Annals and Magazine of Natural History: Series 6

Publication details, including instructions for authors and subscription information:
<http://www.tandfonline.com/loi/tnah12>

On sexual dimorphism in the Nautilus

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Published online: 06 Oct 2009.

To cite this article: A. Vayssire (1895) On sexual dimorphism in the Nautilus , Annals and Magazine of Natural History: Series 6, 16:96, 490-493, DOI: [10.1080/00222939508680313](https://doi.org/10.1080/00222939508680313)

To link to this article: <http://dx.doi.org/10.1080/00222939508680313>

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and silvery white on the ventral surface. Towards the end of March it had lost its dark colour and was of a palish olive-yellow, but the red colour, which seems to be connected with the phenomena of reproduction, and which is frequently very vivid in full-grown males about the region of the head and gills, was slightly developed. On the 30th March my fish made a curious small excavation in the sandy bottom of the aquarium, and for the next two days I observed that it went frequently to this nest, apparently for the purpose of sexual deposition. On the 1st April I obtained a further supply of sticklebacks, which were placed in the aquarium on the evening of the same day. These were dark in colour, and presented a marked contrast to the pale yellow of the original tenant. It is needless to say that violent warfare ensued upon the introduction of the strangers. The nest was destroyed almost immediately, and its erstwhile proprietor devoted itself to making savage attacks upon the newcomers. On examining the pale-coloured individual about half an hour later it appeared to me, and to a friend who had throughout followed my observations, that it had assumed a somewhat darker hue, while in two hours it could not be distinguished from the darkest of the later introductions. We had, however, no difficulty in still recognizing the original specimen by certain habits it had acquired during its solitary confinement, and notably by the fact that it would attack the end of the finger or a pencil placed in the water, whereas the new arrivals immediately retreated.

This rapid and complete change of colour struck me as very remarkable, the more so as it seems quite impossible to account for it. No change was made in the quality of the water, nor was there any change in the quality or quantity of light, even for the shortest time, so that the alteration observed seems to be attributable solely to inexplicable sympathetic influence. I am not aware that such a change has heretofore been observed in any animal, and I thought it might be worth recording in your pages.

On Sexual Dimorphism in the Nautilus. By A. VATSIÈRE.

Our knowledge of the external sexual differences of Cephalopods is in many respects still deficient.

As I had the privilege, in 1887, of examining some specimens of *Nautilus macromphalus*, Sow., and this year of studying a certain number of *N. pompilius*, L., I have thought that it would be interesting to point out the external sexual dimorphism that is found to exist in these mollusks.

On examining a certain number of *Nautilus* shells, taking care to place them with their mouths facing us and the outer lips of the latter uppermost, we find that the shape of the mouth of the shell is somewhat variable. The orifice is sometimes ovoido-conical,

sometimes elliptical, no matter which of the two species we are examining.

If we then notice, as I have been able to do, what is the sex of the animal, we observe that all the individuals having the mouths of their shells broad and more or less rounded are males, and that those occupying the shells with ovoido-conical, that is to say laterally compressed, orifices are females.

It is true that between these two forms of orifice a few intermediate ones occur, but they generally approach the rounded shape and belong to young male individuals, or, at least, to those in which the copulatory organ is not very greatly developed. These differences in the shape of the orifice are due to the larger or smaller size of the spadix, which, situated on the right side of the buccal bulb, eventually equals the latter in bulk and requires a somewhat considerable space to contain it, while it even thrusts the bulb a little to the left. The presence of these two organs, placed side by side, thus gives to this portion of the body a breadth almost as great as that of the region situate on the level of the eyes.

In the female nothing of the kind takes place; the tips of all the tentacles can converge towards the same point without any difficulty, and this gives to the whole an elongate conical shape.

The last whorl of the *Nautilus* shell is consequently found to be more swollen in the males, while in the females it is more elliptical and has a slight tendency to be carinate; we may further add that the rim of the shell is a little more undulating in the females than in the males.

The appearance of the hood likewise varies according to the sex; it is necessary, however, to make allowance for the effects produced upon the tissues by the preservative fluids, and especially by the state of extension in which the animal was at the moment of being plunged into these fluids. If the animal was strongly retracted when it was placed in alcohol, its hood, instead of having a regular shape, is more or less twisted upon itself, in which case it is a matter of some difficulty to detect the sexual differences that may be exhibited by this portion of the body.

In the male the hood is broader, and, as Van der Hoeven very justly remarks, its breadth exceeds that of the female hood of equal length by nearly two centimetres; it follows from this condition that the lateral margins of the hood almost entirely conceal the eyes and the tentacles in the males, while in the opposite sex, since the hood is less extended transversely, the eyes, as well as the first pair, or sometimes the first two pairs, of tentacles, are quite uncovered. It may also be mentioned that in the females the margins of the hood are more sinuous and more incurvate at the level of the eyes.

As regards the mantle, which in the male, according to Van der Hoeven, is shorter and leaves the eyes almost uncovered, while according to the same author it extends higher up in the female, this organ did not exhibit these differences in the individuals that I

examined. If in some of these the mantle enveloped the pedal region to a smaller extent, this seemed to me to be entirely due to the bad condition of the visceral mass, which, pressing upon the bottom of the sac, caused the whole to recede from the pallial investment.

In the present note I pass over the sexual characters based upon the number, structure, and position of the tentacles, since it is my intention to deal with them shortly, and also because I would now insist only upon the characters that can be determined almost without the necessity of extracting the specimen from its shell.

These variations in the shape of the last whorl of the shell in *Nautilus macromphalus* and *N. pompilius* naturally lead us to inquire whether these indications could not be utilized in palæontology.

In the course of his investigations upon ammonites d'Orbigny put forward the theory, in 1841, that the variations in the size of the shell in these cephalopods, observed in the same species and among individuals of the same diameter, might be due to sexual differences; in his opinion the more swollen shells should belong to females.

This idea has been adopted by several naturalists, among whom I would mention especially P. Reynès. M. Douvillé likewise appears to entertain the same opinion.

M. Munier-Chalmas, the learned professor of the Sorbonne, while admitting the sexual dimorphism of the ammonites, which he regards as dibranchiate cephalopods allied to *Spirula*, does not entirely adopt d'Orbigny's point of view. To the differences in size he adds the presence in the males of jugal apophyses, which he considers to be wanting in the females. In an important note on "the possibility of admitting a sexual dimorphism in the ammonites," published in December 1892 in the 'Comptes rendus des séances de la Société géologique de France,' he shows that groups of ammonites may be considered as the males of other groups which would be the females (thus *Oecotraustes* would be the male of *Oppelia*, *Normanites* the male of *Cadomites*, &c.).

Without following this geologist into the study of the variations which he points out in a large number of types of Ammonitidæ, I would remark that, according to my observations upon ten specimens of *Nautilus* preserved in spirit, and also according to those made upon a very large number of shells belonging to the two most widely distributed species, *Nautilus pompilius* and *N. macromphalus*, the differences that are found to exist in the dimensions of the shell, although quite appreciable, are never very considerable, and that, as I have already stated, it is the shell of the male that, with an equal diameter, exhibits the larger size, contrary to that which, according to the geologists, is observed in the ammonites.

It would be of some interest to pursue investigations of this kind in the group of fossil Nautilidæ, in order to see whether in the shells of these cephalopods there do not exist variations in size sufficiently

constant in the same species to admit of a comparison with those which I have just described in the shells of the living *Nautilus*.—*Comptes Rendus*, t. cxx. no. 25 (June 24, 1895), pp. 1431-1434.

On the Structure of the Ectoderm and Nervous System in Parasitic Platyhelminthes (Trematodes and Cestodes). By LÉON JAMMES.

The results of my investigations upon the organization and development of Nematelminthes, which I have recently published, contain a detailed study of the ectoderm in these animals. The layer in question is constituted at its first appearance by a continuous epithelium, the superficial growth of which slackens at an early period. Stretchings result from this fact, and consequently a more and more complete dissociation of the entire layer. The cells preserve their epithelial character or become transformed into nerve-elements, fibrils, and granulations. The nerve-elements are differentiated on the spot. The fibrils result from the elongation, accompanied by a special transformation of the epithelial elements; they occupy the spaces left by the non-multiplication or cessation of growth of the cells of the primitive epithelium. The granules are due to the breaking-up of the fibrils. These different elements appear in varying proportions, according as one examines the successive stages of the same individual or of different individuals; they form a single and unique tissue, in which the nerve-elements remain scattered; the latter constitute, by their accumulation at various points of the body, the nervous regions of authors.

These investigations, extended to the Platyhelminthes, have enabled me to determine that the ectoderm of the latter exhibits in its structure numerous points of resemblance to its homologue in the Nematelminthes. We find in both cases epithelial cells, nerve-cells, fibrils, and granulations. Certain authors have described a layer applied to the cuticle; on account of its appearance they have called it *granular*; but by the greater number of them it has been assigned to the mesoderm. This layer really corresponds to the ectoderm, transformed by processes similar to those which I have described in the case of the Nematelminthes.

My investigations have been made upon a Trematode, *Distoma hepaticum*, and upon two Cestodes, *Tænia solium* and *Tænia inermis*. The continuous descriptions of the nervous system of these animals are not such as to enable us to understand its relations to the rest of the ectoderm. Authors have constantly sought to isolate it and to give it definite and precise contours. The regularly increasing complications which they have described in its structure, in proportion as fresh nervous points were recognized, have led us to imagine the existence of a complex framework capable of uniting all the nervous elements distributed in the bodies of these animals. In