

75.—OBSERVATIONS ON MALE EELS.*

By Prof. P. PAVESI.

It would be useless to repeat the history of the investigations relative to the reproduction of the eel, because it is well known,† and because Dr. Jacoby, in his work "*Der Fischfang in der Lagune von Comacchio, &c.* (The Fisheries in the Lagoon of Comacchio, &c.), has treated the subject in such an exhaustive manner. But I will state that on December 28, 1871, Professor Ercolani, before the Academy of Bologna, and on January 11, 1872, Professors Balsamo and Maggi, before the same Academy, declared that the eel was a perfect specimen of a hermaphrodite, there having been found in one and the same eel organs which certainly were male, together with ovaries. The question, therefore, seemed completely solved, and Professor Cornalia expressed his delight "that the mystery which enveloped the question of its reproduction had been solved, and that these fish could really be termed hermaphrodites," and added that he was "very glad this result had been obtained by Italians, while none of the illustrious foreigners who had been sent to Italy on special missions to study the fish-cultural establishments on the coasts of Italy had been able to make the discovery." A number of professors at various Italian universities published articles and pamphlets on this achievement, some of which were translated into French and German. The only person who declared these statements premature, and opposed the views of Balsamo and Maggi, was Professor Canestrini. The matter now rested for a while, till 1874, when Professor Syrski, of the Austrian university at Lemberg, published a treatise in the reports of the Vienna Academy of Sciences, on studies made by him at Trieste. He selected for his observations small eels, about 40^{cm} [15½ inches] in length, having regard to the general fact mentioned by Günther and Darwin, that probably there is no kind of fish in which the males are not smaller than the females.‡ In some of these eels he found a small organ which he called the "lappenorgan" (the rag-organ), which, although there were no certain indications of the presence of spermatozoa, he did not hesitate to consider as a male organ. Claus, Siebold, and Virchow now began to occupy themselves with this question; and Freud declared that this organ showed great similarity to the histological structure of the testicles; while Jacoby wrote: "The supposed testicles of the eel, described by Ercolani, Crivelli, and Maggi, show, as is proved by a most careful investigation, not the slightest trace of a testicle-like

* Extract from a paper read before the Royal Institute of Lombardy, July 1, 1880. Translated from the Italian by HERMAN JACOBSON.

† For a very full article on this and connected subjects, see F. C. Bulletin, Vol. I, 1881, p. 71.

‡ See F. C. Bulletin for 1881, p. 85.

structure." The controversy began to grow hot. Siebold did not rest until in 1875 he found many male eels in the Baltic near Wismar. Late in the autumn of 1877 Professor Jacoby came to Comacchio to resume his researches. The German Fishery Association stirred up all the fishermen and fish-culturists of Germany, by promising a reward to any one who would send male eels to Professor Virchow at Berlin. Dr. Pauly, of Monaco, with the assistance of Mr. Keiffer, anatomized some eels, and sent one to Professor Benecke of the University of Königsberg, who entirely confirmed the result of Dr. Pauly's patient researches; as also did Dr. Hermes. Meanwhile there came from America the announcement through Prof. A. S. Packard, of Brown University, in the first number of the *Zoologischer Anzeiger* for 1879, that Mr. Edwards, of Boston, Mass., had, in December, 1875, found males of the *Anguilla bostoniensis*. It is true that soon after Professor Packard corrected his own statement, in an article inserted in the *American Naturalist*, to the effect that the supposed spermatozoa were cells with a molecular movement; while Jacoby wrote: "The alleged spermatozoa described in the work of Maggi and Crivelli, are nothing but microscopic fatty particles, or small crystalline bodies, such as are frequently found in fat cells." It could not be supposed, however, that the organs considered as testicles by Balsamo [Crivelli] and Maggi, were a fatty degeneration of the Syrskian organ, both on account of their structure and their different location.

From the preparations and diagrams which I saw at the Berlin Exposition in 1880, it appears that the testicles are stretched along the body cavity, in the shape of two lobular bands. They are covered by a large number of fatty cells. They commence at the liver and pass the anal aperture, the left one a little further than the right, and finally end in a point. When fresh they are said to be clear and transparent, but in alcohol they become opaque. Under the rectum, and over the urinary bladder there is a seminal bag, which terminates in a small tube at the anal aperture. The two live eels which were exhibited in the Berlin aquarium came from Dr. Hermes, in Trieste, and were, after a careful external examination by Dr. Jacoby and Dr. Græffe, determined as male eels. When one of them died, Dr. Hermes very kindly presented the organs referred to to the Berlin aquarium. On examination it was found that these fish were thirty to forty centimeters [12 to 16 inches] long, of an olive-green color on the upper, and a silverish-white color on the lower part. These two colors were very distinct; and there was a blackish spot of an oblong shape in the opercular region. They generally preferred to hide at the bottom of the aquarium among the aquatic plants, but occasionally swam about in the open water.

The above-mentioned characteristics are only individual, although they formed the distinguishing marks of those which possessed the

Syrskian organs. Syrski states that their greatest length is 430 millimeters [17 inches]. The eight specimens measured by Jacoby varied in length from 319 to 480 [12½ to 19 inches], and those measured by Cattie from 270 to 380 millimeters [10½ to 15 inches]. In the males, moreover, the distance between the nasal tubes is greater; the dorsal fin is higher and broader; the diameter of the eyes is noticeably larger, comparing individuals of medium size. But these characteristics, in my opinion, make it doubtful whether these fish were young specimens, because in other fish the young may be recognized by the great development of the fins and the comparative great size of the eyes. Jacoby maintains that another sexual difference consists in the color, while Cattie denies this and maintains, on the other hand, that the difference in the shape of the head is of greater importance—the female is said to have a pointed and the male a round head. The males are said to form about 20 per cent of all the eels.

Not less important are the results of Jacoby's observations regarding the migration and the spawning season. The fact of the ascent of the eels, called at Comacchio "*capillari*" (hair-like), and at the mouth of the Arno "*cieche*" (blind eels), has long been known in Italy, and on it is based one of our principal fishing industries. Thus from time immemorial the descent of the adult eels towards the sea has been explained as being caused by their desire to spawn. There is no longer any doubt that Jacoby found them on the coasts of the Adriatic by thousands; but he also found that these eels migrate in autumn when their stomachs and intestines are entirely empty, and that those which remain are nothing but barren females. Probably all the eels of our rivers, ponds, and lakes are females, because the males stay in the sea near the mouths of rivers, where they wait for the females to come to them.

The perfect development and the functions of the sexual organs seem to be of very short duration; in fact, the descent of the eels takes place from the beginning of October till the end of December; and already in January, February, and March, as Mr. Richardi, of Pisa, informs me, the so-called "blind eels" ascend. It is possible, also, as Jacoby thinks, that the reproducing individuals die after the act of generation, just as Panizza always found the dead lampreys (*Petromyzon marinus*) void of eggs and milt.

There is lacking all decisive proof of the presence of spermatozoa in the Syrskian organs; they cannot, therefore, with absolute certainty be considered as testicles;* and the depth of the sea hides from our eyes the method of fecundation and the first development; but the truth is nevertheless plain, and the idea of the hermaphroditism of the eel may be considered as entirely exploded.

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* See article by J. A. Ryder in F. C. Bulletin for 1885, p. 1.