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Nidification of the Indian Rainbow-Fish.

By M. PAUL CARBONNIER.

The rainbow-fish (*Colisa vulgaris*, Cuv. & Val.) is met with in the tanks and ditches of the country watered by the Ganges. Its length never exceeds 4 centimetres. It is one of the prettiest of known fishes. One is agreeably surprised with the exuberance of colour that nature has bestowed upon this little animal; but its most important peculiarity, from a scientific point of view, is its mode of nidification.

As spawning-time approaches, the male, spreading his brilliant fins, plays round the female, showing her his bright colours; with his long ventral filaments he pats and touches her in all directions, until, overexcited by his caresses, she takes to flight. I believe that all these graceful movements of the male fish, all these amorous proceedings, influence the physical condition of the female and aid the maturation of the ova.

The male fish then commences the preparations for oviposition. Seizing a little *Conferva* in his mouth, he carries it to the surface of the water. The plant, from its greater density, would fall back very rapidly to the bottom; but our little workman sucks in a few bubbles of air, which he divides and places immediately beneath the plants so as to prevent them from descending. He repeats this process several times, and thus, in the first day, forms a floating island 8 centimetres in diameter. The bubbles of air are not coated with a greasy liquid as in the case of the *Macropoda chinensis*; all those which approach sufficiently to touch, unite together and fuse into one.

The next day the male continues his provision of air, which he now accumulates towards the central point. These bubbles exert a pressure from below upwards, the consequence of which is the elevation of the vegetable disk, which, issuing from the water, becomes converted into a sort of dome floating on the surface.

The nest being completed outwardly, the fish busies himself with giving it a firmness which may protect it from shipwreck. With this view he creeps upon it in all directions, and glides over its walls to smooth the surfaces; he forcibly presses this felt with his muzzle and his chest; if one of the twigs is too prominent he seizes it and removes it, or, by means of successive pushes with his head, forces it into the interior. It is by turning and pressing the wall from all sides that he succeeds in rounding it nicely.

The protective roof being finished, the male plays about the female, shows her the brilliancy of his dress, touches her with his appendages, and seems to invite her to follow him. The female then soon enters the nest. While she is feeling its walls and examines its arrangement, the male, bent horizontally under the entrance, turns spirally upon himself, throwing towards the summit of the edifice the lustre of his many-coloured tints.

Speedily the female approaches the male with confidence; she applies her head near the extremity of his anal fin, and thus tra-

verses it as far as the origin of the filaments; then she bends into a semicircle. The male fish, by a like inflexion of his body, embraces her, turns her over, and presses her side, an operation the result of which is a first emission of ova. These, from their lightness, tend of themselves to rise; but, with a foresight which cannot be too much admired, the male in pressing the female forms, by means of his dorsal fin, a concave fold, a receptacle in which the ova undergo the contact of the fecundating principles. Soon after, there is a new visit of the female, and a fresh approximation of the male, until the ovaries are completely evacuated.

The spawning over, the female quits the conjugal roof, leaving to the male the care of rearing the family, a task of which he acquits himself with a truly paternal zeal. Collecting with his mouth the ova scattered through the plant, he raises them into the nest and arranges them in orderly fashion; if they are too much agglomerated, he separates them by a movement of the head and compels them to remain in the same plane; then he issues from the nest, and sets himself with great activity to contract the entrance. When this operation is completed, he goes away and swims round his edifice to examine the whole,—and not without anxiety; for he often goes to fetch fresh bubbles of air, which he places intentionally under doubtful points or under menaced parts.

After seventy hours of incubation the male, foreseeing that the ova require fresh care and quite a different medium, ascends in the nest and pierces its summit; the air-bubbles escape and the dome immediately flattens upon the water, imprisoning all the embryos, the existence of which begins to be manifest.

Fearing lest the young should escape his care, he sets to work to make a new barrier for them. For this purpose he follows and traverses the outer margin of the floating carpet, and pulling at it with force, separates it from the felt, thus obtaining a sort of pendent fringe where stray young ones will not be able to pass; then, having got rid of all anxiety from this side, he takes his young in his mouth and removes them to short distances, always conveying those of the circumference towards the centre.

If some of the young fish venture to descend vertically, he goes in search of them, and carries them back to the protective dwelling. This surveillance lasts until the embryos, having undergone their complete evolution, have acquired strength and agility. Their numerous and frequent flights announce to the male the end of his troubles, which comes about eight or ten days after the sinking of the nest.

The same pair of fish gave me three ovipositions during the summer of 1875, each consisting on the average of 150 ova.

The embryos of the rainbow *Colisa* undergo a series of transformations analogous to those which I first indicated as occurring in *Macropoda chinensis*. Want of time and the dread of affecting the existence of animals which are still rare prevented my following this investigation with all the attention that the subject deserves; but I propose to resume it hereafter.

All my observations on the Indian *Colisa* were made in Paris, in

small aquaria containing about 15 litres, the temperature of the water being kept at 23°-25° C. (=73°·4-77° F.).—*Comptes Rendus*, December 6, 1875, p. 1136.

Zoological Notes made during a Residence at Scheveningen.

By M. P. HARTING.

In these Notes we find some particulars as to the membrane of the egg of *Cyanea*, the otoliths of *Cyanea* and *Chrysaora*, the nervous system and organs of the senses of an *Encope*, and some interesting researches upon the chromatophores of the embryos of *Loligo vulgaris*. The observations made by M. Harting upon these last organs lead to some results which differ in certain points from those arrived at by Harless, Brücke, and, more recently, F. Boll.

The embryos of *Loligo* which furnished the Dutch naturalist with the most favourable objects of study were only from 3 to 4 millims. long. In living individuals of this size the body is sufficiently transparent to allow of the employment of transmitted light, and show clearly the relations of the chromatophores to the tissue surrounding them.

When the chromatophores are in a contracted state, they present the appearance of small, nearly black globules, from 0·020 to 0·030 millim. in diameter, and consequently invisible to the naked eye. They are therefore without influence on the ground of the general colour of the animal, which is milk-white. When they extend, the chromatophores begin to show the colour which is proper to them—that is to say, yellow, brownish or reddish yellow, and more or less reddish violet; and their transparency increases with the degree of expansion at the same time that the colour becomes brighter.

M. Harting did not observe the chromatophores in course of division; he believes that the increase in the number of these organs takes place by the appearance in the clear spaces of new chromatophores which are at first yellow and afterwards pass to other colours. With the exception of a very small number of yellow chromatophores of very small size, which the author regards as being in course of formation, the diameter of these organs in the expanded state varies from 0·150 to 0·200 millim.; so that they have from 7 to 10 times the diameter and from 50 to 100 times the surface of the contracted chromatophores. When the vitality of the animal is still great, the contraction and expansion take place in a very rhythmical manner, and may arrive at the number of ten to twelve changes of state per minute. When life begins to fail in the embryo out of its envelope, the movements slacken; they afterwards cease completely; and when the animal is dead, nearly all the chromatophores remain in a state of expansion. This fact is scarcely explicable in accordance with the views of those naturalists who, like Harless and Boll, assume the existence of contractile fibres of muscular nature inserted in the walls of the chromatophores, and producing expan-