

XVII.—MEMORANDUM ON FISH CULTURE IN JAPAN, WITH A NOTICE OF EXPERIMENTS IN BREEDING THE CALIFORNIA TROUT.

BY SEKIZAWA AKEKIO.

The Imperial Japanese Government has taken the steps towards carrying on a complete system of fish culture by founding on its property, in different places, hatching establishments, from which many thousand young fish are now annually supplied to some of the rivers which had been exhausted of fish. The first stations established were those at Yuki, Kanagawa Ken, and at Shirako, Saitamo Ken, in 1877. Each of these establishments has a capacity for raising upwards of 30,000 fish.

A great difficulty is met with in this country in getting a good supply of cold water; spring water can rarely be found in abundance, and there is none which can be used; and its temperature varies a good deal with that of the air, and it does not rise to the temperature of 57° F. This is a great drawback.

The hatching establishments have recently been increased to the number of five, which are situated as follows: One in Shiga Ken, another in Shidzuoka Ken, two in Nagano Ken, and the other in Ishikawa Ken. Four temporary camps are also built at convenient places on the rivers for the purpose of supplying fish to those rivers. At these camps salmon eggs are hatched and the young fry kept until they are fit to be turned into the rivers. This work begins towards the end of December, and by the middle of the following April the fry may be set free in the rivers.

The largest establishment in Japan at the present time is that in Shiga Ken. This has an abundant supply of water, with the temperature of 54° F. in summer. It has a sufficient capacity to raise any number of fish. For this establishment lake-trout eggs were brought from Lake Biwa, which is near the hatching station, and the results have been highly satisfactory. There are now at this place 40,000 healthy fish, one year and a half old and in splendid condition; also 250,000 young fry in a thriving condition.

It is worthy of remark that the water from the springs and rivers of Japan is nearly always very soft, containing a very little saline matter, of which a large proportion is silica and very little lime.

FOOD OF THE YOUNG FISH.

Owing to the scarcity of meat in this country, and the expense of getting it to the fishing establishments, I have been unable to feed fish on chopped livers and lungs, &c.; but I have found, after due trial, that a mixture of the chrysalides of silk-worms and wheat flour is a very good substitute, on which the fish do well. The chrysalides are ground up in a coffee-mill, mixed with an equal weight of wheat flour, which mixture is boiled for fifteen minutes and then allowed to cool. After this it is pressed through a wire sieve so as to assume the shape and size of finely-chopped meat, and is then ready for use. I have now used this food for three years and found that the fish thrive upon it; it is much cheaper and far more easily obtained in Japan than meat. Analyses of the chrysalides of two kinds of silk-worm and of the mixture of wheat flour and powdered chrysalis have been made by Professor Edward Kinch, of the Imperial College of Agriculture, Komaba, Tokio, with the following results:

1. Chrysalis of common silk-worm (*Bombyx mori*).
2. Chrysalis of mountain silk-worm (*Bombyx yama-mai*).
3. Mixture of wheat flour and powdered chrysalis.

Percentage composition.

	(1)	(2)	(3)
Water.....	10.99	9.28	12.23
Ash*.....	3.24	2.54	3.30
Oil.....	14.83	23.57	7.16
Albuminoids.....	47.28	49.75	25.25
Non-nitrogenous substances.....	23.26	14.86	52.06
	100.00	100.00	100.00

It will be seen that the proximate composition does not differ so greatly from that of meat. It contains a large percentage of nitrogenous matters, and a good deal of fat or oil.

THE FISHERY OF TANEGAWA (SPAWNING RIVER), MIOMOTEGAWA, ECHIGO, JAPAN.

The Miomotegawa (kawa or gawa means river) has its source in Mount Miomote, in the northeastern part of the province Echigo, and thence flowing westward, past Iwafune-gori and Murakami (formerly the castle-town of the Daimio Naito, finally empties into the sea. The length of the river is over 10 ri or 24.4 miles; it is shallow, with a rapid current and clear, and for 10 or 12 miles up from its mouth the bottom is covered with fine gravel. The fish found in this river are *Salmo perryi*,

* Containing—	(1)	(2)
Silica.....	2.12	.83
Lime.....	4.19	1.29
Phosphoric acid.....	68.50	34.30
Potash.....	17.87	17.88

Salmo orientalis, &c., the former being so abundant as to afford the chief supply of salt salmon to Echigo and the provinces around, as well as the more northern districts. Formerly this river was the property of the Daimio of Naito, but now the privilege of fishing belongs to a company made up of the Shizoku, his former retainers. The vast profits which they realize may be estimated from the fact that 750 families of Shizoku are living on the net profits, besides paying government taxes and the expenses of repairing the banks of the river, amounting to 5,000 yen annually. In amount of salmon, no other place except Hokkaido can be compared with this, although the river is so small one can easily wade across. There is no doubt that so large a profit arises entirely from the perfection of the methods employed in fishing.

The Tanegawa is a branch of the Miomotogawa running near the town of Murakami, and about 10 cho (1 cho=119.3 yards) from the mouth of the main river. This is selected because of its being a natural spawning bed, providing as it does a clear bottom, level and covered with pebbles for the ripe fish when they come to spawn. Its whole length is about 1,193 yards and its width 50. A fence is made at the upper part across the water so as to prevent the fish from getting higher, while there is another fence at the lower part which has an opening. When the season comes for spawning, a multitude of the ripe fish enter within the fence and swim towards the upper fence. Then the lower fence is shut up, and thus the fish are imprisoned on the spot between the two fences. As a general rule the fish are thus kept inclosed for about one week, until the whole of them have deposited their eggs, after making their nests for themselves. After the spawning is over, the fish are then all caught in nets. After this another lot is allowed to enter, and the process is repeated until the end of November. It is remarkable that when the fish are coming up the schools are so large as almost to fill the river, when many may be caught with the hand; and therefore it is that several watchmen are employed day and night to protect the fish from poachers.

The fish eggs deposited* in the bed are well guarded, and after the proper time the eggs are naturally hatched. At the beginning of the following May the young healthy fish go down to the sea, and during this time several watching houses are built along both banks of the river, where men protect the fish and see that they pass in safety. This method of propagating fish has been practiced from the earliest times, it being known that the salmon always return to their native river to spawn; and it having also been found that the result was of the greatest benefit to the country. It is said that this method was invented and first adopted by Mr. Aodo, two hundred years ago, and the Daimio of that time, Naito, adapted this place to that purpose. The regulations for fishing and protecting the fish in this remarkable river are still executed precisely as they always have been in other times.

There are several rivers in the neighborhood of the Miomotegawa, in which salmon are found, more or less, but the fish are decreasing in numbers, owing to the irregularity of the fishing and the neglect of fish propagation.

TOKIO, JAPAN, *April 12, 1880.*

SIR: On the 9th June, 1877, I received, through the kindness of Mr. B. B. Redding, fish commissioner, California, ten thousand trout-eggs of the California trout (*Salmo irideus*) from the McCloud River, California, of which one-half arrived safely and in good condition. As the eggs arrived unexpectedly, I was compelled to use well-water for hatching them, as there was then no establishment for the purpose, and I hoped that, with care, some of the eggs might possibly be thus saved. For this reason I built a temporary hatching-house in my garden, and had the water (57° F.) drawn from the well, pumping it day and night.

All the preparations were completed on the 13th of June, and the apparatus was then fixed, viz: 2 hatching-boxes, 1 foot wide by 6 feet long and 8 inches deep, covered at the bottom with a fine gravel; and a reservoir which contained 400 gallons of water; and the eggs were placed in the box arranged in the usual way. After a week the eggs began to hatch, and from the 7th of July I fed the fish with the yolk of eggs for a month, and afterwards with a mixture of chrysalis and wheat flour. During this period several difficulties had been encountered, and a great many eggs had perished by a disease (showing itself by a white spot on the eggs) and by the neglect of the employés, &c. Finally, it was found that the water was insufficient in quantity to keep the young fry as they grew.

On the 13th of July the establishment at Yuki was completed and the fish were transported there, but on account of hot weather, and the scarcity of ice nearly all the fish died, and those which arrived at their destination alive were only one thousand.

From the year 1877 till the present time the fish have grown satisfactorily, and their average weight is now five pounds, and their greatest length 1 foot and 7 inches.

Among the growing fish I have found a few fully ripe, 3 males and 5 females, and I have already taken 20,000 eggs, and the impregnated eggs are now in the hatching-box (12th April, 1880).

I forward to you herewith a drawing of the mature fish, which is taken of the natural size, and by which you will see how the McCloud trout flourishes in fresh water.

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