

51.—THE PISCICULTURAL ESTABLISHMENT AT GREMAZ (AIN), FRANCE.*

By C. RAVERET-WATTEL.

About four years ago I had the honor to call the attention of the National Acclimatization Society to a piscicultural establishment which had been founded in the Department of Ain, at Gremaz, in the township of Thoiry, for raising trout as an industry. I pointed out the special interest which, in my opinion, this establishment seemed to possess, as its founders, Messrs. Lugin and du Roveray, have succeeded in solving a problem of considerable importance from an industrial point of view, viz, to furnish the young fish with food solely composed of living prey proportioned to its size.

It was exceedingly important to find some natural food for the young fish, and since Messrs. Lugin and du Roveray have demonstrated the great usefulness of the *Daphniæ* in this respect, several pisciculturists have looked for some practical means of providing a sufficient quantity of these small crustaceans. Attempts to multiply them rapidly in ditches filled with slightly muddy water succeeded; but this method presents serious inconveniences. According to Mr. Chabot-Karlen, the *Daphniæ* gathered in these ditches are extremely tender; the least agitation kills vast quantities; the greatest precautions are therefore required to gather them; and, moreover, these small crustaceans impregnated with muddy water must be carefully washed in clear water, in order not to become actual poison for the young fish.

The method employed in the Gremaz establishment is by far preferable. As I have stated in my previous report ("*Bulletin de la Société d'Acclimatation*," November, 1882), the *Daphniæ* are raised in the very basins which are destined for the fish. When a basin has been sufficiently prepared for the development of these small crustaceans, they are allowed about a month's time to increase; then the fish are put in the basin, where they at once find abundant and substantial food. Whilst this stock of food is being consumed, other provision is made. A neighboring basin is prepared like the first; *i. e.*, it is abundantly stocked with *Daphnia*. After another month has passed, the fish—which by that time have consumed nearly all the food in the first basin—are put in the second, where they again find ample food. A month later they are again put in the first basin, which meanwhile has again become stocked with *Daphnia*, and so on. This method is extremely simple and convenient. Messrs. Lugin and du Roveray, however, do not confine their efforts to raising *Daphnia*, but they likewise

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use larvæ of insects, and especially small fresh-water shrimps, which, as we shall see, form an exceedingly abundant article of food, particularly in winter.

When, in the year 1882, I visited the Gremaz establishment for the first time, I was positively astounded at the quantity of *Daphnia* in the basins, forming dense clouds in the water. But that was in the beginning of October, after a long period of fine and warm weather, during which these small crustaceans had had the chance to multiply at an enormous rate. I was, therefore, curious to return to the establishment to see how matters stood during the bad season. From this point of view, no better moment could have been selected for my visit. Without being exceptionally severe, the winter in this region has been somewhat prolonged. Shortly before my arrival the thermometer had fallen to 13 degrees below zero. On the day of my visit it was still 3 degrees below zero, and the basins, which had a feeble current of water, were covered with ice. The ice had been broken in several places, and we could, consequently, examine the water underneath. I must say that the *Daphnia* appeared to me to be just as numerous as during the fine season, which, however, is easily explained in water as cold as that in these basins; but when we dipped out some of the water from the bottom of the basins, with a sort of canvas purse-net, we brought up incredible quantities of larvæ of the *Chironoma* and still more larvæ of the *Ephemera*. The whole bottom of the basins seemed to be one mass of animal life. At every haul we got a big dish full of these larvæ, which are an exceedingly valuable article of food for the young fish. The water which is artificially prepared for the *Daphnia* is, therefore, likewise well suited for the development of other small aquatic animals which can be utilized as food for young fish.

But Messrs. Lugin and du Roveray are not contented with this source of food. Alongside of the basins there are small rivulets, artificially made, for raising small fresh-water shrimps (*Gammarus pulex*), which, by a method similar to the one employed for the *Daphnia*, are caused to multiply in enormous numbers. In these rivulets, filled with water-cresses and other aquatic plants, the little shrimps, which form so important a part of the food of the trout, are raised. Every day the daily ration allowed to the fish is gathered with nets in a few minutes; and it is a curious spectacle to see this food given to the fish. The young trout come from all directions in dense masses. They vigorously attack the little shrimps, and do not allow a single one to get to the bottom of the water. No matter how large the quantity of shrimps it vanishes in a few moments.

The young fish of Messrs. Lugin and du Roveray thrive admirably on this diet. Three basins, each having a surface of about 120 meters, contained about 70,000 fish of this year's raising, grouped according to size, and all in excellent condition. From their well-developed stomachs and their finely-rounded forms, it will be seen that these young fish have

not only never suffered hunger, but that they have always had abundant food of excellent quality. This kind of food, composed exclusively of insects and small crustaceans, is exceedingly suitable for these young fish on account of the large quantity of phosphate of lime which it contains;¹ and this circumstance explains the rapid growth, and the exceptionally fine and vigorous condition of the young trout raised at Gremaz.

It may be well to add that the profitable use made of the small shrimp-streams will soon give way to a still simpler method of utilizing these small crustaceans, by proceeding in exactly the same manner with *Daphnia*, *i. e.*, the fish will be successively, or rather alternately, passed from one basin to the other, to consume a stock of food previously prepared for them. By experiments Mr. Lugin has ascertained that a basin 35 meters (114.8 feet) long, and 3 meters (9.84 feet) broad, with an average depth of water of 40 centimeters (1.3 foot),² may contain 20,000 young fish from eight to twelve months old, or 3,000 two-year old trout, having an average weight of 250 grams ($\frac{1}{4}$ or a little more than one-half pound). These 20,000 young fish, or 3,000 trout, consume about 10 kilograms (about 22 pounds) of small shrimps per day,³ or 300 kilograms (about 660 pounds) per month. It has been proved by experiment that a basin having the above-mentioned dimensions can produce 300 to 350 kilograms (660 to 770 pounds) of shrimps, without at all interfering with the *Daphnia*, *Nais*, *Limnæa*, insect larvæ, etc., which simultaneously develop in the same basin. Under these conditions food will never be lacking. It is sufficient to have two basins for each lot of fish, so as to transfer them each month from one basin to the other.

The system employed at Gremaz is, therefore, exceedingly profitable from an industrial point of view. But it is specially destined to render excellent service in stocking rivers with fish. Doing away with all difficulty as regards food, it makes it possible and even economical to keep the young fish, intended for stocking rivers, for a certain time in the basins free from all danger. Those young fish which, owing to the lack of suitable or sufficiently cheap food, had to be set out in the rivers at a very early age, before they had had time to gain strength, may

¹It is well known that the substance which forms the skeleton of insects and crustaceans is, with many species, largely composed of calcareous matter, and is exceedingly rich in phosphate of lime. It is probable that to this circumstance must be attributed the results of Stoddart's experiments: "Three lots of young trout were placed under absolutely identical conditions; one lot was fed on fish, the second on *Annelida* and mollusks, and the third exclusively on insects. All the fish of the last-mentioned lot developed much quicker than those of the others." In England insects are also considered excellent food for young trout.

²These are the dimensions adopted for the new basins of the Gremaz establishment, the projected enlargement of which contemplates the creation of 136 such basins.

³10 kilograms (22 pounds), dry measure, of small shrimps represent about 7 litres (about 1 $\frac{1}{2}$ pints) of liquid measure.

now be safely left in the basins till they have grown stronger. When several months old the young fish is already vigorous; it knows how to flee from danger; it is, therefore, better able than younger fish to escape numerous accidents and causes of destruction. Rivers may, therefore, be stocked with much greater prospect of success; and it may safely be asserted that 3,000 or 4,000 young fish, ten to twelve months old, are infinitely more valuable for stocking a river than 10,000 or 15,000 very young fish, which, not being strong enough to bear the change from the basin to the river, often perish in large numbers when placed in the river, where they become an easy prey to older fish living in the same waters.

This opinion is at this day shared by the vast majority of pisciculturists in Great Britain. Nearly everywhere in England and Scotland it is considered that the best young trout for stocking rivers are those which are about a year old, and which for this reason are called "yearlings."¹

These young fish are strong enough to seek their food, and consequently to avoid the principal cause of mortality in young fish, *viz*, inanition; they can easily be transported, and will bear a change of water without difficulty. These young fish cost, it is true, considerably more than others, but as the final expense is much less, and the result is much more prompt and certain, there is an absolute advantage in using them for stocking rivers.

There is only one point in the system which leaves something to be desired: If one operates on that large scale which is required for stocking an entire river, it involves considerable labor to assure the feeding of the young fish with artificial food. As the animal is, so to speak, *made* during its early age, and as during this period its assimilating organs acquire their strength and their power of absorption, a young fish which is insufficiently fed not only grows very slowly, but will never become a fine fish. It has been ascertained long since that if, of young fish of one and the same hatching, one portion is immediately placed in the river, whilst the other portion is kept in basins and fed with extreme care, the first will, after a short while, be twice as large as the second, because they have food which is better adapted to their needs; only, the losses among those which have been kept in basins will not be as large (unless the circumstances are particularly unfavorable), whilst the ranks of those which have been placed in the river have often been thinned to such an extent as to leave hardly any. They have fallen a prey to water-rats, perch, pike, and even to older trout.

Thanks to the system of raising employed by Messrs. Lugin and du

¹ This term is really applied to fish which in many cases are from 10 to 14 months old. Practically speaking, the age of a fish is counted from the date when it begins to eat, and not from the date when it was born. Thus, a trout of 1887 is a fish which commenced to eat in February or March, 1887, although it may possibly have been born about the end of the year 1886, and not in the beginning of 1887.

Roveray, all these inconveniences disappear; kept in basins, protected against all danger, the young fish, abundantly fed on live food, develop as well if not better than under natural conditions, without involving any serious expense for their food; and when the suitable moment has arrived, they can easily be transferred to the waters for which they are intended, without running the risk of losing many.

It is therefore greatly to be desired that the administration should abandon the use of very young fish for stocking rivers (as they are nearly all doomed soon after they have been placed in the river) and give the preference to fish ten or twelve months old, which, as is stated above, have yielded the most satisfactory results in England and Scotland.

Messrs. Lugin and du Roveray, convinced of the advantages of their system, propose, at their own expense, to stock a water-course which, being subjected to special supervision, will enable them to make an absolutely convincing experiment.

**52.—REPORT ON THE PISCICULTURAL ESTABLISHMENT OF
PIEDRA, ARAGON, SPAIN.***

By F. MUNTADAS.

All persons who devote themselves to practical pisciculture will remember the change of opinion which took place some years ago, owing to the weakness of many persons whose experiments proved failures. Our Acclimatization Society, however, has never allowed itself to be influenced by the "piscicultural malaria;" it has always stood firm and preserved its faith in the future; it well understood that the discovery of two fishermen of the Vosges Mountains could not become merely a subject of curiosity or pleasure. It is true that a large number of amateurs have taken a wrong road, but many others have followed the right road, and have made marked progress in the successful method of raising salmon.

From the moment that the question of raising large quantities of young fry and young trout was agitated, it became necessary to pay attention to many different circumstances, and not to forget the cost of raising fish; for the problem is to derive some profit from the new industry, and, according to Mr. Larbaletrier's expression, "to make money by pisciculture, and not pisciculture by money."

All the methods of artificial feeding are expensive and, what is worse, do not entirely answer the purpose; it therefore became necessary to find and use natural elements. In short, it became necessary to give the young trout what it needed.

* *Rapport sur l'établissement de pisciculture de Piedra, Aragon (Espagne)*. From *Bulletin mensuel de la Société nationale d'Acclimatation de France*, 4th series, Vol. IV, No. 8, August, 1887. Translated from the French by HERMAN JACOBSON.