

down to 355 fathoms, the greatest depth ever found in Skagerrack being a little more than 400 fathoms. Although I had not very long time for the explorations, I was very successful indeed. The most interesting haul during the cruise may be one in lat. 58° 35' N., long. 10° 15' E., depth 150 fathoms, bottom clay. Among other things, I got there two specimens of the rare Synaptoid *Olizotrochus vitreus*.

I suppose you know that the Swedish naturalists are never allowed to keep any specimens obtained in the expeditions fitted out by the government; all belong to the Royal Museum of the Vetenskaps Akademien; and thus I have no right whatever to make a bargain with the animals that I collected in Greenland.

I am very much obliged to you for your kindness in sending me the catalogue.

*Report on a Memoir by Dr. Dufossé, "On the Noises and Expressive Sounds which the Freshwater and Marine Fishes of Europe produce."* By M. C. ROBIN.

The memoir submitted to our examination is a considerable work, a true monograph; it has cost its author numerous investigations. This subject has been, on his part, the object of very diverse observations, the summary of which has on several occasions been inserted in the 'Comptes Rendus.'

The first part of Dr. Dufossé's work consists of a very extended history, summing up all that naturalists and physiologists have said with regard to the noises produced by certain fishes. This history commences with Aristotle, whose remarks upon this question deserve to be recalled.

"Fishes," he says, "having neither lung, nor trachea, nor pharynx, have no voice. Those which have been said to have one, produce nothing but certain sounds and whistlings. Such is the kind of grunting of the *Lyre*, the *Chromis*, and the fish called the *boar-fish*, which is found in the *Achelous*. We may also cite the *Chalcis* and the *cuckoo-fish*: the former makes a sort of whistling; the second emits a sound approaching that of the bird whose name it has received in consequence of this resemblance. All these fishes produce what has been called *their voice* either by the rubbing of their branchiæ, which they have garnished with points, or by means of certain internal parts near the intestine, and which contain air. It is this air the agitation and friction of which produce a sound. Some *Selachii* also seem to whistle. All this, however, can only improperly be called *voice*; we must say that it is a sound." (Hist. Anim. Lib. iv., Camus's translation, Paris, 1783, tom. i. p. 221.)

The sounds emitted by fishes may be very varied *irregular noises*, such as those which the *Cyprini*, the loaches, the *Dactylopteri*, the *Hippocampi* and others produce with their lips or their opercula, or by moving certain articulations.

There are other, *regular noises*: various *Scomberoidei* produce

these by the friction of the pharyngeal bones; the *Orthogorisci* cause them by the friction of their intermaxillary teeth; various Cyprinoides, Anguilliformes, Siluroidei, &c. cause them by expelling into the œsophagus the air of their swimming-bladder.

Lastly, there are noises which, while *regular* and *voluntary*, like the preceding, result from certain peculiarities presented by muscles in course of contraction in fishes furnished with an air-bladder which has no communication with the œsophagus. These have been observed in *Peristedion cataphracta*, *Trigla*, *Sciaena*, *Zeus*, *Umbrina cirrhosa*, and *Hippocampus brevirostris*.

The mechanism of the production of the first two varieties of these sounds was already pretty well known; but M. Dufossé, by a fresh examination and by his dissections, has given more precision to several of the anatomical and physiological notions relating to it. This part of his investigations, which is already old, has, moreover, been the subject of a favourable report from our regretted colleague, Constant Duméril (see 'Comptes Rendus,' 1858, tome xli. p. 610). Therefore we will dwell only upon the later communications of the author, made from 1858 to 1862 (Comptes Rendus, 1862, tome lxiv. p. 393), which appear to us to be still more valuable than the preceding ones.

He has set himself to show, that the *regular sounds* which fishes emit may be voluntarily produced, and are not a simple consequence of some other physiological action. They are consequently, in certain cases, true acts of expression, however rudimentary.

M. Dufossé has shown that in the fishes which voluntarily produce regular sounds, these are commensurable as musical sounds; and although they are more imperfect than those emitted by serpents, as Lacépède had already remarked, he has determined their note in all the species which he has observed. He has also shown, by conclusive experiments, that all the fishes which emit noises or regular expressive sounds in the air, produce them also in the water—that is to say, in the medium in which they live and are naturally in relation to each other.

In the case of several species, the intensity of the sounds is so great that, when produced by a single individual, they may be heard at a distance of several metres; this is the case with certain *Trigla*, *Zeus*, and especially *Pogonias chromis*, &c. When emitted by animals combined in shoals, they may be transmitted still further; more than once, under these conditions, they have frightened the crews of ships, who did not know to what cause to ascribe the noises produced around and beneath their vessels. They have been the source of more than one fable spread among maritime populations. M. Dufossé has himself ascertained the existence of these noises, by going frequently, and not always without danger, to pass whole nights on the open sea in fishing-boats.

In the case of the fishes with an air-bladder which does not communicate with the œsophagus, M. Dufossé has ascertained experimentally that the wall of this reservoir was affected by strong and frequent movements during the production of the sounds. He has thoroughly studied the nerves and muscles then in action. His

vivisections, aided by touch and auscultation, proved to him absolutely that the muscles themselves are the agents producing the vibrations from which the sounds formed originate (*loc. cit.* 1862, p. 394). Since then a distinguished physiologist, M. Armand Moreau, by submitting the nerves which run to the air-bladder of the gurnards to the action of an electric current, has ascertained that the striated muscles of the air-bladder contract and cause the reproduction of the characteristic sounds, and this in the animal when killed by section of the spinal cord (*Comptes Rendus*, 1864, tome lix. p. 437).

This mode of formation of sounds by contraction of the muscles of the air-bladder was not known before the investigations of M. Dufossé. Science has to thank him for this discovery, and for the care which he has taken in observing the diversities of this phenomenon from species to species of the fishes which present it.

We shall conclude this report by calling the attention of the Academy to another point in this work, because it will certainly become the subject of fresh experiments made by means of the registering and other instruments which now-a-days serve to determine the real nature of a great number of organic phenomena. According to M. Dufossé, it is not the readily visible movements of the air-bladder that are the cause of the sound heard while they last. Although much greater than the concomitant trepidations which cause the sonorous vibrations, these contractions merely tighten or relax certain parts of the air-reservoir; and the use of the latter in this respect is to act as a sounding-board, an organ for the reinforcement of the sounds produced, which are comprised between  $si^2$  and  $re^6$ .

It is well known that the striated muscles during contraction give rise to a peculiar sound, which is called the *muscular sound*, *rotatory sound*, *susurrus*, *wrinkling*, or *myophonia*, and has been well studied by Wollaston, Erman, Gilbert, Laennec, and many modern observers. According to M. Marey this muscular sound corresponds sometimes to the *ut*, and sometimes to the *si* of the lower octave of the piano. Now, according to M. Dufossé, the noise produced by the fishes of which we are speaking is this very muscular sound, caused by the contraction of the voluntary muscles of the air-bladder; and the latter plays, with respect to it, the part of an organ of reinforcement in a sufficiently marked manner to enable it to reach our ears.

The Academy will see that, if the correctness of this ingenious analysis of the mechanism of production of the sounds produced by the air-bladder should be experimentally confirmed, the acoustic property of muscular contraction will be raised to the height of a phenomenon productive of sounds, not merely commensurable, but even expressive. In the absence of experiments made by your committee, it cannot yet pronounce a formal opinion upon this point. But it recognizes that, by the sagacious and laborious employment of his knowledge of comparative anatomy and physiology, M. Dufossé has discovered new facts which have elucidated several previously obscure ichthyological questions. — *Comptes Rendus*, November 4, 1872, tome lxxv. pp. 1074-1078.