

III.—*Remarks on the Homological Position of the Members constituting the THECATED SECTION of the CLASS ROTATORIA.* By CHARLES CUBITT, F.R.M.S.

(Taken as read before the ROYAL MICROSCOPICAL SOCIETY, June 5, 1872.)

PLATES XXIII. and XXIV.

By THECATED I mean all those animals that are invested in a THECA or sheath, which, whether organically attached to the animals or not, forms no part of the general integument of the body which will be denominated the *corium*. These Forms, moreover, are all supported on a *pedicle*, or footstalk, by means of which they attach themselves permanently to some support or basis, either individually or in clusters.

In a somewhat hurried epitome communicated to the 'Monthly Microscopical Journal' in October last, I confined myself to a cursory review of the homologies of two species, the first, a Form that I had inadvertently placed in the Genus Floscularia as Floscularia *coronetta*; and the second, Limnias *annulatus*, a rare species, which I in that communication called Melicerta *annulatus*; and finding that certain objections have been raised to the temerity of associating Melicerta, Limnias, Tubicolaria, and Cœcistes in one Genus; Lacinularia, Megalotrocha, and Conochilus in another Genus; and placing these two Genera in the same FAMILY while constituting a FAMILY for the reception of Stephanoceros and Floscularia; I feel it incumbent on me to extend these remarks somewhat further in support of the views I had so briefly set forth; for having since that date been closely occupied in the collection of materials for a Memoir of the THECATED SECTION of the CLASS ROTATORIA, which I trust, at no distant period to submit to the review of my brother microscopists, I have had ample opportunities for confirming the views I had so briefly set forth; and in this short review it will be necessary to confine my remarks to a consideration of their DERMAL and ALIMENTARY SYSTEMS.

I find myself following the steps of Mr. Gosse, who in the year 1851 published a consistent classification for the CLASS ROTATORIA in the 'Annals and Magazine of Natural History,' in which he subdivided these particular Forms which I define by the term THECATED, precisely as I find them work out on a careful consideration of their anatomical details. Mr. Henry Davis was fully aware of this when he described and so carefully delineated two new species, although he felt dissatisfied with the position in which he provisionally placed them; still, accepting the Ehrenbergian notion, the one which he denominated Cœcistes *intermedius* should have been Limnias *intermedius*.

This SECTION divides itself into two FAMILIES—FLOSCULARIÆ,

containing the two Genera *Stephanoceros* and *Floscularia*; and *MELICERTADÆ*, containing the two Genera *Melicerta* and *Lacinularia*: and to see at a glance where the first FAMILY differs from the second, and where the Genera of each agree in their general organization, the diagrams (Plate XXIII., Figs. 1, 2, 3) are submitted, on each of which a line is drawn from the mouth to the anus; and if we consider this to be the axis of the body, we find in the first FAMILY that both the marginal wreath of setæ, the *trochus* (which I employ also for the ciliated wreath of the second), and the secondary belt of cilia, the *cingulum*, surround the axis, and the anus is placed on the *neural* side, the side on which the ganglion is seated; but in the second FAMILY the trochus subtends the axis, and the cingulum, after traversing the margin of the *corona* (the miscalled *disk*), also surrounds the axis, while the anus is situated on the opposite, the *hæmal* side. The trochus is indicated on the figures by a full black line, and the cingulum by double fine lines.

There is a particular reason for rejecting such inconsistent terms as *dorsal* and *ventral* in this SECTION, for in the FAMILY *FLOSCULARIÆ* they virtually represent the *same* side of the animal. I shall therefore, with the examples of both Huxley and Allman before me, employ *hæmal* and *neural*, on the same grounds that Allman adopts them in his 'Memoir of the Fresh-water Polyzoa,' viz. that "notwithstanding an apparent contradiction in denominating as 'hæmal' any portion of an animal totally deprived of a blood-vascular system, they have the advantage of stating a simple fact."

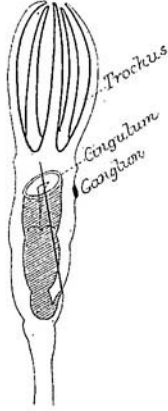
The organization of these two FAMILIES differs conspicuously in their *physique*, and equally so in their DERMAL and ALIMENTARY SYSTEMS; and in selecting an individual from each, for the purpose of eliminating their true relations, I shall employ *Floscularia campanulata* to illustrate the one, and *Melicerta pilula* the other, from the fact that they have recently been recorded as 'New Species of Rotatoria' by Dr. F. Collins;* this last species being a Form with which I have for some years been intimately acquainted, which I had denominated *Melicerta pilula* (long before I committed my observations to print), from the fact that she fortifies the gelatinous basis of the theca with her own *excremental pilules*. This, as a new species, was recorded in a paper communicated to the Quekett Club in the year 1868 by Mr. J. G. Tatem, who at that date admitted that he had no specific title wherewith to denominate it. And Dr. Collins, in describing this, states that "the pellet with which the animal builds its tube is formed in a *kind of sac* situated at the lower extremity of the abdomen, and is discharged through the cloaca." He describes also a new species of *Floscularia*, which he denominates *Floscularia trilobata*, somewhat similar in appear-

* 'Science Gossip,' January, 1872.

FLOSCULARIÆ

MELICERTADÆ

Fig. 1.



Stephanoceros

Fig. 2.



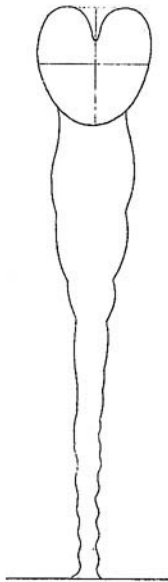
Melicerta

Fig. 3.



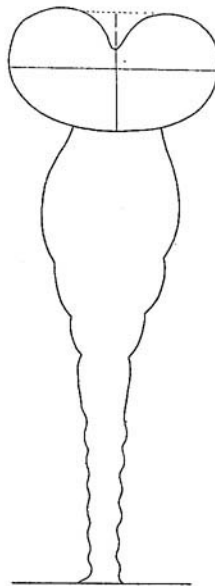
Lacinularia.

Fig. 4.



Lacinularia socialis

Fig. 5.



Lacinularia albo-flavicans

ance to *F. campanulata*. "The dorsal lobe is frequently much longer than the other *two*, and when such is the case it is *commonly* curved forwards over the funnel-shaped mouth, and presents a somewhat hooked appearance: the setæ are also *differently arranged*," *i.e.* from those of *F. campanulata*, "being placed between the lobes as well as on their summits." "The cloaca is situated high in the body;" he shows it at the neck. Let Dr. Collins imagine himself in the same predicament, and he will have a case equally consistent with the laws of animal physiology. The so-called intestine is shown to extend all along the hæmal side of the body, on the side *opposite* to the ganglion; but in every individual of this FAMILY the anus is situated on the *same* side as the ganglion.

DERMAL SYSTEM.

The theca in the first FAMILY (Plate XXIV., Fig. 1) is secreted from a secerning gland situated at the foot, and the integument, after expanding at the base upon its selected habitat, ascends to the neck of the animal, and from thence it returns downwards along the body, forming an *annular* space between the inner and outer integuments, which space is filled with a hyaline fluid similarly with the *ectocyst* of *Lophopus crystallinus* of the Polyzoa. In Floscularia, however, this fluid becomes somewhat turbid in the older animals.

The inner lining forms a *tubular* space commencing at a point somewhat below the anus, thus leaving a free passage for the discharge of the ova and fæces along the body of the animal. The attachment of the theca with the pedicle differs in extent in different individuals. I have had ample opportunities of proving beyond dispute that this organic attachment of the theca is real, having liberated numerous patients from their selected supports without in any degree injuring the theca; and when in this free condition, and left with perfect freedom of motion, these animals made considerable invaginations of the theca with every regression of the body, which under such abnormal conditions were frequently repeated, both at their anterior and posterior regions.

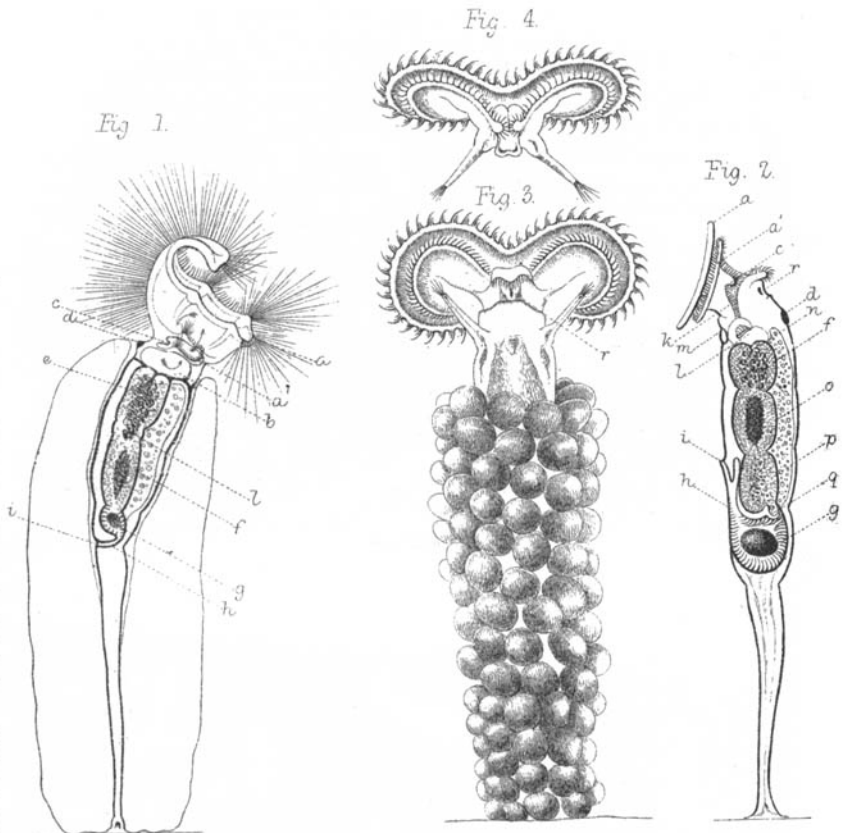
The animals of the Genus Floscularia manifest a predilection for liberating themselves from their investing thecæ, and re-establishing themselves in new ones, a habit which is not practised by *Stephanoceros*. But there is a peculiarity with the theca of *Stephanoceros* that does not obtain to such a definite extent with any of the Floscularia; I refer to the corrugations which occur along the whole length of the theca, and upon the origin of these corrugations much misapprehension has been manifested. They have actually been attributed to the "tube sinking from its own weight"; the absurdity of which is at once apparent when we know that the specific

gravity of the substance of the tube is *less* than that of the water in which, when liberated, they float. These corrugations are due to natural causes, aided by mechanical effects; they are produced by the acts of the animal's regressions, which are very frequently indulged in for periods of some hours' duration, and which are no doubt periods of repose, when beyond the mechanical effect of such a contracted position there is possibly a partial arrest in the secretion of the substance of the theca.

The theca of the FAMILY MELICERTADE, on the other hand, is never organically attached after it is once deposited; the gelatinous basis of which this foundation is formed is secreted by a secerning gland, situated in the anterior region, and in a neural aspect, in close proximity with the ganglion, and it is discharged from an orifice in the centre of the *figurum* (Plate XXIV., Figs. 2, 3, r). This cup-like organ is present in every individual of this FAMILY, and is furnished with cilia in every species that attaches any foreign substance to the theca. It is, however, unciliated in *Melicerta annulatus*, where the theca is free from any extraneous accession except such as become attached parasitically. In *M. pilula* it is also unciliated, for here the animal fortifies the gelatinous basis with her own voided excremental pilules. And in *Lacinularia volvox*, that free roving cluster, it is also unciliated where the theca is always devoid of any foreign accession.

There are two species in which the theca is constructed upon a symmetrical plan, *Melicerta ringens* and *M. annulatus*, and it attains a high degree of perfection in *M. ringens*; and I take this opportunity of recording that it has been my privilege to discover the particular organs by whose functions the mathematical precision with which the pellets are deposited upon the theca is governed. They have their homologue in *M. annulatus*, the only other species that constructs its theca on a symmetrical plan. I refer to the two "hooked spines" situated on the hæmal side of the neck, which are the most conspicuous organs on the emergence of the animal, and these have been erroneously called "lips." I must, however, content myself with stating that, notwithstanding their being situated on the hæmal side, they are employed in governing the mathematical precision with which the pellets are deposited on the opposite side; and in this brief review I confine myself simply to recording the fact. A more detailed description will be given in the 'Memoir' on which I am at present employed.

In the particular instances of *Melicerta ceratophylli*, *M. crystallinus*, and *M. intermedius*, the theca is formed of a consistent shape, and with well-defined walls, leaving a clear space for the motions of the inhabitants, but without any system of parts symmetrically arranged, and with these, the *upper* portions are more densely blended with foreign accessions than the *lower*; while with *M.*



Floscularia Campanulota

Melicerta pibula

REFERENCE.

- | | | |
|--------------|--------------|------------------|
| a. Trochus | f. Stomach | m. Parotid Gland |
| a' Ginglymum | g. Intestine | n. Cardia |
| b. Calix | h. Rectum | c. Liver |
| c. Lingula | i. Anus | p. Pancreas |
| d. Ganglion | k. Pharynx | q. Pylorus |
| e. Cardiacus | l. Maxillæ | r. Figurium |

Najas and *M. longicornis*, the gelatinous basis is deposited in great profusion round about the animal, forming a corpulent mass apparently with no internal integument. But there is evidently some connection with the animal and the internal walls of the theca, for rapid regressions of the animal always produce an inversion of the substance of the theca at the top, but not a coalescence of the material and perfect closing of the top, as Mr. Davis assumes to be the case with *M. longicornis*; and in these two species the lower portions are more densely blended with extraneous matters than the upper. The substance of the theca of *M. Najas* is of a very supple consistency, for it frequently happens that diatomaceæ are involved within it, when they are seen to progress and regress in their usual manner, although with more difficulty. These two species manifest a similitude with the members of the Genus *Lacinularia* in the nature and deposition of the gelatinous basis of the theca.

In the Genus *Lacinularia* I place *Megalotrocha* and *Conochilus*, retaining, however, their specific distinctions for facility of recognition, as *Lacinularia socialis*, *L. albo-flavicans* and *L. volvox*. They all arrange themselves in clusters by an attachment of the foot either to some vegetable substance or otherwise to each other, as in the last instance, *L. volvox*; and notwithstanding the evidence that exists to the contrary, I beg to submit that the theca of *L. albo-flavicans* also becomes blended with foreign particles, similarly with the theca of *L. socialis*, when the animals attain a certain age; it has, as a natural consequence, the ciliated figurum, the same as *L. socialis*; while in *L. volvox*, where there is a total absence of foreign accessions, the figurum is unciliated.

I am fully prepared to find the allegation that I here record of an investing theca in *L. albo-flavicans* disputed, and I can only attribute the misconception that has hitherto prevailed on this matter, to the supposition that when a theca has been detected it has been accepted as *L. socialis*. A little incident that I here relate will confirm such to be possible. In the early part of last season Mr. Thomas Bolton, of Stourbridge, advertised for the benefit of microscopists a supply of *Megalotrocha albo-flavicans*, and being somewhat scarce in the neighbourhoods with which I am most familiar, I wrote for a supply, and was informed that "as they had all invested themselves in a gelatinous sheath, they must be *Lacinularia*." Mr. Bolton subsequently forwarded me a hand-sketch of an individual that he had "measured up and dimensioned on my system," and an inspection of this showed me at once that it was a *bona-fide* *Megalotrocha*, according to Ehrenberg's classification, and not *Lacinularia*, as my friend had been led to assume from the presence of the investing theca.

The points which distinguish the one species from the other are very conspicuous, which a glance at Plate XXIII., Figs. 4 and 5,

will at once make manifest ; for although they both exhibit a palpable bilaterality in the corona, they differ essentially in their respective characters, for we see in *L. socialis* that both axes of the disk are equal, while in *L. albo-flavicans* the horizontal axis is just double that of the vertical. Dujardin denies the propriety of their separation, but Ehrenberg considers the *absence* of a divesting theca, and the attachment of the ova by a filament to the body, to be sufficient grounds for separation. Now the very assumption of the filament attaching the ova to the body is the best evidence we could desire, to show that the group is invested in a gelatinous matrix. The *appearance* of the filament is simply the microscopical rendering of the integument of the theca itself surrounding the ova. Ehrenberg's drawing speaks for itself.

ALIMENTARY SYSTEM.

However dissimilar the organization of the setiferous trochus (*a*) of the one FAMILY may be with the ciliated trochus of the other, they are constituted to perform the same functions in the animal's economy as the first instrument employed in securing and directing prey to the mouth. In *Stephanoceros Eichhornii* and *S. Horatii* the corona is invested in one continuous series of setæ all along the margin of the trochus, but in *Floscularia* the lobes only are furnished with these prehensile organs, with the one exception of *Floscularia campanulata*, where they occur also in one continuous and unbroken series. Plate XXIV., Fig. 1.

In the first FAMILY the alimentary particles, when captured by the trochal setæ, are directed by their intermittent action into the *calix* (*b*), in which the ciliated *cingulum* (*a'*) is situated. I employ the term calix to the funnel that precedes the alimentary canal, not in its botanical significance of the leaf-like organs that surround and support the corolla, as Professor Allman has applied it to the diaphanous membrane surrounding the lower portions of the tentacles of the Polyzoa, but in its more general signification of a *cup*. The cingulum creates a vortex within the calix, in which the particles, alimentary or otherwise, become involved, passing by its influence upwards on the hæmal side, and downwards on the opposite, where they become subjected to the scrutiny of the tongue-like little organ the *lingula* (*c*), that exercises such a marvellous faculty in selecting from the heterogeneous mass those portions which are specially qualified for alimentary purposes, and in rejecting others as refuse ; and situated on the neural side just above the ganglion (*d*), within the calix, its position and functions are identical with the *epistome* of the Polyzoa.

The calix communicates, by means of an cesophagus, with a capacious chamber, the *cardiacus* (*e*), and it is seen that alimentary

matters, whether animal or vegetable, frequently pass through the *maxillæ* (*l*), suffering but little disintegration from their action when they return again and again into this chamber, the walls of which are lined with follicles, that, notwithstanding the position this chamber occupies in relation with the jaws, I assume to be *gastric* follicles, for the *stomach* (*f*) which succeeds it in this FAMILY consists of a single chamber, whose sides are thickened by large turgid cells that secrete the *bile*. The stomach discharges its fæcal contents at once into the *intestine* (*g*), wherein they become formed by the action of its cilia into crude pellets, that are discharged by a short rectum (*h*) to the anus (*i*), and the anus in this FAMILY is situated on the neural side, the same as with the Polyzoa, and is placed at the lowest extremity of the body, and not, as Dr. Collins represents it, on the hæmal side at the *neck* of his pseudo-new species: he has simply mistaken the integument of the ovarium, which *is* placed on the side opposite to that occupied by the anus, and it is frequently found to be devoid of ovarian nuclei. The rectum and anus are always placed on the neural side in this FAMILY, and at the lowest extremity of the body.

In the second FAMILY the ALIMENTARY SYSTEM differs essentially from the other, for the provender which is first brought by the persistent action of the trochal cilia under the influence of the ciliated cingulum, whose action creates two currents that act in opposite directions, the one from the right and the other from the left, by which the heterogeneous mass of particles is conveyed to the *lingula* (*e*), that is here situated on the opposite, the hæmal side, where, by the influence of this organ, the particles so involved are segregated and severally disposed both for alimentary and fabricating purposes; when those selected for aliment pass at once by a ciliated *pharynx* (*k*) to the *maxillæ* (*l*), which organ in this FAMILY is provided with a *parotid gland* (*m*), situated in close proximity therewith, and the *maxillæ* produce a much more complete degree of mastication than that organ in the first FAMILY. In MELICERTADÆ it occupies a bulbous chamber, which is separated from the *stomach* (*f*) by a *cardia* (*n*), and the stomach virtually consists of three chambers, for wherever digestion is concerned, certain ingredients are necessary for its due performance;—gastric, biliary, and pancreatic fluids—which in the vertebrates are secreted from a separate set of organs that communicate with the alimentary canal by ducts; but with the Rotifera the alimentary canal consists of a single channel divided into three compartments, that are each organized to secrete these several fluids, so that in Melicerta the first chamber is the stomach proper (*f*), whose sides are lined with *gastric follicles*, that convert the masticated food into *chyle*; the second (*o*) being the biliary chamber acting in the capacity of a *liver*; and the third (*p*) a *pancreatic*

chamber wherein the *chyle* becomes converted into *chyme*, and from this chamber the digested food passes by means of a contractile *pylorus* (*q*) into the *intestine* (*g*), which is highly ciliated, and wherein the *fæces* become formed, by the rotation of the contained cilia, into well-defined pellets, that are ejected by a muscular contraction of the long *rectum* (*h*) to the anus (*i*), which acts as the common duct for both the *fæces* and the ova; and the monocyst at its junction with the anus is seen to be considerably folded in upon itself. In the particular instance of *M. pilula* the *fæcal pilules* attain a much greater bulk than in any other species, and with such pilules this little Melicertian fortifies the gelatinous basis of the *theca*, which, like every Form, is secreted from the *figurum* (*r*), that in this particular species is unciliated.
