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THE EGGS OF THE FRESH-WATER LING.

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The discovery of the eggs of the burbot or fresh-water ling (*Lota maculosa*, LeSueur) deposited by the parent fish, exhibited in the tanks of the Ottawa Fisheries Museum, is a matter of unusual scientific interest.* While the burbot is not a valuable or esteemed species, it is, in many ways, an interesting fish to the naturalist. It is known in different parts of Canada by no less than fifteen different names,† most of them uncomplimentary; indeed, as the late Frank Buckland said, many years ago, of the British burbot or burbolt, "they are such a stupid and ugly fish that I cannot advise trouble to be taken with their dissemination they are so destructive to the eggs of all other fish they eat an enormous quantity of fry, and they swim after the manner of eels." The same author stated that they are a nocturnal fish, spawn in the deepest holes in lakes, 480 to 540 feet deep, and after having been frozen stiff will revive. Belonging, as the burbot does, to the family *Gadidae*, which includes the cod, haddock, hake, whiting, and other valuable food fishes, it might be imagined that it is excellent as a table fish. Of its edible qualities the most opposite opinions are held. On some lakes of the Northwest it is highly regarded; but in other localities, indeed generally, it is not regarded with favor, and has been even pronounced poisonous. In this connection, the following extract from a special report, published in the Blue Book of the Marine and Fisheries Department, 1900, has an interest and may be appropriately quoted here (*vide* report mentioned pp. lv-lvi).

* The eggs were collected by Mr. Andrew Halkett for study in a fresh living condition, while others were preserved by him in formalin.

"If great variations obtain regarding the naming or mis-naming of this fish, a corresponding diversity of opinion exists regarding its edible qualities. At a remote Hudson Bay post, in the Canadian Northwest, I found that the flesh was regarded as poisonous, indeed, cases of poisoning after Indians and employees of the post had eaten the fish were mentioned, and it was pointed out that even the dogs would not eat it. The dogs are usually fed on the excellent whitefish and decline being put off with inferior fare, and it is a fact pointed out by various explorers that the dogs of the Northwest, used in the dog-trains, refuse to eat the burbot. I found, however, at another Hudson Bay post, that the fish was often eaten and was regarded as most excellent, no ill effects having been noticed. Belonging as it does to the cod family, it should be an excellent fish for the table, like its near relatives the cod, haddock and hake. In one of the lakes of New York State (Lake Winnipiseogee) it is pronounced equal to the whitefish for table use, and the liver is generally considered a rare delicacy.

"Dr. Richardson (*Fauna Boreali-Americana*) is recorded to have said that 'the flesh of the fresh-water cusk is firm, white and of good flavor; the liver and roe are considered delicacies, when well bruised and mixed with a little flour, the roe can be baked into very good biscuits, used in the fur countries as tea bread.' Professor Brown Goode spoke of it as a very excellent fish, especially for boiling; though Dr. T. H. Bean pointed out that apart from the liver, the fish is not esteemed in the Great Lake region and northward, but in the rivers of Montana the burbot is in great favor."[†]

Pennell states that the flesh of the English burbot is white and firm, and is considered superior in flavor to that of the eel.

It has a very wide geographical distribution in the old world and on this continent. It has been recorded in Germany, Austria, Russia and other countries; but it is of very local occurrence in the British Islands, being wholly absent from some rivers and plentiful in none. The belief prevails that it is decreasing in numbers and doomed to extinction. It does not appear to be

[†] Report of Department of Marine and Fisheries (Fisheries) 1900, p. lv.

found in Scottish or Irish waters. From New England and the basin of the St. John River, New Brunswick, it extends through the Great Lakes and more northern waters to the Manitoba and Athabaska lakes and rivers, while specimens have been procured in the Okanagan and Columbia river regions in British Columbia. Drs. Jordan and Evermann speak of it as abundant in the north as far as Bering Straits and the Arctic Seas, but rare in the Ohio and Upper Mississippi. A number of specimens are preserved in the Ottawa Fisheries Museum, some being local, *e.g.*, Lake des Chene, Ragged Lake, Algonquin Park, Healy's Falls, and Rock Lake, Haliburton Co., Ont., and one specimen sent from Swan River, near Vernon, B.C. As a rule it is regarded as a pest, and fishermen are of opinion that it is a great destroyer of the spawn and young of valuable fishes; but its feeding habits require accurate investigation.

As the cod and most of the *Gadidæ*, so far as known, produce eggs, which, as Dr. A. S. Packard states, "rise to the surface of the water, on which they float," it has long interested naturalists to know of what character are the eggs of the burbot, the only fresh-water member of the family. If, as seems practically certain, the burbot is a species of the cod family which has changed its habits and become a non-marine form, it was highly interesting to ascertain whether its eggs retained the characteristics of its ocean-inhabiting relations or not. Fish authorities and embryologists have long been on the look out for the eggs of the burbot for that reason. The minute delicate glassy transparent globes, floating lightly, like invisible soap-bubbles near the sea's surface, are called pelagic or buoyant eggs; and the eggs of the cod, haddock, pollock, whiting, hake, marine ling, and other *Gadidæ*, are typically pelagic. Could it be that a species of that family, permanently resorting to fresh water, would have retained that interesting type of egg, or has the character of the egg changed with the change of the habitat of the fish?

Thirty years ago a Belgian investigator, Dr. C. Van Bambeke, described the egg of the fresh-water ling, inhabiting rivers and lakes in Europe,* but he never secured them after being deposited

* Mém. Couronn. l'Acad. Roy. de Belgique, tome XL. 1876.

naturally. He took them from the parent fish before they were deposited, and while he obtained and described the egg and published a drawing of it, no one could say if the features described were normal or not, and it was not possible to say whether or not it possessed buoyancy, and belonged to the pelagic type of ovum. Van Bambeke's account described the egg of the burbot as an extremely small, spherical, translucent ovum, with a pale greenish oil globule, surrounded by a thin coat of protoplasm, the globule being held in a fixed situation, in the yolk matter, by a column, or thick strand, of tenacious protoplasmic material. How does this description compare with the features of the eggs, several hundreds of which were deposited, at the end of January, by the parent fish in the Ottawa Fisheries Museum and examined under moderate powers of the microscope? A study of these eggs yielded this remarkable result, that they have all the features of the typical pelagic eggs which occur abundantly in the ocean where cod, sea-ling and other Gadoids spawn. The burbot's egg is somewhat buoyant, of minute size, extremely transparent, and delicate in structure. As Van Bambeke stated, there is a single large oil-globule, greenish in hue, though almost colorless in transmitted light, but not fixed or held in place by a strand of protoplasm. Now, the burbot is a close relative of the sea-ling (*Molva vulgaris*) and of the sea-cusk (*Brosmius brosme*, Muller), and bears a strong external resemblance to them, having an elongated eel-like body, a flattened head, a small first dorsal fin, and a very long second dorsal and anal fin, as well as a rounded spatulate tail. The sea-ling and sea-cusk produce small pelagic eggs, each of which contains a single large bright oil-globule, that in the ling's egg pale greenish; that in the sea-cusk's egg being terra-cotta in tint. The egg of the fresh-water ling almost exactly resembles the ovum of its marine relative in all essential features. The ova of the marine ling (*Molva vulgaris*), to quote from the large Scottish monograph (the most elaborate account of fishes' eggs ever published),* "are less buoyant than some other Gadoids, e.g., *Gadus morrhua* and *G. æglefinus*, and sometimes, though living, sink to the bottom in quiescent water, yet success-

* Professors McIntosh and Prince, Trans. Roy. Soc., of Edinburgh, Vol. xxxv, Pt. iii, No. 19, p. 668.

fully develop. The ova of the ling are, indeed, more delicate and more susceptible to unfavorable conditions than those of the cod and haddock." Now, these observations would apply exactly to the present egg. It is so light that the slightest movement in the water carries it hither and thither. In still water it falls to the bottom, and, indeed, unlike marine eggs, which are in water of greater specific gravity, the egg of the fresh-water ling cannot permanently float. It is perfectly spherical and has a diameter of 1.77 mm. ($=.0695$ inch) and the globular oil sphere measures .354 mm. ($=.039$ inch) in diameter. The egg of the marine ling measures 1.68 mm. ($=.066$ inch, or even $.0916$ inch) in diameter and the oil globule .96 mm. ($=.037$ inch), so that the fresh-water species produces an egg in general of smaller size, indeed in proportion, it may be said to the different size reached by the full grown form in both species. Whereas the burbot reaches a length of only 12 to 30 inches and a weight (according to Pennell) of 2 to 8 pounds; the marine ling may measure 24 to 72 inches in length and a weight ranging from 15 to 60 pounds.

None of the burbot's eggs were fertilised, so that no germinal disk was formed, though a thin layer of protoplasm surrounded the ball of clear yolk fluid. The yolk was not granular, and the bright globule of oil lay free in the yolk and moved readily about as the egg revolved when pushed by a scalpel on the stage of the microscope. In some of the eggs a thin irregular envelope of protoplasm collected round the globule, but in most examples it was not present. A perivitelline space separates the yolk-globe from the thin capsule of the egg. The capsule itself is a simple transparent shell, as in all pelagic types of ova; and in optical section it appeared as if double, and concentrically striated—a false effect—but repeated and careful examination showed radial striations in the thin capsule; these striations apparently corresponding with minute dots or pits occurring all over the exterior. The micropyle showed the usual features, a slight conical thickening in the centre of which was the aperture seated in a crater-like depression. As in the case of the marine ling, the eggs of this fresh-water form are delicate in the extreme, and very readily

burst when manipulated under microscopic examination.* The tension, due to capillary attraction when a cover-glass was placed upon the glass-side, caused them to burst, and the bright oil-globule lightly bounded out of the egg, while the thick yolk slowly poured out like clear mucilage. Unfortunately, no ripe male fish was available or the early embryonic stages of the fertilised ovum, and larval form of this species, could have been studied for the first time. In view of the character of the eggs, as now discovered, the larva is without doubt a very minute and delicate creature, far more minute and delicate than possibly any other young fresh-water fish. The post-larval stages of the marine ling, we know, are very wonderful and extraordinary owing to the enormous wing-like ventral fins, "their most striking feature being the extraordinary length of the ventral fins of an ochre yellow color, with specks of black pigment scattered over the inter-radial membrane."*

No doubt Buckland when he defined the spawning period of the European burbot as from the end of January to the beginning of March based his conclusion upon an examination of the ovaries in dissected specimens, and his conclusion was accurate, as the mature eggs now described were deposited about the twentieth of the month of January. The statement that the spawning sites selected are in the deepest holes in lakes, etc.,† cannot be correct, as a delicate and practically pelagic egg, such as that now demonstrated to be the burbot's egg, must be deposited in clear shallow water, and judging by analogy, the development will be rapid, and the young hatch out in a few days, possibly ten to twenty days. Actual observations alone can decide the validity of these surmises, but the newly-deposited egg, as now described, differs from that of any other fresh-water fish hitherto recorded.

* Professor McIntosh noted this feature in *Molva vulgaris* and said, "The zona is not so soft and tough as in the cod and haddock ; but shows greater resistance, bursting rather than collapsing under pressure." Trans. Roy. Soc. Edin. Vol. xxxv, p. 827.

** McIntosh and Prince : *op. cit.* p. 830.

† Buckland, Nat. Hist. Brit. Fishes, 1881, p. 35.



Prince, Edward Ernest and Halkett, Andrew. 1906. "The Eggs of the Fresh-water Ling." *The Ottawa naturalist* 19(12), 219–224.

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