Annals and Magazine of Natural History

Series 4

ISSN: 0374-5481 (Print) (Online) Journal homepage: <http://www.tandfonline.com/loi/tnah10>

Observations on the Natural History of the Crayfish

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To cite this article: M. Chantran (1870) Observations on the Natural History of the Crayfish, Annals and Magazine of Natural History, 6:33, 265-267, DOI: [10.1080/00222937008696245](https://doi.org/10.1080/00222937008696245)

To link to this article: <http://dx.doi.org/10.1080/00222937008696245>

Published online: 19 Oct 2009.

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longitudinal vessels, situated near the plane of horizontal symmetry of the intestine, springs a vascular branch, which sometimes bifurcates and opens into the ventral vessel, so that the blood starting from the dorsal vessel is obliged to traverse the whole network before entering the ventral vessel.

These arrangements are partly masked by the hepatic cells in the living animal. They seem to indicate that the intestine of the *Naiades*, which is clothed with vibratile cilia, plays an important part in respiration.

The ventral vessel is prolonged to the posterior extremity of the caudal lobe. There it bifurcates, giving origin to two branches, which run along the margins of the triangular lobe, cutting off at its lateral angles two equilateral triangles. From each of these branches, opposite to each respiratory digitation, springs a branchlet which penetrates to the apex of the digitation, where it is recurved in a loop, and is then connected with the vascular loop of the digitation of the same side. From this two lateral vessels are produced, which unite with the prolongation of the two parent branches to form the dorsal vessel.

Suppressing the special contrivance of the respiratory lobe of *Dero* we arrive at the type of the vascular apparatus of *Nais* proper.—*Comptes Rendus*, June 6, 1870, tome lxx. pp. 1226-1228.

Observations on the Natural History of the Crayfish.

By M. CHANTRAN.

Copulation.—The copulation of the crayfish takes place during a period which includes the months of November, December, and January. The male seizes the female with his large nippers, turns her over, and whilst he holds her lying on her back, places himself in such a manner as to pour out the fecundating material upon the two outer lamellæ of the tail. After this first operation, which lasts some minutes, he conveys her rapidly beneath his abdomen in order to effect a second deposition of semen upon the plastron round the external opening of the oviducts, by means of the curious mechanism so accurately described by M. Coste.

Oviposition.—According to the degree of maturity of the ova at the time of the union of the sexes, oviposition takes place at a period varying from two to forty-five days after copulation. At the moment when this function is about to be performed, the female lies upon her back and brings up her tail upon her plastron, in such a manner as to form with her abdomen a chamber enclosing the aperture of the oviducts, and the wall of which secretes a viscous fluid intended to fasten the eggs to the abdominal appendages during incubation. When things are in this state, the laying of the eggs takes place. It is effected at once, usually during the night, rarely during the day. Incubation lasts about six months; and the hatching takes place in May, June, or July.

Moults.—The first moult takes place ten days after exclusion; the second, third, fourth, and fifth at intervals of from twenty to

twenty-five days; so that the young animal changes its carapace *five times* in from ninety to one hundred days, corresponding to the months of July, August, and September. From the end of this last month until the end of April in the following year there is no change.

The sixth moult takes place in May, the seventh in June, and the eighth in July. There are consequently *eight* moults in the first twelve months of the life of the young crayfish.

In the second year there are five moults:—the first and second in August and September; the third, fourth, and fifth in May, June, and July.

In the third year I have observed only two moults, of which the first takes place in July and the second in September. From this time the young crayfish becomes adult, on entering upon its fourth year.

When the crayfish are adult, moulting takes place only once a year in the females; it occurs, however, twice in the males, which explains why the latter are larger than the females, the growth being in proportion to the number of moults. In the adult males the first moult takes place in June and July, and the second in August or September. The single moult of the females occurs in August or September.

To effect its moult, the animal places itself on its side; with its head and back it raises its carapace, which swings like a lid upon its hinge; then, when it has thus completely disengaged the anterior part of its body, it separates entirely from its old carapace by a sudden movement of the posterior part. This operation, which lasts about ten minutes, is favoured by the previous secretion of a gelatinous material between the two carapaces, which facilitates their disengagement.

Twelve hours after the moult the legs of the crayfish are already sufficiently firm to pinch strongly; twenty-four hours afterwards they are completely hardened. The walls of the back remain longer flexible; but at the end of forty-eight hours they have attained nearly a normal degree of consistency.

The young animals remain attached to the false legs of the mother for ten days after exclusion, when the first moult takes place; this is effected actually under the tail of the mother*. If the young detach themselves before this period, they cannot live separately; but after this first moult they sometimes quit their mother and return to her again, up to the twentieth day, at which period they can live independently.

* *Note by M.C. Robin.*—I have ascertained, by means of the microscope, as shown by M. Chantran to the Academy, that the young remain suspended beneath the abdomen of the mother by means of a hyaline *chitinous* filament, which extends from a point of the inner surface of the egg-shell to the four most internal filaments of each of the lobes of the median membranous lamina of the caudal appendage. This filament exists when the embryos have only attained about three fourths of their development before exclusion.

I am inclined to think that after their first moult the young cray-fish feed, beneath the tail of their mother, upon the pellicles of the eggs and the carapace thrown off in this first moult; but I am waiting for further observations before asserting this positively.—*Comptes Rendus*, July 4, 1870, tome lxxi. pp. 42–45.

The Brachiopoda a Division of Annelida.

By EDWARD S. MORSE.

At a meeting of the Boston Society of Natural History, June 1st, 1870, Mr. Edward S. Morse made a verbal communication on the position of the Brachiopoda in the animal kingdom. He referred to the branch of Mollusca as it was understood forty years ago, when, misled by external characters, many worms, like *Serpula* and *Spirorbis*, and a group of crustaceans, the Cirripedia, were included with mollusks, and remarked that, from a proper recognition of their characters, these diverse forms had been eliminated from time to time, and referred to their proper branches. After long and careful study, Mr. Morse was prepared to state that the Brachiopods were true Articulates, and not Mollusks, and that their proper place was among the worms, forming a group near the tubicolous Annelids.

He stated that for the past year he had been deeply engaged in the study of the Brachiopoda, and more particularly their early stages. Besides material from the coast of New England, he had had, through the kindness of Prof. A. E. Verrill, a large lot of *Discina* from Callao, Peru, belonging to the Yale College Museum. From these he had studied their early stages; but as he had in preparation a memoir upon the subject, he would now confine himself to the considerations that follow.

He first spoke of the structure and composition of the Brachiopod shell, and pointed out the relations between the cæcal prolongations of the mantle in *Terebratula* and a similar structure in the test of Crustacea. He had also noticed a marked resemblance between the polygonal cells in the shell of a young *Discina* and a similar feature in certain lower crustaceans. The scale-like structure of the test of *Idotea* resembled the scale-like structure in *Lingula*. The skin of *Nereis* had similar punctures or dots, as seen in *Terebratula* and also in the peduncle of *Lingula*. He had submitted the shell of *Discina* to chemical tests, and believed it to be chitinous. Gratiolet had already given the chemical analysis of *Lingula anatina*, and found forty-two per cent. of phosphate of lime, and only six per cent. of carbonate of lime. The position of the valves of all Brachiopoda were dorsal and ventral; and this was a strong articulate character, to be compared to the dorsal and ventral plates of the Articulates. The horny setæ that fringe the mantle of Brachiopods was a feature entirely absent in the Mollusca, and peculiar to the worms.

The bristles of worms differ from those of other articulate animals in having sheaths containing muscular fibre, while in other Articulates the hairs were simply tubular prolongations of the epidermal