130.—ON THE ARTIFICIAL PROPAGATION AND CULTIVATION OF OYSTERS IN FLOATS.

By Prof. W. K. BROOKS.

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Without expressing any opinion as to the value of the process of "fattening" oysters by placing them for a few days in cars floating in fresh water, I wish to point out that there is no similarity between this process and the process of propagation which is here described.

My attention was first called to the value of floating cars in oyster culture by Mr. William Armstrong, of Hampton, Va., who informed me, in 1884, that "seed" oysters which he had placed in floating cars in the mouth of Hampton Creek grew more rapidly, and were of a better shape and more marketable, than those which grew from seed planted on the bottom in the usual way.

One of the results of my study, in 1879, of the development of the oyster was the discovery that there is a period of several hours, immediately after the embryo acquires its locomotor cilia, when it swims at the surface, and this is the period when it is swept into contact with collectors. As soon as the shell appears the larva is dragged down by its weight, and either settles to the bottom and dies or swims for a time near the bottom. The tendency to swim at the surface is an adaptation for securing wide distribution by means of the winds and currents, which sweep the young oysters against solid bodies which may serve for attachment; and the greatest danger to which the oyster is exposed, at any part of its life, is that it may not, at the swimming stage, find a clean, hard surface for attachment.

As it is microscopic and only about half as thick as a sheet of thin paper, it may be smothered by a deposit of sediment or mud so light as to be invisible, and most of the failures to get a good "set of spat" are due to the formation of a coat of sediment upon the collectors before the young oysters come into contact with them.

It occurred to me this summer that this danger could be entirely avoided by the use of floating collectors, for little sediment can fall on a body which is close to the surface of the water, and most of this will be swept away by currents, which will, at the same time, sweep the swimming embryos down into the collector, and thus insure an early, abundant, and successful "set."

I accordingly constructed a floating car, made so as to permit the free circulation of the water. This was filled with clean oyster-shells and moored in the channel in front of the laboratory at Beaufort, N. C., on July 4. As all the oysters in the vicinity were in very shallow water, they were nearly through spawning, and the conditions were therefore very unfavorable; but, notwithstanding this, I immediately secured a

good "set," and the young oysters grew with remarkable rapidity, on account of the abundant supply of food and fresh water which gained ready access to all of them, and the uniform temperature which was secured by the constant change of water.

This method of oyster culture may be applied in many ways, of which the most obvious is the production of seed oysters for planting.

The seed which is used for planting in Maryland and Virginia, as well as in Delaware and further north, is now procured from the natural beds of our waters by tonging or dredging, and as the demand for oysters for this purpose is certainly one of the elements which have led to the depletion of our beds, there is a widespread feeling that the exportation of "seed" should be prohibited.

By a small investment of capital in floating collectors any one on tidewater could easily raise large quantities of much better, cleaner seed than that which is now procured from the natural beds, and if the laws permitted the sale and transportation of this seed without restriction at the season when the demand exists, it could be sold at a profit for less than the cost of tonging.

Northern planters could also raise seed for themselves by constructing floating collectors in the warm water of the sounds of Virginia and North Carolina, where the length of the summer would permit several collections to be made in one season. The oysters thus reared are large enough for planting in five or six weeks, and in the latitude of Beaufort there is an abundance of spat from the middle of April to the 1st of July, and it can be collected until September.

The method may also be used by planters for collecting their own seed, especially in regions remote from a natural supply. If there are no oysters near to furnish the eggs, a few spawning oysters may be placed among the shells in the collector, after the French method, to supply the "set."

It can also be used for the direct production of marketable oysters, especially over muddy bottoms and in regions where public sentiment does not permit any private ownership of the bottom.

As food for the oyster is most abundant at the mouths of muddy creeks, where the bottom is too soft for oyster culture by planting or by shelling, this method will have especial advantage in such places, for there will be no danger of sanding or of smothering by mud at the surface, and there is no limit to the number of oysters which can thus be grown on a given area, for the free current of water will bring food to all of them.

The very rapid growth will more than compensate for the cost of the floats, and Mr. Armstrong's experiment shows that, in addition to all these advantages, the oysters are of a better shape, with better shells and more marketable, than those grown at the same place on the bottom.

Finally, this method will do away with the necessity for a title to the bottom, and will thus enable a few enterprising men to set the example

of oyster culture, and, by the education of the community, to hasten the time when wiser laws will render our natural advantages available for the benefit of our people.

The most economical method of constructing floats must, of course, be determined by practical experiments, but a float constructed by connecting two old ship-masts together by string-pieces, with a bottom of coarse galvanized iron netting, would have sufficient buoyancy and enough resistance to water to support a large quantity of submerged shells and oysters for two or more seasons, and a coating of copper paint each year would protect the timbers from worms.

The floats should be open at the ends, to permit free circulation, and they should be moored in such a way as to swing with the current.

131.—SOME OF THE LIFE-NEEDS OF FISH.*

By Dr. OTTO ZACHARIAS.

Water is the main condition of the life and well-being of fish. The water should contain food in the shape of infusoria, snails, worms, and insect larvæ, but people trust to kind nature to furnish a constant supply of these. In the vast majority of cases this confidence is somewhat well placed, but as a general rule nature will supply only the absolute needs. If a good harvest of fish is to be a certainty, the needs and habits of fish should be thoroughly studied, and care should be taken to remove everything which will interfere with these needs and habits.

Fish breathe through their gills, which consist of four double rows of cartilaginous leaflets. The blood-vessels distributed through them give to the gills a bright red color. Four bony arches support the double lamellæ, which exercise their important functions under a piece of horny skin called the "gill-cover." For the purpose of breathing the fish passes water into the branchial chamber; here it comes in contact with fringe-like leaflets, which it supplies with oxygen. The water makes its escape by the gill-opening. If you take a fish out of the water its breathing process is interrupted, the gill-leaflets begin to shrink, and become dry, when they are unable to absorb the needed air from the atmosphere.

Any one who has carefully examined the gill-fringes of a whiting or pike must be convinced that these tender organs will be injured by muddy or impure water, just as our lungs are injured by inhaling bad air or air filled with particles of dust. The first point to be observed, therefore, should be to prevent water, in which fish are to be kept, from becoming impure by the refuse from factories, mines, &c. Refuse floating in the water will exercise some chemical, but principally a mechanical, influence by constantly irritating the respiratory organs. In this

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* "*Ueber die Lebensbedürfnisse der Fische.*" From *Mittheilungen des Westpreussischen Fischerei-Vereins*, No. 5, Dantzic, March 4, 1886. Translated by H. JACOBSON.