

ISC.—EFFECT OF COLD ON FISHES.**By NEIL HEATH.**

[Abstract, by Chas. W. Smiley, of a paper read before the Auckland Institute, July 2, 1883.] c

It is asserted that, though shallow rivers and ponds have been converted into solid ice in countries where the winters are protracted and severe, all the imprisoned fish have not been destroyed, but that, when the ice had thawed, many of them were restored to their usual health. Though dead in appearance they were only asleep hibernating, and like many animals that pass the long winters in a state of lethargy, they would in due time recover their animation. It is not an easy matter to ascertain that in such rivers and ponds the whole of the water is unquestionably frozen, and obviously the theory must be held over until we can prove that the waters were completely frozen, and that the fish had actually been imprisoned in the solid ice.

It struck me that as the *Mataura* with her freezing-chamber was lying at the wharf a few facts might be learned which would throw light upon the subject. The *Mataura* was freezing her cargo of sheep for the London market, and why should she not, if intense and continuous cold only suspended the life of the fish, carry to England slabs of ice inclosing numerous specimens of fish hitherto unknown in that land, and which would only require to be thawed in English rivers? Why put ourselves to the trouble of bringing ova to New Zealand, only to be destroyed by native species, when we could thus import vigorous, full-grown fish?

I will place before you a statement of the steps which have been taken to show that fishes can return to life and energy after imprisonment in ice.

Captain Greenstreet, of the *Mataura*, cordially helped me to use the freezing-chamber in the vessel, and in it were placed two pannikins, the one containing a salt-water fish in salt water, and the other a goldfish in fresh water. At the same time two other pannikins were placed in the "shoot," the coldest part of the freezing apparatus, the one containing a salt-water fish, and the other a silverfish. The water in these vessels was at the ordinary temperature. The cold in the shoot being many degrees below zero F., it did not take long to convert the water into ice, and at the end of an hour and a half I was satisfied that all of both kinds of water had become solid, and that the two fishes were as hard and firm as the sheep that were hanging in the freezing chamber. Both pannikins were then removed and placed in tubs filled with

water at the ordinary temperature. The one contained salt water for the salt-water fish, the other fresh water for the silverfish. In a short time the heat of the water in the tubs found its way to the surface of the ice in contact with the interior of the pannikins. The blocks, becoming in consequence reduced in bulk, parted, the former finding its way to the bottom, the latter remaining at the surface. On examining these blocks of ice it was observed that both fishes must have retired from the surface of the water towards the bottom during the freezing, and that about half an inch of the lower part of the silverfish rested on the bottom of the vessel. It must therefore have been outside the ice. The other fish was entirely surrounded. The appearance of both was identical. Both lay on the side, the head was higher than the tail, the distended gills were filled with ice, and the iris of the eyes had neither dilated nor contracted; the aqueous humor was apparently frozen. The rays of light no longer penetrated to the retina, and the eyes presented the appearance of balls of opaque ice. The silverfish was the first to be free, and it was observed that at the moment when the fin near the gill was freed from all restraint the little organ commenced to move very gently, so much so that it was impossible to say but that motion was due to the parting of the ice. A few moments later there was no mistake about the matter. The fish was alive. The tail resumed its activity. As soon as the ice had disappeared from the gills, they began to open and close, and the little fish moved about languidly, dreamily, groping its way. Up to this time the aqueous humor of the eye had not thawed, all was darkness to the fish. It seemed to be feeling its way, but soon the ice was dissolved, light entered, and the silverfish was swimming as easily and nimbly as ever. It is now alive in a glass tank.

The salt-water fish was gradually detached from the encircling ice, but close attention failed to notice any signs of life. When entirely free it sank to the bottom dead. Perhaps the sudden contraction of the water at freezing point following so rapidly upon the expansion had in some way injured the fish. Obviously the air-bladder had burst, for all buoyancy had departed. Why did the fish which had been taken from the sunny waters of the Pacific but a few weeks previously survive an ordeal that proved fatal to one fresh from the cooler waters of the Waitemata? I cannot tell.

It may yet be proved that fishes, which are usually classed with cold-blooded animals, can survive imprisonment in ice. Even the slight injury caused by the fishing-hook to the salt-water fish may possibly have contributed to its death.

I frequently visited the freezing-chamber to see how the other prisoners were faring. The former two had been placed in the "shoot," and consequently I had had no opportunity of observing how they behaved as the ice gradually closed around them. But in the freezing-chamber there was every facility for doing so. In an hour the increas-

ing coldness of the water in the pannikins was rendering their movements less active. They glided from one side to the other, and from the surface to the bottom, but in an uneasy manner. Their attitude was that of expectancy. An hour afterwards they were apparently going to sleep, the goldfish on its side, the other in its ordinary position. The fins kept moving in a lazy manner; there was no twitching, no abrupt action. The motion reminded one of the vibration of a wire slowly but surely coming to rest. The eyes were clear, and to all appearances a deep and placid sleep was falling stealthily upon them. Two hours afterwards they were in the same position, but there was no movement. The ice was advancing upon them. Some of the spikes of ice had already reached parts of their bodies, and reflecting the light from the candle produced a beautiful combination of color. The two creatures were sleeping in the light of a gorgeous sunset. After eight hours' exposure to the temperature of the freezing-chamber, and two more to the much lower temperature of the snow-box, I felt sure that the ice was solid. I removed the pannikins to the thawing-tubs and sat down to watch for indications of life, but none appeared. When freed from the ice the salt-water fish floated about for a short time in the same position as that occupied when it was inside the block of ice, and then slowly sank to the bottom. The goldfish on being freed continued to float for upwards of an hour, during which I sat watching it. Next morning it was still floating, not erect like the other, but on its side, with the tail slightly depressed. It was apparently dead. At night it maintained the same position, and I gave it up for dead.

I have made this statement in hope that others who have time and more enlarged facilities for carrying out a series of experiments will proceed with the investigation. (From Transactions and Proceedings of the New Zealand Institute, 1883, vol. xvi, pp. 275-278.)

181.—THE SCOTCH COD AND LING FISHERIES.*

The great Scotch cod and ling fisheries last from March till July along the northeastern coast of Scotland and near the Shetland and Orkney Islands. Vessels furnished with a deck are beginning to be employed in these fisheries with great success. At the end of June the larger vessels give up the cod and ling fisheries and engage in the herring fisheries on the east coast of Scotland. The crews of these vessels are composed exclusively of experienced fishermen, and, in a vessel of 30 tons, the crew generally numbers 7 or 8 men. They are not paid in cash, but receive their share of the catch. The fishing is done by lines.

* *Det skotske Torske- og Langefiske.* From the *Norsk Fiskeritidende*, Vol. III, Bergen, January, 1884. Translated from the Danish by HERMAN JACOBSON.