cone may be made to fit the glass tube very tightly by rubber packing. The joint where the glass exit tube passes through the side of the aquaria must

also be made tight by rubber packing. The strainer must be made of pure block tin, and the convex portion perforated by holes one-fortieth of an inch in diameter, these holes to be as close together as the strength of the tin will allow. To the extremity of strainer tube may be attached rubber hose, which conveys the water off. The glass entrance tube passes through a piece of pine wood, so notched as to keep the tube in the center of the aquarium. The clamp for exit rubber tubing may be made of spring brass, and at the extremity have a thumb-screw for adjusting.

I might add that an advanatge will be found in having the aquaria of the above size, which are large enough for several million Spanish mackerel eggs, but were they larger it would be difficult to establish a sufficient current of water, while it would be increasing the number of aquaria needed if they were made smaller. All the parts, as you may see, are such as may readily be replaced and fitted at the station. Experience has not demonstrated the truth of the opinion that this form of apparatus will serve for cod hatching, but the probability is so great that a trial at least might be made, with reasonable hopes of success.

Mr. Barry suggests an automatic arrangement to keep the water at a certain height, but I see no need of additional complications. The advantages of this glass aquarium, arranged as described, may be summed up as follows:

1. It is inexpensive, and all the parts are easily duplicated.
2. It furnishes a regular supply of water, the amount at our command.
3. The eggs float without being in the least disturbed.
4. The perforated surface of the strainer looks downward, and its circular slope prevents clogging by eggs or dirt; if such, however, collect, a feather readily removes without disturbing the good eggs.
5. It is entirely of glass, save the strainer, which is of block tin, and not influenced by salt water.

In using the above apparatus the eggs may be introduced after they have come up, care being taken by changing the water to free them from sperm, which readily decays. After the young fishes are hatched, they should be carefully siphoned into another vessel and the supply of water immediately established, for the young fish need a greater amount of fresh water than the eggs. I think it best to change on hatching, for by this means we free the fish from the influence of the egg membranes, which decay.

Although light is absolutely necessary for the healthy development of the egg and young fish, yet at no time should the sun shine directly upon them. This may do in nature, but in our artificial work the small body of water is heated, which must fall at night, subjecting the fish to a change they can only occasionally survive. I might also add, the mackerel are believed to spawn most freely in the afternoon, and if this be true, 18 hours later the fish would be ready to hatch, and the sun would not yet have acquired much power.

1. Respecting the most suitable station for hatching, I would advise on shore. It will require less men and less money to carry on; the matters of temperature (equal) and light are more at our command.

2. The best locality for a station is on the eastern shore. This is explained by the prevalence of southerly and westerly winds, which drive the fish to the eastward. The fact is apparent to the fishermen, and this their explanation. In conversing with Mr. Smith he informed me, "There exists no more favorable spot than at the mouth of Cherrystone Creek. There are several pound-nets in this locality, with a light-house to serve as a station." Under the light-house proper are a series of braces which serve to strengthen the structure, and on these a floor is often laid, where the keepers raise plants, &c. Now, this floor is just the thing, and canvas sides can be readily arranged, to raise or lower at will. There is always a vacant room in the light-house. If this place meet not with your approbation, by next summer a wharf is to be built at Plantation Creek, on which a station could be erected.

3. All the apparatus needed for the work would be a large tank, with a hand-pump to fill it with water; four men to stand watch and visit the nets and secure eggs. And I believe that if the men are permanently there during the season, all the eggs necessary for the work can be obtained. A superintendent will also be needed to direct movements and institute changes, if necessary, in the working of the apparatus.

As to the time of fishing the nets, this will depend alone upon the convenience of the "run" boats that carry the fish to market. I might add, the spawning of the fish begins about the middle of June and lasts until the latter part of August, or such our observations taught us this summer, and this also was the opinion of the fishermen themselves.

WOOD'S HOLL, MASS., *August* 23, 1883.