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XLII.—*On a proposed New Order of Gasteropodous Mollusca.* By JOSHUA ALDER and ALBANY HANCOCK.

[With two Plates.]

AT the last meeting of the British Association at Oxford we took the liberty of bringing under the notice of the Natural History Section two or three curious little mollusks, which had recently been found by our friend Mr. W. P. Cocks on the coast near Falmouth. These mollusks belong to a group very little known to British naturalists, but interesting on account of their zoological relations, and the modifications they show in the molluscan type. Want of time prevented our making our communication to the Oxford meeting so full as we could have wished, but having since had the opportunity of making further investigations, particularly with regard to their anatomical characters, we now offer our remarks on this group in a more detailed and somewhat amended form.

The three species which we then described we considered to be new. On showing our drawings to Dr. Johnston, however, he at once recognized our *Chalidis nigricans* to be his *Limapontia nigra*, a species which we had previously not been able to make out. There cannot be a doubt that our little animal belongs to the genus *Chalidis* of Quatrefages; these genera therefore must be synonymous; and as the name of *Limapontia* has precedence, it becomes necessary to adopt it. The description and figure published by Dr. Johnston in Loudon's 'Magazine of Natural History,' taken from a single specimen, did not give the characters so well as could be wished; it will, therefore, we trust not be thought superfluous if we redescribe and figure it on the present occasion, especially as this is the species upon which our anatomical details are founded.

Limapontia nigra, *Johnston.* Pl. XIX. figs. 4, 5, 6. Johnst. in Loud. Mag. Nat. Hist. vol. ix. p. 79.

Body black, or sometimes of a transparent brownish green, rather depressed, the sides slightly overhanging the foot. When in full progression the sides are almost parallel, but more frequently they are a little convex, and when the animal is at rest it becomes nearly circular. *Head* truncated in front and flat at the sides, where it is elevated into two crest-like ridges, arched from behind forwards. *Eyes* large, situated at the posterior extremity of the crests, in a pale circular space, which is prolonged on the crest. *Foot* of a yellowish colour, slightly stained by the viscera; narrower than the body; the sides are parallel, and it tapers gradually to a bluntish point behind; in front it is truncated with the angles rounded. Length $1\frac{1}{2}$ line.

A single specimen was obtained by Dr. Johnston in Berwick Bay; since which it has been found in great abundance by Mr. Cocks at Falmouth, in small pools among the rocks, between half-tide and high-water marks, feeding upon *Conferva glaucescens*. We have also got it in similar situations at Cullercoats, and Mr. Richard Howse has taken it at Whitburn.

The following observations on this species have been communicated to us by Mr. Cocks:—" They are found on *Conferva glaucescens*; they eat its branches and the microscopic larvæ with which the plant is infested. In July 1847 I procured a portion of the Conferva, not more than one inch in length and four-eighths in breadth, containing upwards of twenty patches of spawn; each patch contained from 50 to 150 ova. Stragglers are sometimes met with on the *Conferva albida*; but the spawn, never. I have found them in the shallow pools on the rocks at half-tide in the months of April, May, June, July, August, September, October, and November. In December I visited all my old haunts, but without success: the slugs had migrated, and the Conferva was in a decayed state or dead. In fine warm weather they congregate on the surface of the Conferva, but in dull, cold, or windy weather, they descend towards the lower portion of the plant. They are active, very hardy, and tenacious of life. I have kept them in bottles for a month or six weeks, without changing the water, with apparently very little injury."

They appear to be most plentiful during the months of June and July, at which time we met with them in great abundance at Cullercoats; but on visiting the same spot again in the autumn not a single individual was to be found. It is probable that the old individuals die off during the winter, and the young brood do not come to maturity until the following year. Their remaining so much longer on the Cornish than on the Northumberland coast may be accounted for by the difference of climate, as their position in shallow pools exposes them a good deal to change of temperature. The spawn forms a small pear-shaped, transparent, gelatinous mass (Pl. XIX. fig. 7), with the ova, which are yellow, imbedded in the centre. Some spawn, deposited by an individual, in a vessel of sea-water, on the 3rd or 4th of June, was hatched, and the larvæ swimming about on the 20th of the same month. The larva very much resembles that of the Nudibranchs, as may be seen by a reference to the figure (Pl. XIX. fig. 8), having, in that state, a transparent shell and an operculum, which afterwards disappear. A transparent and nearly colourless variety of *Limapontia nigra* is frequently found at Cullercoats, in which the green biliary organ is seen through the skin, as represented in Pl. XIX. fig. 5.

This species, when bruised, has a peculiar sweetish smell, like that of moist sugar, which appears to be derived from the Conferva it feeds upon.

In Lovén's 'Index Molluscorum Scandinaviæ' this species is made synonymous with *Planaria limacina*, O. Fabricius, and *P. capitata*, Müller. The former we can find no description of, but the *Fasciola capitata* of Müller (Verm. 70) may be either this or a nearly allied species. He describes it however to be spotted with white, which is scarcely a character of *L. nigra**.

ACTEONIA CORRUGATA, n. s. Pl. XIX. figs. 2, 3.

Body limaciform, black, depressed, somewhat bulged at the sides, and covered with regular wrinkles like an *Arion*. On each side of the body there is a slightly elevated ridge, with a few pale tubercular spots. *Head* carinated at the sides; each carina being produced above into a short, flat, ear-like tentacular process, which is whitish. The *eyes* are placed in circular palish spots at the posterior extremity of the ridges. The posterior extremity is obtuse and pale; there is also a palish spot near the centre of the back. *Foot* linear. Length one-eighth of an inch.

Found by Mr. Cocks at Falmouth along with the last, and feeding upon the same Conferva, but rare.

The genus *Acteonia* was formed by M. de Quatrefages for a small mollusk found on the French coast. It comes very near to the last, the chief difference being in the form of the carinated ridges at the sides of the head, which in this are produced into flat, blunt, angular projections making an approach towards tentacles.

* Perhaps *Fasciola capitata* may be the black species of *Pella*, described in the 'Ann. of Nat. Hist.' vol. xviii. p. 289, which agrees with Müller's description in having a ridge along the side, and is also sprinkled with pale spots.

Genus Cenia*.

Animal limaciform; the back elevated; head slightly angulated, and bearing two linear tentacles on the dorsal aspect, behind and exterior to which are the eyes. Anus a little behind the centre of the back.

Cenia Cocksii, n. s. Pl. XIX. fig. 1.

Body robust, considerably elevated on the back; black above, fading into fawn-colour at the sides. *Head* slightly angulated at the sides, and having a black central stripe, the sides of which, as well as the tentacles and the area surrounding the eyes, are yellow or fawn-coloured: on each side of the back, near the region of the anus, is a slight ridge with three or four pale tubercular spots. *Tentacles* of moderate length, cylindrical and linear; the points obtuse. *Eyes* very large. Length three-sixteenths of an inch.

Two or three specimens were found at Falmouth by Mr. Cocks on *Chorda lomentaria* and *Dumontia filiformis*, in pools between tide-marks.

We dedicate this species to its discoverer, whose exertions have added many species to the different departments of the British fauna.

These animals have been placed by M. de Quatrefages in his order *Phlebenterata*, which, it will be recollected, is formed by detaching the *Eolididæ* from the other *Nudibranchiata*, and uniting them with these to form a new order, founded upon the gastric, or, according to that author's views, the gastro-vascular system of organization. This order we have already objected to, both on account of our opinion of the incorrectness of the theory which the name involves, and because it breaks up the order *Nudibranchiata*, which appears to us to be a natural group, well-distinguished by their external characters, and, though somewhat different in their internal anatomy, showing modifications, in that respect, so gradual that it is scarcely possible to draw a line of distinction which would separate them even into families. M. de Quatrefages seems now inclined to give up this group as an order, but thinks it convenient to retain it as a section of the *Nudibranchiata*. We cannot, however, agree in any arrangement that would bring the *Eolididæ* into closer relationship with these little animals than with the other families of the *Nudibranchiata*; nor do we think that these animals can with propriety be referred to

* In our communication to the British Association we proposed the name of *Ictis* for this genus, but having since found that this name is already appropriated to a genus of *Mammalia*, we have now changed it to *Cenia*, an ancient name of the place near which it was found.

an order, so remarkable for the beauty and variety of the branchial appendages with which the species are adorned. The mollusks now under consideration are, on the contrary, distinguished by the extreme simplicity of external form, and by the absence of any specialized breathing organs. It would, therefore, be more in conformity with the views on which the existing orders of *Gasteropoda* were established by Cuvier, to consider this group as forming a separate order, characterized by the absence of specialized branchiæ; and as the function of respiration is entirely performed by the skin, we propose to call this order PELLIBRANCHIATA, and to include in it the following genera:—

Elysia, Risso (*Actæon*, Oken).
Limapontia, Johnston (*Chalidis*, Quatrefages).
Acteonia, Quatrefages.
Cenia, Alder and Hancock.

The *Placobranchus* of Van Hasselt, a genus involved in great obscurity, may possibly belong to this order, as it has a very evident relationship with *Elysia*; but, as it is stated to have lamellated branchiæ, disposed on the back and lateral lobes, we think it more probable that it is an aberrant group of the *Nudibranchiata*, forming a passage to the present order through the genus *Elysia*, the latter being itself a slight departure from the more simple form of the *Pellibranchiata*.

On the other hand, this order is nearly allied to the *Inferobranchiata* through a small mollusk which we have already described in the 'Annals of Natural History*,' having very much the form and appearance of the *Pellibranchiata*, but possessing external plumose branchiæ, under the right side of the cloak, as in the former order, to which it must consequently be referred. This animal we take to belong to the genus *Pelta* of Quatrefages, though the characters he assigns to that genus differ in many respects from those we find in our species.

In consequence of the extreme degradation from the molluscan type that M. de Quatrefages has stated to exist in these little animals, they have become objects of much interest in a physiological point of view, and we therefore consider ourselves fortunate in having the opportunity of examining two or three of the genera, and especially in having got one of these in such great abundance, as, notwithstanding its minuteness, to enable us to make out its anatomy very satisfactorily. The anatomy of this species (*Limapontia nigra*) we now purpose giving in detail, and from the slight examination we have been able to make of the other two genera, species of which we have described, we believe it may be taken as a fair example of the anatomical characters of the order;

* Vol. xviii. p. 289.

and as the species subjected to dissection is one of the most simple forms of the group, it is consequently likely to show any departure from the molluscan type in the greatest degree. It will be seen, however, that no such extreme degradation as that supposed to exist by M. de Quatrefages, is to be found in our little mollusk, whose organization, though showing some interesting modifications, agrees upon the whole with that of the other Gasteropods.

Anatomy, by ALBANY HANCOCK.

In describing the anatomy of these animals we shall confine ourselves almost entirely to that of *Limapontia nigra,* as of it alone have we possessed a sufficient number to warrant our entering at all into details on the subject. We would premise, however, that on account of the extreme minuteness of this species, we have been compelled to use the compressor, and to rely on this mode of investigation to a considerable extent. Being fully aware of the danger arising from examinations conducted solely by the aid of transmitted light, especially on animals so highly organized as the *Pellibranchiata,* we have taken every precaution to avoid error; and having had an exhaustless supply of specimens, we have verified most of the points over and over again. To prevent the confusion arising from the multiplicity of parts, we soon found it necessary to separate the viscera, and it was not until we succeeded in doing this that we made out the generative system, which is of vast complication in this animal. The digestive apparatus is much simpler, and may be almost entirely determined without the aid of the compressor. We observed nearly the whole of this portion of the anatomy in an individual whose skin was rendered transparent by removing the epidermis and pigment cells: the œsophagus and intestine, being filled at the time with matter, rendering these parts opake, were seen very distinctly; the two lateral branched vessels forming the biliary organ were also observed in connexion with the sides of the stomach.

We have said thus much on the mode of investigation, that the authenticity of the following details may be duly estimated.

The Digestive System opens on the inferior surface of the head, where a small puckered orifice indicates the entrance to a short channel, which leads to a muscular buccal mass (Pl. XX. fig. 1 *a*). This is circular when viewed from above, but, when seen in profile, is irregularly quadrate, with a projection in front from the inferior angle. We could not distinguish the least appearance of corneous jaws. The tongue (*b*) however is very easily seen: it is a prehensile organ, and appears to be placed in the cavity of the mouth as in the *Eolididæ*; that is, it is bent fr m behind forwards and supported in the centre of the cavity on a fleshy arch. When seen in the compressor, it is always doubled near the middle, as may be observed in *Eolis* under the same circumstances. It is composed of ten or twelve plates or joints, each bearing a large crystalline spine, or rather process, apparently of a flattened or scoop-like form. These spines or processes are directed backwards to the œsophagus. In connexion with the anterior, or outer extremity of this prehensile organ, is placed what might be taken for an oval sac (figs. 1 *c* and 2 *a*), containing spines, much resembling those of the tongue, but smaller. Professor Allman has pointed out in *Actæon* an appendage of the same kind, and supposes it to be a vesicle for the purpose of generating the spines of the tongue. In two or three species of the *Polycerinæ*, as well as in some species of *Doris*, we have observed a similar organ, and have ascertained that in these species it is not a vesicle but a portion of the channel of the mouth, immediately in advance of the tongue, having the interior lined with rows of minute spines, forming, in fact, a prehensile collar, which on being everted forms a circle of curved spines, directed inwards, so as to lay hold of the food and carry it backwards to the tongue, which immediately conveys it to the œsophagus. In *Actæon* and *Limapontia* there can be little doubt that this sac-like appendage is an organ for the same purpose, though, on account of the minuteness of the species we have examined, we should have found much difficulty respecting it but for the homology above alluded to. Be this, however, as it may; judging from analogy, this sac-like appendage cannot be for the purpose assigned to it by Professor Allman, for the spines of the tongue are generated at the opposite extremity, as any one may convince himself by viewing the tongue of *Purpura* or *Buccinum*, when the spines will be observed at the *inner* extremity in a state of growth, apparently soft and not perfectly formed.

Immediately in front of the buccal mass, and probably connected with the channel of the mouth, is a folliculated organ (fig. 1 *d*), which, perhaps, from its position and character, may be considered a salivary gland.

The œsophagus (*e*) is a long, slender tube, passing from the posterior part of the buccal mass near the inner termination of the tongue, and ending about the centre of the body, where it dilates gradually into a stomach of no great size (*f*); but whose entire configuration we could not determine, having only seen its anterior portion, the rest being overlapped by the opake granular substance of the hepatic organ.

The intestine (*h*) is short and slender: it arises from the left side of the upper surface of the stomach, and, taking a sweep backwards and towards the right side, ends in the anus (*i*), which is median, and a little behind the centre of the body.

At first we could scarcely determine the position of this organ, though we had traced the intestine almost to its termination; and, notwithstanding that there is at this part of the back a swelling indicating its presence, yet there is no prominent nipple, and it is very difficult to see the opening. The position of the anus however was made manifest by our observing excrementitious matter passing out of it, and its situation cannot therefore be doubted. We succeeded in gaining further proof of the position of this excretory orifice by using the compressor, so as to force the contents of the intestine through it. This was attained by placing the animal in the instrument with its dorsal ridge exactly in profile, and then adjusting the pressure, with great care, to avoid rupture. In this way we, more than once, forced out the contents of the intestine.

Along each side of the back immediately below the skin, and distinct from it, is a wide, somewhat folliculated, and branched vessel (*g*, *g*, *g*, *g*), having the interior lined with a layer, more or less thick, of dark green granules. These vessels are joined to the sides of the upper surface of the stomach, which is nearly covered with the granular substance. In these vessels we think we perceive the true homologue of the liver of the more typical mollusks; and in proof of this opinion we would refer to the nature of their contents, which, as just stated, are green and granular. When these granules are highly magnified, each is found to be an aggregation of very minute corpuscules within a delicate membranous vesicle, having much the character of the microscopic structure of the glands of the papillæ of *Eolis*.

In *Cenia* and *Acteonia* the digestive system would appear to be similar to that of *Limapontia*; both are furnished with a muscular buccal mass without jaws, but having a lingual apparatus formed as in *Limapontia*; the hepatic organ has the same disposition as in that genus; and the anal aperture in both is indicated by a slight swelling on the median line near the centre of the back, though we have not determined its position in these two genera with the same precision as in *Limapontia*.

This account of the alimentary system is very different from that given by M. de Quatrefages in the description of his *Chalidis cærulea*. The anus and intestine he has altogether overlooked, and the two lateral hepatic vessels he has called the stomach, that organ having likewise escaped his observation: there can be no doubt, however, that *C. cærulea* is as highly organized as *L. nigra*.

The Generative System lies immediately beneath the organs of digestion, and is highly complicated and of great extent, filling by far the largest portion of the body. Each individual possesses both male and female organs, as well as the additional apparatus of a spermatheca, as observed in the Nudibranchs. The external orifices are placed on the right side of the body and are three in number; two immediately below the eye, and one nearly half-way along the body. Of the two anterior orifices, the one in front is that of the male intromittent organ (Pl. XX. fig. 4 *a*), and the other, which is close behind it, is that for the passage of the ova (*l*); the third orifice (*m*) is in communication with the spermatheca, and is that by which impregnation is effected. Of the position and nature of these orifices there can be no doubt, for we have had frequent opportunities of observing the animals during *coitus*, and have also seen them when spawning. The male intromittent organ lies doubled upon itself immediately within the orifice, and when partially exserted (fig. 4 *a*) is of a subconic form, but is capable of much elongation and attenuation. The point (figs. 4 *b* & 5 *b*) is furnished with a minute curved crystalline spur-like process, which is perforated (fig. 6 *a*). The base of this process is united to a tube (figs. 4 *c* & 5 *c*), which, passing through the axis of the penis, runs a short way backwards and is joined by the oviduct at *j*, immediately after it is united to the duct of the testis at *g*, and then terminates in an elliptical bulb (*p*) at the end of the copulatory passage, just where it receives the duct of the spermatheca (*r*). Near to the point where the oviduct joins this tube, it is attached to what occasionally assumes the appearance, in the compressor, of two elongated glands (*m*) with undulated walls, but which is very possibly a portion of the large mucous gland belonging to the female parts, afterwards to be more fully described. In tracing the male organs backwards, it is seen that the duct of the testis, after its union with the tube of the penis, runs for a short way parallel to the copulatory channel, as will be by and by more particularly mentioned; and after communicating with it at *f*, soon reaches the median line of the body, about midway between the head and the tail. The duct of the testis then suddenly dilates, and, almost directly afterwards, divides into two branches, one going to each side of the body (*d d*); here these branches again divide into two nearly equal portions, one of which goes towards the head, the other towards the tail; these portions divide and subdivide two or three times, the extremities ending in blind sacs. This multiple organ, there can be no doubt, is the testis, though we have no direct evidence in proof of this. Its anatomical relationship, however, appears sufficient to warrant this opinion.

The ovarium (*h' h h*), like the testis, is also divided into two parts; one, much the larger (*h h*), occupies the posterior portion of the body; the other (h') lies on the left side immediately behind the buccal mass, and extends backwards as far as the middle of the body. This organ is composed of large globular vesicles of a yellow colour, six of which make up the posterior, and four the anterior portion. The ova are generated in the interior of these vesicles, which are united by short ducts into pairs; each pair having a single channel of communication with the central duct. Thus it would appear that the ovary as well as the testis has a dichotomous arrangement. The channels of the two portions of the ovary are united near the median line of the body, a little in front and to the left of the union of the two divisions of the testis; and almost immediately after their junction, the common oviduct, passing towards the right side, is suddenly enlarged and doubled once or twice upon itself (i); it is then as suddenly constricted, and shortly afterwards reaches the tube of the penis at j, just in advance of its union with the testis, as before stated. At this point the tube of the penis is attached to the upper surface of a large pellucid gland (k), which lies along the right side of the body, extending from the base of the penis to the orifice leading to the spermatheca. The colour and general appearance of this organ resembles that of the mucous gland of *Eolis*, and like it, no doubt, secretes the transparent jelly-like envelope that covers the eggs. This gland is of an irregular form, but neither its shape nor general structure could be determined with precision, on account of the distortion produced by the compressor. The opake granular portion associated with this gland in *Eolis* would appear to be wanting, unless the two glandular-like organs (m), before noticed in connexion with the tube of the penis, are the homologues of this part, which we are rather inclined to think is the fact.

The mucous gland terminates in front in a widish channel which opens externally (l) immediately behind the base of the penis. It is through this opening that the spawn, as before stated, issues from the body; but we have not been able to ascertain how the eggs reach this channel: most probably the oviduct, shortly after its junction with the tube of the penis, sinks down into the channel of this gland; and thus, as in *Eolis*, the passage for the eggs is accomplished. Whether this be the mode of communication or not, it is certain that the eggs find their way into the channel and anterior portion of the mucous gland, for we have had ocular proof of the fact. On one occasion, observing an individual spawning, we placed it in the compressor, and detected numerous ova, as described, in the anterior portion of the gland and also in the channel: a little more pressure forced them out at the orifice.

The spermatheca (q) is an oval sac of considerable size and of a brownish yellow colour. It lies a little behind the buccal mass, near the median line of the body. From its right side issues a small duct (*r*), which, turning backwards, communicates with the bulb (*p*), or dilated portion of the copulatory passage, at the point where it receives the tube of the penis. From thence the copulatory passage or channel (*o*) leads backwards, and for a short way runs parallel to the duct of the testis, to which it is closely adherent; it soon contracts and turns to the right side. At the point where the contraction takes place it communicates at *f* with the duct of the testis; afterwards the walls of the channel continue parallel until it approaches the external orifice, when it suddenly expands into a sort of shallow pouch (*n*). During copulation, the intromittent organ, entering at this orifice, will pass along the channel just described, probably as far as the bulb, or dilated portion, in connexion with the short duct of the spermatheca; from thence the seminal fluid will readily reach that vesicle, to be there retained until required for the fertilization of the ova. How this takes place will be seen if we trace the eggs from the ovary to the external outlet.

The eggs pass from the ovigerous sacs by the small ducts before described, and, reaching the central duct, find their way at once into the dilated portion (*i*) of the common oviduct; and there, probably, are advanced another step towards maturity: they then pass along the constricted part of the oviduct, and reach the tube of the penis near its junction with the bulb of the copulatory passage, when they will be within the influence of the fluid stored up in the spermatheca, and also of that of the testis of the same individual. The bulb (*p*), or dilated portion of the channel leading to the spermatheca, may be probably a sort of reservoir for the retention of the fertilizing fluid secreted by the testis of the same individual. If so, this fluid may be supposed to pass from the duct of the testis at the point (*f*) where it communicates with the swelled portion of the channel, and it may be here that the eggs are fertilized. During coitus the seminal fluid will pass directly onwards through the duct of the testis to the tube of the penis. And thus, perhaps, we arrive at a correct understanding of the function of those two points of union. The eggs, after being thus fertilized, pass downwards into the channel of the great mucous gland (*k*), and then become enveloped in their final covering previous to expulsion through the opening (*l*) at the base of the penis.

It would appear, from the diagram of *Chalidis cærulea* given by M. de Quatrefages, that he has confounded the ovary with the testicle, and that which is called the testicle is probably a portion of the great mucous gland. The salivary gland has the appearance of the spermatheca. Further than this, these organs seem to have escaped observation.

In *Cenia* and *Acteonia* we have not been able to investigate the reproductive organs; they both, however, have the intromittent organ provided with a curved crystalline spur-like point.

The generative system of *Actæon* (*Elysia*), as given by Professor Allman, appears to have a considerable resemblance to that of *Limapontia*. We think we can recognise the same parts, though Professor Allman differs from us in assigning to them their various functions. To arrive at a just conclusion on this difficult subject, it is necessary, in the first place, to ascertain the position of the external orifices, and their connexion with the several parts of these complicated organs. Unfortunately in *Actæon* these points could not be determined. In *Limapontia*, on the contrary, we have had the good fortune to succeed in making them out with sufficient certainty; consequently we have been able to speak with more confidence than we should have otherwise done. The large irregularly-formed organ in *Actæon*, which is designated *testis*, is undoubtedly the same that we consider the mucous gland. The opening of the gland externally, and the detection of eggs in the anterior portion of it and in its channel, are sufficient to prove that this cannot be the male secreting organ. If then this be the mucous gland in *Actæon*, the testis must be sought for elsewhere. It seems to have escaped notice. The vas deferens, however, has been traced backwards until it bifurcates near the median line of the body in the same way as it does in *Limapontia*. Here, therefore, judging from analogy, the testis begins; and it will probably be found occupying a position in the neighbourhood of the ovary. The oval pouch (y) is most likely the homologue of the dilated portion of the common oviduct, and the small tube that passes from it backwards, dividing dichotomously, will prove, very probably, to lead from the ovarium. The oval body (x), we would surmise, corresponds with the dilated portion of the copulatory channel at the base of the spermatheca; like it, it is in communication with the vas deferens, or testis, and with the oviduct; and, if this conjecture be correct, it will also communicate with the oval sac which we take to be the spermatheca: it will likewise have an external outlet.

From the description we have given of the reproductive system of *Limapontia*, it is evident that it does not differ in any material degree from what has been observed in the Nudibranchs.

The ovary and testis are certainly considerably modified, and are differently arranged in the body; their ducts, however, and the duct from the spermatheca, as in *Eolis*, are all brought together on the superior wall near to the channel of the great mucous gland, and then communicate with each other. Hence the inference that the eggs may possibly receive the fertilizing influence of two individuals, as we suppose to be the case with the Nudibranchs. The most interesting modification of these organs is in the position of the external orifices. In *Eolis* all these three are placed close together within a common opening: in *Limapontia*, as before described, the orifice leading to the spermatheca is removed to a considerable distance from the other two. The nature of these orifices becomes therefore better understood. From this arrangement we have been enabled to determine beyond a doubt, that the channel leading to the spermatheca is really the copulatory channel, and that the orifice at the base of the penis is that through which the eggs pass; and thus the anatomy of this animal becomes confirmatory of our views, elsewhere expressed, of these parts in *Eolis*.

Vascular and Respiratory Systems.—From the minuteness of the species on which our observations were made, we have not been able to trace the former system to any great extent. The heart, however, we have determined with sufficient precision: it is composed of two distinct chambers,—a ventricle and an auricle. These may be seen by placing the animal sideways in the compressor. We succeeded in this way, after having made several fruitless attempts in the usual manner, of depressing the animal with the back uppermost. In the more transparent individuals the heart may be observed beating near the middle of the back, within an indistinct, irregular, oval swelling, without the aid of the compressor; but the best way of ascertaining its parts is that, above-mentioned, of compressing the animal sideways, and thus obtaining a profile view of the heart. In this position the two chambers are rendered quite obvious. They lie immediately below the skin, within a clear space, which perhaps indicates the extent of a pericardium. The ventricle is placed in advance of the auricle, and is pyriform, with the apex in front; the auricle is a little larger than the ventricle, and is separated from it by a very marked constriction: its form resembles that of the ventricle, but is a little narrower and has the attenuated end posterior; this end terminates in a well-defined vascular trunk, which appears in close contact with the skin. By adjusting the pressure so that, when the parts are rendered sufficiently transparent, the heart is permitted to swell and contract, the blood may be seen passing along the aorta, which issues from the anterior apex of the ventricle. In this way we could trace the aorta as far as the buccal mass, where it bifurcates. On leaving the ventricle it dips a little downwards, and then advances towards its destination.

Further than this we have not been able to make out the vascular system.

When subjected to the pressure of the instrument, the pulsations of the heart are very slow, but when the animal is at liberty it beats with great rapidity,—probably ninety times or even more per minute. We could not ascertain the number exactly on account of the restlessness of the little creature, and the impossibility of seeing the pulsations excepting in some particular lights.

M. de Quatrefages describes his *Chalidis cærulea* to be without a heart or any traces of a vascular system. We have seen that *Limapontia nigra* possesses not only a well-formed bipartite heart, but that it has also an arterial system, and from the sudden contraction of the auricle behind it, it is evident that the venous system is not altogether deficient, or that portion of it, at least, which M. Milne-Edwards calls branchio-cardiac. The deductions of M. de Quatrefages therefore, in this instance, cannot be sustained.

Respiration appears to be performed by the whole surface of the body, as it is entirely clothed with vibratile cilia, not even excepting the under surface of the foot*. The cilia are large and vigorous, and their action may be detected under favourable circumstances with a powerful single lens.

Nervous System and the Senses.—We have not paid sufficient attention to this part of the subject to enable us to give a detailed account of its anatomy. The cerebral ganglia were consequently not fully determined: they are placed as usual round the commencement of the œsophagus, and are four or more in number. The central or upper pair are somewhat pyriform, and are placed further apart than usual: they are connected by a stout commissure. The lateral pair are rather smaller than the central ones, and are of an elliptical form: they appear to be united below the œsophagus by a short collar and two small oval buccal ganglia; but these were not determined with sufficient certainty. Nerves pass from these central ganglia to all parts of the body.

The optic nerve is of considerable length, and springs from the outer margin of the central ganglion, where it joins with the lateral one. This nerve enters the base of the black pigment cup of the eye, which is large and pretty regularly formed. Half-buried within the mouth of this cup is a spherical crystalline lens, which is protected in front by a cornea, that passes close in advance of it: the whole is enveloped in a thin membranous sac.

* *Limapontia* is not, by any means, the only slug that has the under surface of the foot ciliated. We have detected these minute organs on the same part in the Nudibranchs, and in *Purpura*, *Littorina* and *Patella*. It is therefore probable that all the Gasteropods have cilia on the crawling disc.

The auditory capsule contains a single spherical otolithe, and is attached to the central ganglion at the root of the optic nerve.

In *Acteonia corrugata* the auditory capsule is also furnished with a single otolithe.

EXPLANATION OF PLATES XIX. AND XX.

PLATE XIX.

Fig. 1. *Cenia Cocksii*, much enlarged.
— 2. *Acteonia corrugata.*
— 3. Side view of the head of the same.
— 4, 5, 6. Different views of *Limapontia nigra.*
— 7. Spawn of the same magnified.
— 8. Larva of the same.
— 9. A portion of one of the lateral hepatic trunks of *Cenia Cocksii*, showing its granular appearance.
— 10. A few of the granules more highly magnified, exhibiting their minute structure.

PLATE XX.

Fig. 1. General view of the digestive system of *Limapontia nigra* : *a*, buccal mass ; *b*, tongue ; *c*, prehensile collar in advance of the same ; *d*, salivary gland ; *e*, œsophagus ; *f*, stomach ; *g g g g*, lateral hepatic trunks ; *h*, intestine ; *i*, anus ; *j*, cerebral ganglions.
— 2. Tongue removed from the buccal mass : *a*, prehensile collar.
— 3. Two joints or plates of the tongue more highly magnified.
— 4. General view of the reproductive system : *a*, penis ; *b*, crystalline point of the same ; *c*, tube of the penis ; *d d*, testis ; *e*, duct of the same ; *f*, junction of the duct of the testis with the bulb of the copulatory channel ; *g*, junction of the duct of the testis with the tube of the penis ; *h h h*, ovigerous sacs containing ova ; *i*, dilated portion of the oviduct ; *j*, junction of the oviduct with the tube of the penis ; *k*, mucous gland ; *l*, external orifice leading to the same, and through which the eggs pass ; *m*, two elongated glands probably connected with the mucous gland ; *n*, shallow pouch at the external orifice leading to the spermatheca ; *o*, copulatory channel ; *p*, bulb of the same ; *q*, spermatheca ; *r*, duct of the same.
— 5. Intromittent organ of *Limapontia nigra* : *a*, penis ; *b*, crystalline point ; *c*, tube.
— 6. Crystalline point (much magnified) of the penis of *Cenia Cocksii*, exhibiting the perforation at the extremity *a*.
— 7. Profile view of the heart of *Limapontia nigra* : *a*, ventricle ; *b*, auricle ; *c*, aorta ; *d*, venous trunk leading to the auricle ; *e*, dorsal skin ; *f f*, clear space, probably showing the limits of a pericardium.
— 8. Cerebral ganglions of *L. nigra*, with nerves : *a a*, central ganglions ; *b*, commissure uniting the same above the œsophagus ; *c c*, lateral ganglia ; *d*, buccal ganglia ; *e e*, eyes ; *f f*, auditory capsules.
— 9. Auditory capsule, with otolithe, more highly magnified.
— 10. Eye greatly magnified, exhibiting the nerve, pigment cup, lens, cornea, and general capsule.