80.—FRY PLANTED IN RIVERS OF BELGIUM IN 1886.*

[Extracted from the report of the Commission on Fish-Culture to the Minister of Agriculture, Industry, and Public Works.]

The plantings of fry made in 1886 in the tributaries of the Meuse River have been entirely successful. The following has been the extent of these operations:

Fry were planted as follows:

Kind.	Number.
Salmon (*Salmo salar* Lin.)	63,000
Trout (*Trutta fario* Lin.)	217,000
Lake trout (*Trutta lacustris* Lin.)	30,000
Thymallus vexillifer Ag	30,000
Salmo salvelinus Lin	12,000
Total	352,000

They were distributed as follows:

Where distributed.	Kind.	Number.
River Semois and tributaries	Trout	51,000
Do	*Thymallus vexillifer*	9,000
River Lesse and tributaries	Salmon	6,000
Do	Trout	57,000
Do	Lake trout	12,000
Do	*Thymallus vexillifer*	9,000
River Molignée	*Thymallus vexillifer*	6,000
River Bocq	Trout	6,000
River Ourthe and tributaries	Salmon	57,000
Do	Trout	63,000
Do	*Thymallus vexillifer*	6,000
River Gulpe	Trout	19,000
River Beek (Voeren)	do	3,000
River Solière	do	6,000
The Villancour brook	do	12,000
Lake Gileppe	Lake trout	18,000
Do	*Salmo salvelinus*	12,000

Since 1885, when the Government undertook to stock the Belgium rivers, there have been planted, in all, in the tributaries of the Meuse, and in Lake Gileppe 737,000 young of salmonoids.

The plantings of young fish have been arranged in such a manner that in 1890, when the contract between the Government and the parties furnishing the young fish expires, all the tributaries of the Meuse which are to be stocked, will have received the kind and number of fish adapted to the nature of their water. But the quantity of young fish to be furnished within this period (about 1,000,000) is not sufficient to stock the rivers as thoroughly as it should be done. The question therefore arises, whether it is not possible to produce a certain quantity of young fish on the spot. For this purpose the keepers of waters

* "*Rapport sur les déversements d'alevins en* 1886." Brussels, 1886. Translated from the French by HERMAN JACOBSON.

and forests in certain localities should be furnished with Jacobi boxes, which cost only 5 to 6 francs [96 cents to $1.16].

These arrangements are simple. They are long wooden boxes, with gratings at the ends, and at the bottom of which there is a bed of gravel on which the fecundated eggs rest. These boxes are placed in running water, which passes through them by the gratings fixed at each end. The eggs are therefore placed, so to speak, under natural conditions. Although certain observations might be made relative to this method, and although in more than one respect it leaves much to be desired, it nevertheless offers great advantages. The keepers should be charged to capture in the waters of their districts the necessary spawning fish, and the eggs obtained from them should be hatched in the waters about to be stocked. This method is not expensive and is exceedingly practical, and would serve admirably to maintain a constant state of production in our waters.

Next year experiments at acclimatization may be commenced with certain valuable kinds of fish, which are not yet found in Belgium, and which it may be desirable to introduce. Among these we mention the *Salmo fontinalis* and the *Salmo irideus*. As experience has shown, these two kinds of fish seem to adapt themselves perfectly to the nature of certain Belgian waters. The necessary fry will be produced, with very little expense, in the hatching houses in the Government botanical garden.

It appears that a man may safely transport a certain quantity of fry at a temperature of 1° C. [33.8° F.] in the apparatus, and of 10° C. [50° F.] in the atmosphere, for a distance of more than 20 kilometers [12⅓ miles]. Transportation in wagons for long distances has likewise been perfectly successful.

From the following observation it will be seen how important it is that the air should have free access to the apparatus. An experiment was made relative to the power of resistance of young fish to the difficulties connected with transportation. Two sets of apparatus, each containing 3,000 young trout, packed as described below, had been sent to Jemelle, whence on the following day they were to be sent to Brussels. On the evening before, the young fish were placed in the receptacles, the water in which was, up to the moment of starting, being constantly renewed. They arrived at Jemelle on March 12, at 9.49 a. m., and were placed in a cellar of the station. In spite of the instruction, the receptacle for the ice was left on one of them. As the temperature in the cellar was only 7° C. [44.6° F.] ice was not used. The temperature of the water was 8° C. [46.4° F.]. On the following morning, in the apparatus which had been left covered only 300 young fish were found alive, while in the one which had been left open there were only 20 dead. The heavy mortality in the first apparatus must be ascribed to the circumstance that there was not sufficient air, for the young trout

in both these apparatuses came from the same hatching, and the conditions of their existence were exactly the same.

When the cover was removed from the first apparatus, the surviving fish were found to be near the surface trying to get a breath of air. The water had a soapy appearance and the characteristic odor of fish in a state of decomposition. On the bodies of the dead fish, which had all undergone the fatty metamorphosis, there was found a very luxuriant cryptogamic vegetation of a whitish color. The surviving fish were placed in another apparatus containing fresh water, and arrived in Brussels in good condition on March 13, the water during the transportation having a temperature of 5° C. [41° F.]. As has been stated, the dead fish rapidly underwent the fatty metamorphosis, and a species of whitish mold developed on them, which gave to the water the appearance of a solution of brown soap, and a nauseating odor. The dead fish are very obnoxious in the apparatus, as they produce germs which soon taint all organisms. It is also important frequently to inspect the apparatus, especially if the young fish have to stay in it any length of time. In this case the water should be aerated, and renewed if possible, and all dead fish should be carefully removed at once.

It is also extremely dangerous to transport in one and the same apparatus young fish of different age. Young salmonoids are extremely voracious; when shut up in a narrow space, they will bite and endeavor to devour each other, thus frequently inflicting wounds which are fatal.

As has been shown in the transportation of young fish from Bavaria, it is also important to use only very pure water, filtered if possible; the impurities of the water get into the gills of the young fish and choke them. In the same transportation it was proved that the apparatus should not be too high, for too great a column of water exercises an abnormal pressure on the fish, which they are not able to bear. The management of very large transporting cans is exceedingly difficult.

We have noticed that the young of the *Thymallus vexillifer* are the most difficult to transport. When in a healthy condition they make efforts to swim towards the surface of the water; if they remain at the bottom it is a sure sign that they are sick. Salmon and trout, on the contrary, keep quietly together at the bottom of the apparatus; if they become restless and rise to the surface to get a breath of air, it is a sign that the oxygen in the water is diminished, or that the temperature is too high. As the case may be, the water should be aerated or renewed without delay, if it is possible to do this under good conditions. Care should be taken, however, not to renew the water as long as the young fish are in good health, for, as has been stated, any change of the element in which they live will invariably cause them suffering. However, if the water has become vitiated by the presence of dead bodies, one should not hesitate to renew it as soon as possible.

We also made an experiment in transporting grown fish of the *Cyprinidæ* family. We selected five *Cyprinus auratus*, which were fully de-

veloped, and among which there were three females with eggs. They were placed in an apparatus exactly like the one described below. The water had a temperature of 18° C. [64.4° F.], which is suitable for the transportation of cyprinoids, as we had ascertained in 1885, by experiments with young fish of the same kind. The transportation from Brussels to Jemelle proved a perfect success, and on their arrival at the latter place the fish were in good condition, and were placed in a small reservoir at the station.

We believe that the planting of young fish shortly before or after the absorption of the umbilical sac offers great advantages, as the younger the organism the better it will adapt itself to the element in which it is to live. When young fish are fed artificially, the instinct of preservation becomes weakened, the young fish become indolent, and are less able to escape their enemies and to seek their natural food, and consequently easily succumb in the struggle for existence.

However this may be, the attempt to stock our watercourses with young fish only a few weeks old has been perfectly successful. From information furnished by the keepers of waters and forests, and by fishermen, it appears that in those waters where young fish have been planted, numerous young salmonoids have been observed. Those which were planted in 1885 have already attained considerable dimensions, and next year they will have reached a marketable size.

It may be assumed that in three years the young fish will have reached the weight of one-half kilogram [$1\frac{1}{10}$ pounds]. This is a very small average weight, for the lake trout weigh much more at the age of three years. Assuming, on the other hand, that two-thirds of the 771,000 young fish planted up to date reach this age, we would have a total weight of 257,000 kilograms [566,582 pounds], which, at the price of $1\frac{1}{2}$ francs [about 29 cents] per kilogram, would represent a value of 385,500 francs [$74,401.50]. By stocking the watercourses with fish, therefore, the Government places at the disposal of the country a wholesome and cheap article of food.

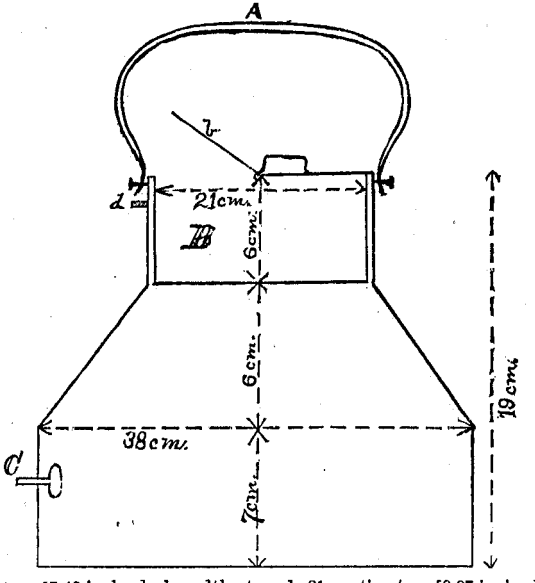
INSTRUCTIONS FOR PLANTING FRY.

Apparatus for transporting fry.—The transportation of young fish is a very delicate operation, and requires the greatest care. The cans in which young fish are transported are made of zinc, and covered with a special varnish. They have the following form and dimensions:

Each apparatus has a capacity of 11 liters [about $11\frac{1}{2}$ quarts], and will contain 3,000 young fish. When filled with ice, water, and young fish, the apparatus weighs about 14 kilograms [about 31 pounds]. The cans are transported from the stations where they are landed to the places where the fish are to be planted by means of a pack-saddle (brace), similar to the one used by water-carriers.

Maintaining the temperature.—The employees in charge must see to it that the water in the apparatus is kept at an even temperature. The

most suitable temperature is 5° C. [4° Réaumur or 41° F.], and it should not exceed 10° C. [50° F.]. The two extremes of temperature are marked in red on the thermometers furnished to the employees. If the water in the apparatus exceeds the maximum temperature, care should be taken to reduce it to a suitable degree by increasing the quantity of ice in the ice-box.



Height, 19 centimeters [7.48 inches]; breadth at neck, 21 centimeters [8.27 inches]; breadth of body of apparatus, 38 centimeters [14.96 inches].

A, handle for carrying the apparatus; B, reservoir for the ice; *b*, cover of this reservoir; C, spout for attaching rubber tube (by lowering this tube more or less, the water flows more or less rapidly from the apparatus); *d*, hook for holding up the tube.

It might happen that during transportation a solution of continuity might occur in the column of mercury in the thermometer. In this case the mercury should be reduced to its normal condition, by taking the instrument in one hand and pressing it, or by attaching it to a string and making it describe a rapid circular movement.

Aerating the water.—The respiration of the young fish vitiates the water in the vessels containing them. The renewal of oxygen is indispensable for keeping the fish in good health; and to neglect this would be to expose these young organisms to certain death. The air should be renewed at short intervals. Although this operation is necessary in all kinds of weather, it should be more frequent on very hot days; during the moments of rest the aerating pumps should be worked incessantly.

Nearly all authors are of opinion that during transportation the jolting of the vehicle is sufficient to aerate the water, but this is a mistake. As was shown at the transportation of young fish in 1884, it is very dangerous to count on the agitation of the water for obtaining aeration.

To do this will probably cause the rapid death of organisms of so delicate a nature as young fish.

There is an aerating apparatus consisting of a simple syringe furnished with a perforated mouth-piece. To renew the air, one breathes by means of the syringe into the water of the apparatus, and then places the mouth-piece at a short distance from the surface of the water, and makes the piston go down, not losing sight of the circumstance that little fish of a very delicate nature are concerned. The air should, therefore, not be blown into the water too violently.

Renewing the water.—When the distance to be traveled is very great, it will be well, whenever a favorable opportunity offers, to renew the water in the apparatus. To do this, one should have clear and drinkable water. In no case should muddy water, containing impurities, be employed. To renew the water in the apparatus, one inclines the tube C, so as to make the water flow off slowly; then he adds slowly, through the ice-box, new water, so as gradually to change the temperature of the element in which the young fish are kept. Too sudden a change of temperature would endanger the life of the young fish.

81.—NOTES ON HATCHING AND PLANTING YOUNG FISH IN ITALIAN WATERS.*

By Prof. PIETRO PAVESI.

In an address on fish-culture, delivered February 27, 1885, I stated that lavarets (*Coregonus wartmanni*) from the Lake of Constance had been placed in Italian waters at Lario at two different times (on February 27 and March 5), when the young fish had almost lost their umbilical sacs, and measured about 11 millimeters [nearly one-half inch] in length. Doubts were expressed as to the success of this experiment, but the eggs hatched. After the young fish appeared, however, the usual mold was observed. There are two suppositions to account for this mold: one, that it is caused by the quality of the water used in the hatching apparatus, in which case filters of the Waplitz model will have to be employed; the other, that some of the shells of the eggs broke in transportation and thus favored the development of mold.

I have now to report that my experiments resulted successfully. During October, November, and December, 1885, a number of little fish were caught near Bellano, which were about 4⅛ inches long, and in shape and color bore a strong resemblance to the fry I had planted. The fishermen cooked and ate some and found their flavor excellent, while some specimens that were sent to me here leave no doubt as to their being the same fish (*Coregoni*) planted by me. By planting more

* These notes are taken from an open letter to Prof. B. Benecke, of Königsberg, Germany, which is extracted from the report of the Italian Society of Natural Science, Milan, 1886. Translated from the Italian by HERMAN JACOBSON.