

## XXVII.—EXPERIMENTAL INVESTIGATIONS UPON COD HATCHING AT WOOD'S HOLL, MASS., DURING THE WINTER OF 1880-'81.

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BY MARSHALL McDONALD.

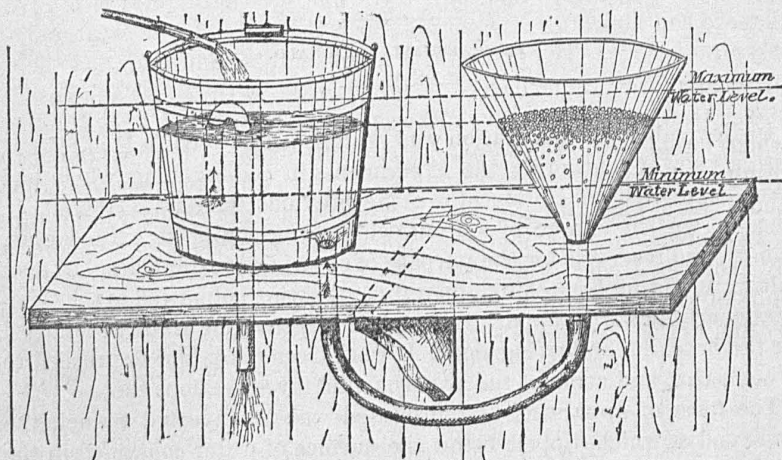
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In November, 1880, a station was established at Wood's Holl, Mass., with a view of continuing the experiments in cod-hatching which had been conducted at Provincetown the previous winter. Capt. H. C. Chester was in charge of station, which was equipped with engine, pumps, and reservoir for the purpose of securing constant circulation of salt water through hatching apparatus. Having submitted to the Commissioner plans of an apparatus which it was thought would be adapted for the hatching of floating eggs, I was directed by him to proceed to Wood's Holl and conduct the experimental investigations there.

The form of apparatus first proposed was an inverted funnel, the lower end of which dipped below the surface of water contained in the trough, upon which it rested, the supply of water being brought in by a tube at the upper or smaller end of the funnel, so that when once filled with water the column was maintained by the pressure of the air. In this way the movement of the water through the cone, or funnel, was similar to that in the ordinary upright cone used for hatching heavy eggs, except that the current was from above down instead of from below up. It was supposed that the buoyancy of the eggs would counter-balance the downward movement of the current of water, so that the eggs would be kept in suspension in the funnel. This apparatus answered very well for a few days after impregnation of the eggs, when they were much more buoyant than at a subsequent stage. In a short time, however, either by becoming loaded with sediment, or by actual increase of specific gravity, the buoyancy became less and less, and the eggs were carried out and lost. This apparatus, though promising in results on first appearance, proved in practice to be a failure, no eggs whatever having been hatched in it, the several lots used being entirely lost.

As all eggs require constant accessions of fresh water in order to secure development, it was evident that some form of apparatus must be had recourse to in which the water could be continually renewed without carrying off the eggs in its efflux. These eggs being buoyant and occupying a layer at the surface of the water, it was thought that by introducing the water into the lower part of the vessel containing

them and then withdrawing it through the same opening the necessary change of water could be effected. In order, however, to accomplish this alternate influx and efflux of the water conveniently, it was necessary to make use of some automatic device, so that the work could go on without the continual supervision of some expert. The method by which this was effected is shown in the accompanying sketch.



Apparatus for hatching buoyant fish eggs.

In all of the various forms of apparatus that were used at different times during the season, a certain percentage of eggs was hatched, where no accident intervened to terminate the experiment abruptly. The percentage of loss, however, was very large—much larger than could be tolerated in any method where practical results in hatching were to be looked for. These losses were to be attributed mainly to two causes: the increase in the density of the eggs as incubation went on by the accumulation of sediment, and the inferior density of the water employed as compared with sea water. Could these methods have been used where water of the density of the sea was available, and where perfect means of filtration could be provided, I have no doubt but that all the forms of apparatus used would have given good results in hatching.

The largest percentage of hatching was attained in the upright glass funnels, in which the eggs, twice a day, were thoroughly washed by a jet of water, the effect being, by the attrition of the eggs upon each other, to keep the surfaces perfectly clean and to maintain their buoyancy. The percentage of hatching in the majority of the cases was very small, not more than from 5 per cent. to 15 per cent. of the total number of eggs employed. In one experiment with a glass funnel, containing 40,000 eggs, the water in which, from its location near the stove, was uniformly several degrees higher in temperature than the water in the

hatchery, 25,000 young fish were obtained. These were sent in charge of special messenger to Annapolis and deposited in the Chesapeake Bay at that point.

The range of the investigation at Wood's Holl was largely limited from the fact that we were able to obtain during the time that I was there, only a single lot of spawning fish, from which, though some millions of eggs were secured, the larger part were lost, and we obtained only some four or five thousand fry. The succession of spawning fish that we had hoped for was not obtained, the extreme cold weather having prevented it. The station was accordingly abandoned, and the experiments discontinued before the appearance of the schools in Ipswich Bay. Had the station been kept open, and the supplies of eggs obtained, which would have been available from this source, I have no doubt the result of the winter's work would have been to establish precise methods and forms of apparatus for the hatching of the cod egg on a large scale.

In connection with this work important investigations were conducted by Professor Ryder in regard to the embryology of the cod-fish. Results of these investigations have already been communicated in detail by him to the Commissioner.