80.—LIVE FOOD FOR YOUNG FISH.*

By Dr. SCHWAAB.

So many reliable reports have been made in detail on the production, shipping, and hatching of the eggs of food-fish, that a report of this or that one's personal experience can scarcely add much to our knowledge of the subject. Some data may, however, be useful regarding the feeding of young fish at the time when the umbilical sac disappears, and when the lack of suitable food frequently causes deplorable losses of promising fry. During last summer I made some observations regarding live food in the hatchery of *Karthaus-Prüll*. Quite young fish in the beginning generally refused dead food, such as pounded brains, veal chopped fine, fish entrails cut up small, which is eagerly taken by larger fish; and every fish-culturist knows what trouble and perseverance is required to induce young fish to take this food. While young trout, and especially the young of *Salmo hucho*, will take dead food, sinking to the bottom, only with great hesitation or not at all, it is surprising to see with what eagerness the young fish snatch at suitable live food. Scarcely has the live food been placed in the tank when the attention of the young fish is attracted to it, and immediately they begin to chase it. In the beginning the young fish frequently dash past the prey, as young chickens will often in their inexperience pick the ground by the side of the grain; often they drop the food, to seize it again immediately. Sometimes two or more make a dash at the same object, or they endeavor to pull the half-swallowed prey out of the mouth of some other fish. By the most ludicrous leaps and turns they endeavor to hold fast to the live morsels and to swallow them. If we compare the way in which young fish treat live food with the manner in which they treat dead or unnatural food, we will at once become convinced that live food is better adapted to their needs. As the experiments in feeding young fish with live food, begun last summer and continued till autumn, were successful, it is deemed proper to publish a report on them, in the interest of other fish-cultural establishments, although they cannot claim to be complete, because the time of observation and the space in which these experiments were made were limited.

Besides some specimens of aquatic animalcules whose names we did not know, the food consisted of—

1. The *Cyclops quadricornis;* and
2. The larva and chrysalis of the *Culex*.

The *Cyclops quadricornis* belongs to a very numerous family of crustaceans which are found in puddles and ponds, are exceedingly pro-

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lific, and which are called *Cyclops* on account of the single eye in the middle of the flat head. Owing to its small size the *Cyclops* proves a welcome food to all young fish. We got them from a stone basin, about a meter deep, located under large chestnut trees, where the water changed but little and where there were not too many algæ.

In order to obtain a larger number of *Cyclops* I had a large barrel filled with water from this basin. In doing this I was guided by a recollection from my boyhood's days—how that in a barrel containing rain-water numerous exceedingly lively animalcules were observed by us, and it seemed a perfect miracle to our childish thought that these little beings could have originated in the rain-water barrel. I lived in hopes that the same phenomenon would repeat itself in the present case. The experiment was entirely successful, for in even larger number than the *Cyclops* there soon appeared new animalcules, which turned out to be the larva and chrysalis forms of the *Culex*. How often has the question been asked, For what purpose is the *Culex* in this world, and of what possible use can it be? [The *Culex* is simply a musquito or gnat.] Before attempting to answer this question we must notice the life of these insects, and especially of that variety which, on account of the singing noise it makes, is called *Culex pipiens*, and whose "better half"—only the female *Culex* stings—causes men on fine summer evenings to express a doubt as to their right of existence.

If in winter, by means of a candle, we examine somewhat closely the vaulted ceilings and walls of a cellar, we frequently find in moist or dark places hundreds and even thousands of gnats (*Culex*); these are the females of the generation produced in autumn, which in these sheltered places, in a sort of torpor, wait for spring. When the sun rises higher in the heavens and warm spring days come, when the ice disappears from ponds and puddles, the gnats leave their winter quarters and begin the propagating process. For this purpose they seek some sheet of water, settle along its edges or on a floating leaf or blade of grass, bend the point of the back part of their body toward the water, and lay their dark-colored long eggs, running to a point. These eggs adhere to each other with their long sides, and when thus united resemble a small boat pointed in front and back and slightly hollowed out on the top. Such a pile of eggs floating along the surface of the water and adhering to the edges is the result of a single act of laying, and contains from 200 to 350 eggs. After a few days the hardly visible larvæ slip from the eggs on the side turned toward the water, and move about in this their proper element. The entire process resembles the more easily observed laying of eggs by butterflies, and the hatching of their larvæ, the voracious caterpillars.

The young larvæ of the *Culex*, after they have reached the water, grow rapidly, feeding on exceedingly fine vegetable formations such as are always found in great abundance in the mud of stagnant water, and change their skin several times. They are generally seen floating on

the surface of the water; the head is bent downward and the respiratory tube, surrounded by very fine cilia, points upward like a finger. If one reaches for them, or slightly agitates the surface of the water, they go rapidly toward the bottom with quick, eel-like wriggles, to rise again in a similar manner after a short time.

After the skin has changed for the last time the larva becomes a chrysalis. The larva and chrysalis are as different from each other as the chrysalis of a butterfly from a caterpillar. But while the chrysalis of a caterpillar remains immovable, the chrysalis of the *Culex*, when in the water, is hardly less lively than its larva; and it is, therefore, not astonishing that it has sometimes been taken for a separate aquatic animal. It differs from the larva by its form and the manner in which it carries itself. When quietly resting on the surface of the water it has its thick, plump head turned upward; from the head two respiratory tubes protrude above the surface like two little pointed ears, while the larva has only one respiratory tube, which is somewhat longer and starts from the back part of the body. After eight or ten days the *Culex* slips out of the chrysalis, and the empty chrysalis shells may then frequently be seen floating on the water.

Every female *Culex* lays, on an average, 300 eggs, and after that it dies. The development from the egg to the larva, chrysalis, and the young winged insect is completed in four or five weeks. From spring till autumn about six generations may, therefore, follow each other, in enormously growing proportion; and the vast number of these insects will no longer seem astonishing, their cradle being the water. The water, however, is not only the cradle of thousands and millions of these insects, but it also becomes the early grave of a great many of them; for other animals living in the water, particularly fish, devour every day enormous numbers of these larvæ.

In what manner may the larvæ of the *Culex* be obtained, so as to form the food of artificially hatched young fish? The answer will not be difficult after all that has been said. In the beginning of spring some open receptacle for water, such as an old barrel or tub, is placed somewhere in the open air and filled with water, to which it will be well to add some pond-mud, leaves, decaying straw and perhaps cow-dung, in order to form a basis for the development of the lower grades of vegetable forms which serve as food for the larvæ. After a short time the beginning of animal life may be noticed in the water, which should be filled up from time to time, and soon the barrel will contain thousands of larvæ of the *Culex*. These can be taken out with a gauze dipper, or they may be obtained in the following manner: A rubber tube, as thick as a little finger and from 50 to 80 meters long, serves as a siphon. In order to avoid the disagreeable sucking of the tube, which often results in getting the mouth full of dirty water, the entire tube is put under the water, the air is allowed to escape, one end of the tube is then pressed together with the thumb and forefinger and is pulled

over the edge of the barrel, while the other is left hanging in the water. After stopping the pressure of the fingers the water flows from the free end of the rubber tube and is allowed to flow through a filter (a piece of coarse linen, a pocket-handkerchief, &c.). The larvæ are carried by the current of the water into and through the rubber tube and remain on the filter, on which they may be gathered in any desired quantity; then, on the the improvised filtering cloth they may be transferred to the fish tank, where they can easily be washed from the cloth and thus brought into the water. When the water flows into the tank freely the larvæ are easily driven toward the exit-grate and hindered in their free movements, whereby they are lost to the fish. It is, therefore, advisable, during feeding, temporarily to stop the flow of fresh water into the tank, or at least to diminish its force.

This excellent live food, which can easily be obtained all through the summer, does not exclude the use of fresh dead food, to which we referred in the beginning of this article; and we found that very finely chopped fish-worms were gladly taken by the young fish.

81.—SUCCESS IN HATCHING LOBSTER EGGS IN NORWAY.

By G. M. DANNEVIG.

[From a letter to Prof. S. F. Baird.]

I have the pleasure of informing you that the experiments with the hatching of detached lobster eggs are progressing very favorably. The young are doing well, and some of them have attained what Prof. G. O. Sars calls the third stage. The length of the young lobster soon after hatching is about 9 millimeters; after eight days, when the second changing of the shell or skin takes place, it has attained the length of 12 millimeters; and after sixteen days, when the third change occurs, it is about 15 millimeters long.

For some days the mortality was rather great, but now only 2 or 3 die in twenty-four hours; so that out of 200 picked out for an experiment 95 still remain. They are very greedy, but not so inclined to kill one another as they were at the beginning. I feed them principally with the soft parts of our crab (*Cancer mœnus*, or *Cancer pagurus*, as some call it), which they like very well; but their slender legs sometimes become entangled in the soft mass, and then they die. Five hundred newly hatched individuals are now in a separate appafatus for further experiments, and I wish to find out at what stage the greatest loss takes place. I have great hopes now that I shall master this question during the season, so that I can proceed on a large scale next summer.

FLODEVIG, NEAR ARENDAL, NORWAY, *July* 14, 1885.