THE MOLLUSCS—THEIR SIGNIFICANCE

(*From Après Darwin*)

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The group of molluscs corresponds to the female genital function: vagina, uterus, etc.
The nose, the ears, part of the mouth, etc. . . . are other molluscan features.
Spiral coiling corresponds to the ejection of the polar bodies.

The ovule, the egg or female cell, is primitively characterized by inertia and volume, in contrast to the male cell, the light and agile spermatozoon. The ovule stores up nutritive substances, collects a reserve of material, sometimes even surrounds itself with secretions produced by special glands such as the conchiferous gland. It may be surrounded by a shell or covering as is the case in reptiles and birds.

The same difference which we find between the male and female sexual elements within the organism is also found outside, in the Biological Tree, between the lively worms which may not average more than a few grammes in weight, and the fixed immobile molluscs, surrounded by shells, and weighing up to 200 kilogrammes. This should not cause any surprise since, as we shall show, the group of molluscs corresponds to the female genital function.

Usually deprived of the power of locomotion, these delicate beings shelter their soft and viscous flesh within more or less closed shells of elegant and gracious form: true conches spirally coiled shells, or bivalves, whose beauty, brilliant colouring, and shining mother-of-pearl finish have always attracted the attention of poets, and furnished abundant themes for the exercise of their imagination.

The locomotor organs of molluscs are often atropheid, since these creatures are no longer concerned with moving about; the organs of mastication, of external fecundation, and the sense organs become more or less reduced; the genital glands, on the other hand, undergo considerable development.

Sometimes, amongst gastropod molluscs, there is a well-developed copulatory mechanism, a sharp calcareous projection. Coupling is double: each animal sinks its dart into the tegument of its partner, and leaves it there when the act is accomplished. Some molluscs do not couple, but fertilization takes place within the body. When the penis is introduced into the female pouch, coupling is unilateral, and the individual who plays the part of the male may later take the female role with another partner. Sometimes a whole series of individuals is joined in this way, each one being male to one neighbour and female to another.

We have seen that the transition from worms to molluscs can be schematized by the coiling of the sheath of tubicolar annelids, but it remains to be explained later why the sheath should coil, and why molluscs show this characteristic whorled shape, as most of them do. But first, let us see how the transition from male to female is achieved.

Already in the tapeworm (Taenia) the young segments are entirely male, whilst the older ones have become female. Amongst the hermaphrodite members of the lamellibranchs, the oyster, for example, the male gland always reaches maturity before the female gland; in fact the female arises from the male, just as in the Biological Tree the molluscs arise from the stock of worms. In general, "amongst simultaneous hermaphrodites one of the two glands, most often the testicle, comes to maturity a little before the other",[1] but there are more striking examples of animals which, male when young, become female later. Even though these cases may be rare[9] it is important, in studying the significance of molluscs, to see how this transformation takes place.

An interesting example is furnished by a family of crustaceans, the Cryptonycea. "All the young individuals are males. They still have larval form, live freely, and have not undergone any change from the isopod type. After functioning for a time as males, they attach themselves to a member of the species of crustaceans which serves them as host, where they lose their locomotor appendages, grow much larger, and so alter their external appearance that one would no longer suspect that they had ever been crustaceans."

"Internally, meanwhile, their testicles have atrophied, and ovaries and oviducts have gradually developed. The male has turned into a female, and this is the universal rule for the whole family of Cryptonycea."[2]

An even more convincing example is supplied by the myzostomes, a type close to the annelids, which live as a parasites on the crinoids. In the case of M. pulvinar, "large females are found permanently attached to the host, and upon them, tiny, mobile males. It was therefore thought at first that this species was bisexual, the male being a dwarf. But through observing individuals of appropriate size it became possible to demonstrate that it was *the male himself who eventually became a female*: here again we have successive hermaphroditism, but the testicle has almost completely disappeared when the ovary begins to be distinguishable, and as it is impossible to follow the same individual throughout its existence, the phase where hermaphroditism can be effectively established is very fleeting."[3]

The parallelism between the change from worms to molluscs and that from male to female forms could not be more striking.

When we discussed interiorization and exteriorization in connection with the development of animals and plants, we did not lay down absolute rules. Thus, exteriorization is dominant in the plant; but this does not mean that it exists exclusively. In the root, for example, interiorization is more marked than in the stem. If exteriorization is generally dominant amongst worms, masculinity being, as we have said, an exteriorizing feature, none the less in certain individuals interiorization can be *relatively* more marked, *in comparison with other worms*; such is the case with the females of the group. But, relative to the Biological Tree as a whole, these fine differences fade out; whether male or female, all worms individualize the male genital function. Moreover, this leads us to another question: since molluscs represent the female note, interiorization must be predominant with them.

The easily dissociated body and asexual reproduction which are shown by certain species of worms are exteriorizing features. Now, nothing of the kind is found amongst molluscs, unless it be, in certain octopuses, the detachment of an arm which can be said to play the male role. As the mollusc is completely enveloped by the two lobes of its body which line the valves of the shell, it can be said to be doubly interiorized within that shell.

Another striking peculiarity is the disappearance of metamerism. It is indeed curious to note that metamerism, so marked in worms, disappears completely in the molluscs. This phenomenon, which is due to an extreme degree of fusion of the segments, suffices to show that interiorization is predominant amongst molluscs. It is true that in certain worms segmentation is effaced, but to a less complete degree.

Now that we are beginning to study animals that are better known, it will be sufficient to mention only points of directly significant interest, so that this volume shall not become too large. The reader must remind himself that the same process which has guided us from the beginning continues.

It is always the same theme: animal groups develop their activities in all directions, adapt as well as they can to external influences and to their environment, and this in an independent, egotistical manner. But they are limited in this effort by the function which they unconsciously individualize, that function which dominates them and gives them their shape, their normal differentiation, and even, one may say, their anomalies!

In this "game of patience" which is the Biological Tree, we discover bit by bit the part which each group plays in the whole. Each being not only lives for its own sake and as far as possible isolates itself, but also achieves perfection in its own style. If all the groups mutually complement one another, this does not prevent the medusa, the earthworm, the butterfly, and the bird from each sounding its own perfectly clear note.

Apart from the shell, the mollusc's foot is one of its most characteristic organs. It is used for locomotion. This important feature distinguishes gastropods from tubicolar annelids. The foot upon which the animal proceeds is hollow, a turgescent, erectile organ which, strange to say, contains a cavity large enough, in the lamellibranchs, to hold the viscera forced into it *by a phenomenon of expulsion.* All the arms of the cephalopod together correspond to the foot of other molluscs. The significance of this characteristic organ must now be shown:

The cephalopods, which include octopuses, squids, etc., ... are amongst the most ancient of animals, and their shape recalls to some extent certain of the medusae. Occasionally they have stinging capsules ; if now we add that the movement of these animals may be produced by the backthrust of water violently expelled through the locomotor tube, these reminders can, without establishing a genealogical relationship, help us to apprehend the significance of the animal. In other words, the medusae individualize a hollow muscle, the heart, and the octopuses who resemble them individualize another hollow muscular system.

Their squat, purse-shaped body ends in a mouth endowed with one circular lip, which is generally surrounded by eight or ten long arms. Sometimes these arms which, as we have seen, correspond to the foot of other molluscs, *are joined by a web* of variable length which in some of the octopuses extends to their tips. Add to this the fact that in some species lateral membranes form fins or crests, symmetrical membranous projections which can serve as rudders, and one cannot but be struck by the resemblance which these creatures present to *an enormous uterus with its two tubes.* Indeed, the womb, floating in the depths of the abdomen, upheld by the round ligaments, with its round cervix jutting into the vaginal canal, is rather like an octopus at the bottom of the sea, the more so when the vaginal canal itself is considered as being formed by the complete and total fusion of the arms of the octopus.

The uterus, then, is no more than a hollow muscle like the heart, differentiated and adapted to another use, and this explains to us the resemblance between octopuses and medusae, both of which correspond to hollow muscles: the uterus and the heart.

Taken together, the arms of cephalopods (octopuses) correspond to the foot of other molluscs ; the viscera are expelled into the mollusc's foot as is the foetus into the vagina, the latter being represented by the foot, as by the octopus' web-joined arms. True, no viscera are expelled between the arms of cephalopods, but it must be remembered that these are only one partial aspect of the vagina, whose characteristics are found scattered throughout creation. Locomotion by means of the foot, as found in other molluscs, is produced by means of this expulsive process which recalls that of parturition.

The female argonaut dilates the ends of two of her arms into large racket-shaped projections ; these support a calcareous shell, within which takes place, as in a nest, the incubation of her eggs: an incubation which has not yet been interiorized. The octopus also shows us another interesting type of incubation: when she lays her eggs she does not leave them, but shuts herself up with them in empty bivalve shells.

The octopus has two short cartilaginous stylets on which the muscles take hold. Here it should be noted that the shell of cephalopods has no homology with those of other molluscs. Generally rudimentary, in some species it is altogether absent. In the primitive members of this group, the shells were straight and very large. Perhaps these forms foreshadowed the two marsupial bones. However that may be, even if it is impossible to find among cephalopods the sketch of a marsupial pouch or of a nest, it is none the less equally impossible to deny them the female function of incubation.

Curiously enough, there are cephalopods which detach from themselves a vermiform arm. As many as three or four of these arms, developed into male organs, can be found in the cavity of the female, still possessing a certain amount of vitality. There, Cuvier has taken them for parasitic worms!

Cephalopods, however, can also couple ; this they do mouth to mouth, and it is interesting to note that this coupling amounts to the juxtaposition of two uterine cervices.

Note that the arms of the octopus are covered with suckers which exert a powerful and terrible suction. A remnant of this primitive structure is found in the human vagina whose walls bear transverse ridges and rows of tubercles.

"When the bases of the arms of the octopus are joined by a web, the funnel so formed acts as a swimming organ, as it alternately dilates and contracts." These contractions are found at certain times in the vagina.

Woman has often been called an octopus! this takes on a new meaning now that, biologically, she can be described as an octopus served by organs!

A veritable design for a vulva can be found in certain univalvular shells (Rostellaria, Purpura hæmostoma).

Amongst molluscs in general, "the transition from simple to bivalve shells can be followed. In each valve it is possible to identify the corresponding primary region split posteriorly, according to the plane of symmetry". In the hinge area patterns are sometimes found which, in the species Venus, Lucina, and others, have been called "vulva", "nympha", and "lunala", indicating that the shape of the depression recalls the vestibule of the vulva.

Attached to the tegument of cephalopods are found red, brown, yellow, or blue pigmented organs, the "chromatophores", which by a simple modification can become thermo-sensitive eyes or other complicated mechanisms of unknown significance. Occasionally they can be light-producers.

Be that as it may, all these animals show marked changes of colour under the influence of emotion, and in relation with the visual reflexes. Louis Figuier, in one of his works, states: "Under the influence of strong emotion man's face reddens suddenly, and this is almost a characteristic of humanity (we should add, more particularly of feminine humanity)."

"You change colour, my lord," says the tragedy. The octopus shares this attribute with man. The influence of mind over matter is found in a mollusc, just as it is in the species to which we have the honour to belong. . . . "But the phenomenon goes even further than it does with man. Under the influence of emotion or of passion, man contents himself with blushing; one does not observe his countenance, when dominated by terror, shame, or hope, covering itself with pustules. This is what happens to the octopus. Not only does it change colour, but it covers itself momentarily with little excrescences which make it unrecognizable."

We should not be so dogmatic since, in fact, in man emotion may give rise to urticaria which is sometimes very acute; and again, these pustules do not appear in all the octopuses. Louis Figuier continues: "The argonaut can blush and pale, and through her transparent shell her lovely body can be seen to undergo sudden changes of hue; but there is never a suggestion of those frightful tubercles which can be seen on the octopus, the coarse and boorish tyrant of the waters."

Thus the *modesty* of octopuses and argonauts naturally leads us to consider the upper pole, the head end of man. No great effort is needed to find the molluscan note there. These rows of pearls that poets speak of when they mean teeth are, with their enamel, a faithful reproduction of the mollusc shell, formed by calcification of the epithelial cells. Teeth can be turned into tusks, and these weapons can curl around themselves, so that they become useless, and a nuisance to the animal. It is precisely in this case that they show their origin most clearly.

In the head itself a second migration can be seen. The ruminants have developed horns, replacing the canines and upper incisors. These horns look so like molluscs that authors have given the name of ammonites to certain shells whose shape recalls the horns of the ram, horns which ancient artists depicted around the head and ears of Jupiter-Ammon. Does this not show that they were intuitively aware of the molluscan significance of these organs?

The question of coiling will be discussed later, it can be left on one side for the moment. The shell of the gastropods can be considered as originally having been a conical calcareous tube similar in shape to a tooth or a horn, as is seen in the species Dentalium. Then this tube became coiled into spiral or helical shapes, variously ornamented, so that all that we now see is the summit of the spiral in a conical shell like the Calyptrae for example. An interesting fact is that the pattern of this primary coil can be retraced in the conchae of the nose. The shell, compressed in this way, takes the shape of a horn, or of an animal's claw, which is no more than a very small horn, or else it may flatten, the helix gives way, the aperture becomes enormous, and we have the *auriform shells,* Haliotis, Stomatides, Lamellarides, etc. . . ., some of which resemble more or less the human ear, and hence are caled "sea-ears". "Whilst the former recalled the ears of certain animals, such as the horse or the cat, for instance, the ungulate and comma-shaped varieties bring the resemblance even closer."

Without entering into the very involved details of ears, let us be content with observing that the functions of hearing and of balance are already very complicated in molluscs, such as for instance Pterotrachea. But it must be remembered at the same time that these functions in molluscs are not homologous with our own. In fact the latter (i.e. our own organs) correspond to the fusion and condensation of *entire beings,* which they represent. Already in the internal ear of fishes are to be found a helix and spiral canals. In the development of hearing in bony fishes. invagination may be replaced by a whole process. At first it is a vesicle containing clear fluid. Twenty-four hours after its formation there appears at each of the two extremities a rounded, calcareous corpuscle: "the vesicle itself flattens laterally, and seen from the side its outline *resembles that of a lamellibranch shell* with the hook turned down."[4] In a moment we shall see how this shell, at first complete, becomes reduced, partly disappears, and, so to speak, shortens itself. It must be added that the semicircular canals have at first the shape of two elongated tubercles, terminated by a free extremity.

In describing the middle ear, it is better to start from the molluscs, where the essential features are clearer, less condensed, than in the human organism.

Between the tegument and the shell, as Ed. Perrier has shown, there exists a fold which gives rise to a leep cavity which shelters, amongst other important organs, the gills. In some families, the edge of the fold is extended into a tube, "the siphon", which in the carnivorous species undergoes considerable development.

"In siphonophore gastropods, the aperture of the shell is prolonged into a canal which contains the siphon when the latter remains horizontal (Fusidae), and is bent obliquely or replaced by a simple notch when the siphon takes a vertical position."[5] So it seems that the development of the siphon, which regularizes the flow of water in the branchial chamber where the organs of smell are also located is, bound up, in the carnivorous forms, with the well-known acuity of their olfactory sense.

The edges of the tegument can fold and overlap in such a way that the shell becomes interiorized: then the helix disappears. *In the same way the whole shell can be replaced by simple calcareous granulations,* by little formations of spicules, or even by a sort of cartilaginization of connective tissue which gives its walls a fairly tough consistency (pinna of the ear).

It is principally amongst molluscs (lamellibranchs) which live in holes dug *once for all* in the slime, wood, or stone, that the siphon reaches its greatest development; they can no longer retract completely into the shell, which in some species remains gaping. Membranous folds can form afferent or efferent gutters, and produce veritable tegumentary siphons, in clefts above and below. The unique function of the siphon of Ampullarides is to aspirate air into the gills, without which the animal would have to come out of the water. Sometimes the siphon introduces air and water . . . and here we come to the schema of the midlle ear!

This is, in fact, a bony container prolonged backwards by the mastoid cavities; in front, it communicates with the pharynx through the *Eustachian tube* (the siphon); in its external wall is a large gap closed by the tympanic membrance. Let us add that in the tailless batrachians the middle ear is flush with the skin (they have no external ear), and contains ossicles within it.

If, indeed, the homology with a whole mollusc still remains vague, it becomes clearer when the development of the ear is studied. In fact it can be seen, in man for instance, that the middle ear is at first a thick layer of jetty; the container does not become hollowed out until after the prolongation of the Eustachian canal and the differentiation of the ossicles, *thanks to the atrophy of this jelly.* The space inside the container is thus due to the disappearance of a great number of elements which, not having developed, mask the original character of the organ. This being understood, the homology of the Eustachian tube, with the mollusc's siphon becomes easy: *each carries out much the same function.* The organ is hollowed out in the hardest stone in the body, the petrous or rocky bone, and forms part of it!

The bony foramen which corresponds to the aperture of the shell and is closed by the tympanic membrane is closed in certain gastropods by a calcareous or horny operculum. In Xenophora, this operculum even looks like the human tympanum.

REFERENCES

[1] Caullery, Maurice, *Les problèmes de la sexualite,* p. 44. Flammarion, Paris, 1913.
[2] *Ibid.* Op cit., p. 46.
[3] *Ibid.* Op. cit., 47.
[4] Perrier, Edmond, *Traité de Zoologie,* p. 2620. Masson et Cie, Paris, 1893.
[5] *Ibid.* Op. cit., p. 1964.

(To be continued)

—Brit. Homœo. Jourl., Jan., '60.