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"................... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylio succo."
N. Parthenii Gianettasii Ecl. 1.

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I.—*On the Structure of the Mouth in Sucking Crustacea.* By Prof. J. C. Schiödte*.

[Plate I.]

Part I. Cymothoæ.

1. The peculiar arrangement of the mouth in sucking Condylopoda being the result of a more or less complete fusion and metamorphosis of the organs that compose the mouth in those which bite their food, we may regard the interpretation of the elements of the sucking-apparatus as affording the severest test of our knowledge of the principles which govern the structure of the mouth in Articulata generally. The demands which this difficult task makes upon our knowledge are so great that, in undertaking it, one cannot be long before discovering how little is gained in physiology, morphology, or natural systematic arrangement by even a very accurate knowledge of the structure of the various organs of the mouth in masticating Condylopoda alone. An analysis of these organs, which aims at nothing more than such a knowledge, may supply material for artificial classification; but a truly scientific solution of the problem before us requires more, viz., on the one hand, a true estimate of the mode of coopera-

* Translated from 'Naturhistorisk Tidsskrift,' series 3. vol. iv. Copenhagen, 1866, with two plates, from which the outlines on Pl. I. are copied.

tion of the organs of the mouth in masticating Condylopoda, founded on careful consideration of their anatomic connexion with one another, and, on the other hand, a definition of the morphological equivalents of all the different parts which shall prove its own correctness by its self-consistency. With less preparation than this it would be useless to attempt an interpretation of the structure of the mouth in sucking Condylopoda.

It is one of the imperishable merits of Savigny that he has solved this problem in all essential points with regard to Insects; but with regard to Crustacea almost everything still remains to be done. In this class the investigation becomes complicated by the circumstance that the body is more or less united with the head, so that a varying number of its foremost pairs of limbs may be assimilated to the organs of the mouth in point of form and use. It will therefore be advantageous to begin our investigation with the order of Isopoda. On the one hand, this order occupies one of the highest steps to which the class of Crustacea upon the whole attains in the scale of development of the articulate type, whereby the comparison with the mouth of insects is much facilitated; whilst, on the other hand, it descends so low as to contain numerous parasitic species, and, therefore, is more likely than any other order to supply the key for the interpretation of the mouth in sucking Copepoda. How far this latter expectation will prove true cannot be shown more explicitly in this first paper; but the initiated will no doubt at once discern the application of the present analysis to lower forms.

2. Although it is sufficiently well known that at least some Cymothoæ live upon liquid food, and although Rondelet, more than three centuries ago, has said, concerning one of these parasites, that it sucks like a leech*, the question of the structure of their sucking-apparatus is nevertheless, in a scientific point of view, entirely virgin soil. It is true that Bosc believed that he observed in a *Cymothoa* a retractile sucker with a pair of small palpi†; but Latreille declares that he could not find any such organ, and that he should consider it an anomaly in that

* "Piscibus ita hæret, ut eripi non possit, sugit ut hirudo, nec prius abscedit, quam tabidum et exsuccum piscem reddiderit, reperitur cervici mugilum, luporum, et saxatilium piscium affixus." (Libr. de Pisc. mar. Lugd. 1554, p. 576, "De Pediculo marino.") The woodcut at the head of Rondelet's article on *Pediculus marinus* represents an *Anilocra*, and approaches nearest to *A. mediterranea*, Leach.

† Hist. Nat. des Crust. in Déterville's small edition of Buffon, ii. p. 208. The figure shows that the species on which Bosc has founded his description of the genus was a *Cymothoa* sens. strict.; Brünnich's "Fiskebjörn" (Entom. fig. 5), which he quotes, was more probably an *Anilocra*.

class of animals if it existed, and he suggests that perhaps the jaws protrude during the suction in such a manner that they may have been taken for a sucker*. Milne-Edwards has not entered on the question, but merely given some figures of the different parts of the mouth separately in *Æga*, and a more comprehensive series of illustrations of the mouth of *Cymothoa*†, some of which represent the parts in their natural connexion; all these figures are useful and good as far as they go, but they do not go far enough. We might expect to find more detailed information in Heinrich Rathke's anatomical essay on *Æga bicarinata*; but he says that the organs of the mouth are adapted for gnawing, and upon the whole constructed as in *Idothea*. He adds, however, that the terminal part of the mandibles is very hard, almost cuneiform, and strongly bent downwards, and, further, that the orifice of the mouth is remarkably small in proportion to the size of the animal. These two last statements, which are quite correct in themselves, do not seem easily reconcilable with the first, viz. that the mouth is adapted for gnawing, particularly as Rathke just before says that the mandibles adhere to the head to such an extent that their downward bent extremity cannot be capable of much movement‡. We shall nevertheless see, by-and-by, that each of the authors named, Bosc, Latreille, and Rathke, may be said to be right, to a certain extent.

With regard to the structure of the mouth in masticating Isopoda, we possess more ample information; and the descriptions and illustrations hitherto published, more especially those contained in Milne-Edwards's excellent works, suffice to give a tolerably complete idea of it. If, however, this information is to serve us as a safe guide to the interpretation of the sucking-apparatus of *Cymothoa* and its related genera, it will nevertheless be expedient to reconsider the subject once more, and to place before ourselves a succinct analysis of the principal types which may be observed in the structure of the mouth in masticating Isopoda. We shall preface this analysis with a few observations of a more general bearing.

3. The limbs of Articulata are, in their origin, mere hollow cylindrical prolongations of the skin, which are converted into levers by the deposition of as many and as extensive layers of chitine as the muscles of the animal require for their support, and divided into as many separate pieces as the mode of locomotion requires joints.

* Hist. Nat. des Crust. et des Ins. vii. p. 22.

† Le Règne Animal (éd. accomp. de pls.), pl. 65–67.

‡ Nov. Act. Acad. Cæs. Leop.-Carol. Natur. Curiosor. t. xx. pt. 1, 1843, pp. 26 & 27.

These prolongations take rise from the sides only of the rings of the body—that is, from the pleuræ or lateral folds between the dorsal and ventral plates; and in that case the pleuræ may be covered to a greater or less extent by a deposit of chitine forming a lateral plate, called the epimeron, which affords support for the muscles which move the basal joint of the limb, the hip or coxa.

It is also from the pleuræ alone that the peculiar prolongations arise which are in the service of respiration, either outside the body as gills or branchiæ, or inside as tracheæ. From the dorsal and ventral arches of the rings, on the contrary, no limbs ever take rise, although they often carry other more superficial formations (which may also be subservient to locomotion) for the purpose of supporting or fixing the body, such as groups of sharp granules, indentations, spines, retractile warts, often with hooks disposed in circles, &c. To this last class belong the so-called ventral or false feet of many larvæ. The cerci of Insects with perfect metamorphosis (both of imagos and of larvæ) are merely transformed dorsal spines.

The head consists, as all the other rings of the body, of a dorsal arch, a ventral arch, and two side pieces. In this case, too, it is merely from the side pieces that the limbs take rise, namely the appendages of the mouth, and, besides, the eyes and antennæ. But as the head, besides one or two pairs of antennæ, possesses three pairs of limbs (appendages of the mouth), whilst none of the other rings have more than one pair, the lateral pieces or pleuræ of the head (cheeks and temples) preponderate so greatly over the dorsal and ventral pieces, that they occupy the greater part of the skull, particularly behind and above, where so much space is required for the accommodation of the muscular and nervous systems; whilst the dorsal and ventral pieces lose so much the more in extent as they are here relieved from the office they perform in all the other rings (saving the last of all), viz. to afford surface of insertion for the muscles which move the next following ring. The dorsal piece is therefore reduced to a plate above the mouth (the epistoma), from which separate pieces, viz. clypeus, labrum, labellum, are evolved in proportion as the mouth requires covering from above. The ventral piece, on the contrary (hypostoma, or the sphenoid plate, as it may be called from its analogy to the os sphenoideum of vertebrata), enters into closer relations with the appendages of the mouth, as will be shown more in detail by-and-by; from this, too, separate pieces are evolved in front, namely mentum and fulcrum labii, in proportion as the maxillæ and lingua with their muscles require support and cover from beneath.

The appendages of the mouth are consequently prolongations of the pleuræ of the head. In many Crustacea more or less marked pleural folds may be observed, one fold for each appendage, indicating that the head is composed of as many rings as it possesses appendages of the mouth.

The appendages of the mouth (oral limbs) consist typically of the following parts:—

(1) An articular fold near the base, the hinge (cardo). The corresponding articular fold at the base of the legs (or the limbs organized for locomotion) has been called "trochantin." In those insects where the coxæ at their base are surrounded by sockets, the trochantins form the condyles of the coxæ, being, as well as the latter, free of the epimeron.

(2) A stem (stipes), corresponding to the coxæ of the locomotive limbs, which is developed in proportion to the requirements of the lobes, its destination being to carry the latter and to accommodate the muscles by which they are moved.

(3) Three free lobes, at the end of the stem, of which the two innermost (malæ) serve for subdividing and handling the food and are therefore modified in accordance with the nature of the food. The third and outer lobe is the continuation of the limb as such, and corresponds to those divisions of the locomotive limbs which follow the coxa. When it is elongated and jointed, or shaped as a leg, it is denominated palpus; and its destination is then either to carry organs of sense, to produce currents in the water about the mouth, to cleanse the organs of the mouth, to serve as instrument of prehension, or some other such function.

4. A fundamental difference between Insects and Crustacea is now to be observed, in the relations of the first pair of oral appendages to the side pieces of the skull.

In *Crustacea* the mandibles do not exceed that point of development which is attained by the other appendages of the mouth, and consist like these of hinge, stem, and lobes. Their flexors are also, as far as the head is not united with the body, attached to the hypostoma, and their movement is an oscillation, which has for its axis the whole exterior margin of the stem, and which sometimes is regulated by an imperfect articulation at the exterior and posterior corner of the stem.

In *Insects*, on the contrary, both hinge and stem coalesce with the pleuræ of the head, and their proper muscles are not at all developed. The middle lobe alone remains, and articulates with the side pieces of the skull by an upper and a lower condyle, whilst its muscles fill a great portion of the side piece. The inner lobe is only very rarely developed, and is then always fixed to the middle lobe. As there is no stem, there cannot be any mandibular palpus.

The development of the articulate archetype from the crustacean stage to the insect stage is here the same as that of the vertebrate archetype from fish to mammalia; and this analogy may also be traced in several other respects. In both these series of animals the cephalization is furthered by this, that the principal organ for the handling of the food gradually loses its form of limb by the coalescence of its basal divisions with the side pieces of the skull; in this way these latter gain additional space for accommodating the nervous system, whilst the movement of the jaws at the same time increases in power, because the muscles of the basal divisions of the limb disappear, and all the space on the increased side pieces of the skull is available for the muscles moving the remaining terminal parts of the jaws. The cephalization of the oral limbs of Vertebrata (the lower jaw) may be observed in different stages in reptiles and birds; the same is the case with the mandibles of Articulata. One of the intermediate stages, found in the lower Insects, with imperfect or no metamorphosis, and in sucking Insects, has recently been pointed out by Dr. Meinert in his paper on Campodeæ *.

5. In the hedriophthalmous or fourteen-footed Crustacea the first ring of the trunk † is connected with the skull, and as it ceases to be moveable its dorsal part (pronotum in Insects) disappears, whilst the ventral and lateral parts (prosternum and epimera prothoracica) still remain as separate pieces between the head and the second ring, because they carry a pair of limbs, the fore legs, which enter into the service of the mouth, and therefore assume the shape of maxillæ. These mouth-feet or maxillipeds have their coxæ in proximity to each other in the middle, and correspond thus far to the labium of Insects, that they afford a cover for the mouth from beneath, and assume a similar foliaceous and laciniated shape. Fabricius and his school therefore called them labium, as their morphologic interpretations were based only on the shape and use of the parts.

Next to the coalescence of the stems of the mandibles of Insects with the side pieces of the skull, there is no more important point of difference between the structure of the mouth in Insects and in hedriophthalmous Crustacea than precisely this conformation of the maxillipeds simulating a labium. Covering as it does the mouth from beneath, the existence of this false labium renders unnecessary any other cover; consequently

* Translated in Ann. & Mag. Nat. Hist. ser. 3. vol. xx. p. 361.

† In this paper the expressions "trunk" and "tail" stand for "thorax" and "abdomen" in the terminology of Milne-Edwards and others.

no mentum is evolved from the sphenoid plate, and the tongue, rising from the bottom of the cavity of the mouth, appears immediately over the edge of the sphenoid plate; nor do the ordinary oral appendages of the third pair (second pair of maxillæ) enter into any combination with the tongue as they do in Insects, but remain separate, each on its own side of the sphenoid plate. The consequence is that the tongue occupies a far more advanced place among the organs of the mouth than in Insects. Whilst thus the first great peculiarity of the head in hedriophthalmous Crustacea (its being finished off underneath by labium-like maxillipeds) exercises a very marked influence on the structure of the mouth, causing, so to say, a pressure from beneath, the second great feature distinguishing their head from that of Insects, viz. the free position of the mandibles with regard to the skull, produces a similar pressure from above, and both together result in imparting to the intervening organs of the mouth (the two pairs of maxillæ and the tongue) their characteristic flattened and foliaceous appearance, and in placing the tongue in a very peculiar position to the mandibular lobes, determining its form once for all. The complete severance of the Insect head from the body, which entails its being finished off from beneath by the combination of the third pair of oral appendages, the mentum and the tongue, into a labium, finally its considerably increased thickness, which is caused by the coalescence of the stems of the mandibles with the side pieces of the head—all these circumstances cause the maxillæ and the tongue to be placed on a so much lower level than the mandibles (supposing these to lie horizontally), that the tongue retains free space to develope itself in accordance with manifold and various secondary considerations. But in the head of Crustacea the first pair of oral limbs, being entirely separate from and outside the side pieces of the head, are depressed into a lower level than that of the sphenoid plate, which lies very high; and consequently the tongue is placed *above* the mandibular lobes, and cannot possibly have any other than a deeply bifid shape, as it would otherwise close the aperture of the mouth.

6. The mouth of biting Isopoda presents three principal types, which agree in this, that the oral limbs are placed in a row slanting outwards and forwards on either side of the sphenoid plate, each independent of its neighbours.

The first type comprises Onisci, Aselli, Idotheæ, and Sphæromata. It is essentially the same as the one we meet with in the majority of Amphipoda, that is, upon the whole in those Edriophthalmia which live near the shore or on the bottom of the sea, and feed upon carrion or vegetable food, gnaw wood, attack fishing-nets, &c.

The mandibles have two lobes. The outer lobe is continued into a slender prehensile part, which is split into two or more branches; and these latter are again divided into digitiform teeth; at the base it possesses a large grinding-tooth of varying shape and armature. The inner lobe is very short, more or less subdivided into smaller lobes and fringed, generally membranaceous, sometimes partially or wholly chitinized in one mandible and membranaceous in the other. The stem is more or less developed according to whether it has to carry a palpus or not. The first pair of maxillæ have two slender lobes, both moveable, particularly the inner one; this latter carries on its apex a number (generally four) of cylindrical, pointed, soft, hairy appendages, whilst the apex of the outer lobe is armed with a number of sometimes exceedingly sharply pointed, sometimes perfectly blunt, sometimes spinulous thorns. The second pair of maxillæ have from one to three lobes, of which at least the two outer ones are moveable, the outermost being sometimes palpiform.

As an example of this type, which, moreover, is the best known of the three, we may take a little *Sphæroma* which is very common along the coast of Denmark, but does not seem to have been sufficiently well described as yet; perhaps it is identical with *Oniscus globator*, Pallas (Spic. Zool. fasc. ix. p. 70, pl. 4. fig. 18). The prehensile part of the mandible is split into two branches, each with three to four digitiform teeth, which fit in between those of the mandible on the opposite side (Pl. I. fig. 1, *m*). The grinding-tooth is grooved and surrounded by a fence of spines. The inner lobe is small, soft, with pointed digitiform lobes, and articulates with the underside of the outer lobe in a depression between the prehensile part and the grinder. The stem of the mandible is short; its outer part contains the muscles of the palpus, whilst its own flexors are inserted in its inner section. The palpus is rather short and thick, but free. The stem of the first pair of maxillæ is divided longitudinally by a groove into two sections containing the muscles of the two lobes; the inner lobe (fig. 1, x) has four cylindrical, pointed, soft, hairy, membranaceous smaller lobes, whilst the terminal spines of the outer maxillary lobe are broadly truncate, some of the inner spines bearing spinulæ on their inner side. The second pair of maxillæ (fig. 1, x^*) possess three short lobes, of which the outer one forms a foliaceous biarticulate palpus.

7. The second type is characteristic of Cirolanæ; and as illustrative examples we may take *Cirolana borealis*, Lilljeb., from the North Sea and the Kattegat, and a pretty little active species ornamented with stars of black pigment, which

occurs not unfrequently in the Sound and along the north coast of Zealand. It was already known to Slabber, and was described some years ago by Van Beneden (" Rech. sur les Crustacés de Belgique," Mém. d. l'Acad. Belge, xxxii. p. 88, t. 15) as *Slabberina agata*, but is doubtless the same species that Leach described as *Eurydice pulchra.* Van Beneden refers it to Idotheæ.

The mandibles are destitute of grinders; but their prehensile part is, on the contrary, extraordinarily large, shaped like a flat cup, the outline being almost quadrangular, the outer corner pointed, the whole inner edge finely sharpened, hard as glass, undulato-dentate, the inner corner drawn out into a long dagger-like peg. The inner lobe is fixed closely under the outer lobe, large, membranaceous, divided into two lobules, of which the foremost is entire and covered with setæ in *Cirolana*, but digitilobate in *Eurydice*; whilst the posterior lobule in both genera is cultelliform, with a close row of pointed thorns along the inner margin, which gives to the lobule the appearance of a tenon-saw. The stem of the mandible is long, the palpus slender, and, when not used, placed in a groove round the large labrum and the small clypeus, with the last joint slung round the root of the posterior antenna. The first pair of maxillæ possess two lobes coalescing with the stem; the inner lobe is much abbreviated and has three cylindrical slender appendages, which in *Cirolana* are verticillato-spinulous towards the apex, and furnished with a hard thorn-shaped terminal joint, but which in *Eurydice* are soft, pointed, and hairy; the outer lobe is also rather short, particularly in *Cirolana*, somewhat arched inwards (fig. 3, x), powerful, the apex armed with a bundle of long, exceedingly hard, and pointed thorns, groups of similar thorns occurring all along the inner margin, which, in *Eurydice*, are much elongated and in part spinulous on the inner side. The second pair of maxillæ (fig. 3, x^*) are small, their inner lobe very short, with feather-like setæ and hairy membranaceous digitiform appendages; the middle lobe and palpus are represented by a pair of uniform pointed leaflets. The maxillipeds (fig. 3, px) have oval hinges, small stem, rudimentary lobes, and fully developed, slender, flat palpus. The forehead and clypeus are, in *Cirolana*, trapezoid, flat, in *Eurydice* vaulted, the frontal cone protruding between the first pair of antennæ (fig. 3 a,f).

Cirolanæ represent, no doubt, the highest development of the Crustacean type amongst Isopoda. The outer lobes of their mandibles are built exactly on the same plan as the carnassial teeth of mammalia. They are furnished with pegs to be driven into the body of the victim, one from either side, and to distend gradually the piece which lies between them, until it is cut through by the cutting edges which glide clipping past each other. In harmony with this structure of the mouth is the slender form of the body, the thin antennæ, and the well-developed swimming-feet; and it cannot be doubted, therefore, that Cirolanæ are purely carnivorous. The testimony of different authors goes in the same direction. Thus we find in Ström's physical and topographical description of the district of Söndmör, in Norway, a description of a "Fish-Bear," which must be a *Cirolana* (*C. borealis* in all probability), and which, he says, "creeps into the fishes through the anus and eats the flesh of the fish from the inside, so that, if it only has time, it may eat the whole of the fish." The author of this paper asked Professor Kröyer, the celebrated and experienced connoisseur of Crustacea and Fishes, whether he remembered any fact confirming the conclusions as to the mode of living of Cirolanæ which are suggested by the structure of their mouth; and Professor Kröyer then related that once, near the shores of Norway, not far from Throndhjem, he caught a large codfish which teemed with *Cirolana borealis*. The latter had eaten out such large cavities in the flesh that there was little left of the fish except skin and bones. In the hurry to secure this rich harvest Professor Kröyer tried to help himself by keeping some of the parasites in his closed hand, but they bit him so ferociously that he was obliged to let them go at once.

8. The third type is that of Serolides, of which *Serolis Orbignyana*, M.-E., may serve as an example. The stem of the mandibles (fig. 2, *m*) forms a very large, flat, oblique, quadrangle placed in a slanting position, and is evidently almost exclusively destined to give room for the insertion of the flexors, as the palpus rises from the exterior and posterior corners. The outer lobe has a similar shape, but is somewhat pinched off from the stem in the place where the large labrum begins to cover it in front; there is no grinder, and the prehensile part is thick and slightly spoon-shaped, the apex broadly truncate, with thick rounded edge; the inner margins of the mandibular lobes on the right and left sides meet each other accurately, but do not cross so as to cover each other. The inner lobe is small, divided into two lobules, which are attached to the outer lobe close under its prehensile part. On the right mandible both lobules are very small, soft, bipartite; but on the left mandible the foremost lobule is much increased in size, thickly chitinized, and resembles the prehensile part of the outer lobe by its clumsy, rounded transverse edge. The mandibular palpus is long, slender, the two first joints fitting into a shallow groove running along the outer margin of the stem and continued between

the clypeus and the base of the posterior antennæ, so that the small terminal joint projects between the antennæ. Both pairs of maxillæ are small, completely covered by the large and flat maxillipeds. The first pair of maxillæ exhibit only one narrow lobe (the middle lobe), which is armed at its apex with a few fine spines. The second pair of maxillæ have three small, narrow, and inarticulate lobules, of which the middle one and the external one or palpus are moveable. The cardo of the maxillipeds (fig. 2, *px*) is very large, transversely placed, and divided by membranaceous seams into several plates; the stem is small and short, but has a large foliaceous prolongation on the outer side, whereby the base of the stem becomes as broad as the anterior margin of the cardo, so as to produce the impression that the cardo here lies behind the stem, whereas it really lies, as usual, obliquely outside it; the short adnate lobes form in connexion with the stem a thick crest on the upperside, which is made to fit alongside a ridge, which on either side marks the outline of the broad sphenoid plate. This latter is at the base carinate and at the apex deeply bifid. The palpus is short, thick, biarticulate.

If, now, the clipping and tearing mouth and active appearance of Cirolanæ forcibly suggests the idea of a small shark, it is difficult to contemplate the Serolides without thinking of a little ray or skate. That they live near the bottom is sufficiently evident from their broad, short, slightly vaulted general form, the crested and carinated dark-coloured back, the smooth white under surface, the sickle-shaped imbricate epimera, the flat broad head which is closely fitted into the first segment of the body, the salient eyes placed on the upper surface of the head, the position of the mouth on the under surface, and the limited capability of swimming. Besides, their mandibles, though powerful, are not arranged either for clipping, grinding, or masticating, but only for pinching or squeezing and biting through a hard surface; the maxillipeds cover up the other, very small, appendages of the mouth; and after them follow two pairs of prehensile limbs of the same kind as those of *Mantis*, *Nepa*, and *Squilla*. It cannot, therefore, be doubted that Serolides live upon prey, and that this consists of small rather slow animals living near the bottom, probably mostly such as have firm integuments. The hypothesis suggested by Milne-Edwards (Hist. Nat. des Crustacés, iii. 231), that they attach themselves to fishes, is contradicted by the very feature of their structure to which he refers in support of it. Their flat mouth would be powerless against the skin of a fish, even if the cup-like shape of the anterior parts of the body did not prevent the mouth from reaching the skin. Furthermore, the first pair of body-limbs are not hooked, but long prehensile organs, articulating with the body in such a manner that they can reach far forward in order to catch objects, and then, folded together, keep that which has been caught closely under the mandibles; the second pair of legs, which have the same shape but in a smaller size, are to be considered merely auxiliary organs.

9. These three types may consequently be surveyed according to the subjoined scheme:—

Instrumenta cibaria mordentia, libera, serie obliqua utrinque disposita. Hypostoma breve. Orificium oris amplum. Mandibulæ malis binis instructæ, exteriore fixa.

A. Mala exterior mandibularum mola instructa striata, mucronulata spinosave.

a. Os manducatorium.
Mala exterior mandibularum ramosa, digitate spinosa, prensoria.
Maxillæ priores malis binis, exteriore subrecta, apice spinulosa.
Onisci, *Aselli*, *Idotheæ*, *Sphæromata.*

B. Mandibulæ mola carentes.

b. Os sectorium.
Mala exterior mandibularum depressa, quadrata, margine interiore acutissimo, valide dentato.
Maxillæ priores malis binis, exteriore incurva, multispinosa.
Cirolanæ.

c. Os morsorium.
Mala exterior mandibularum crassa, fornicata; margine crasso, obtuso, edentulo.
Maxillæ priores mala unica, apice spinulosa.
Serolides.

10. Thus prepared, we may with greater confidence enter upon an examination of the structure of the oral sucking-apparatus in Cymothoæ. As examples we may take two often-described species, *Æga psora*, L., and *Cymothoa œstrum*, auct., which represent the two types round which all the other Cymothoæ gather themselves with regard to the construction of their sucking-apparatus. For the sake of comparison I also take into account the *Anilocra Leachii*, Kröyer, a new species from the West Indies, which approaches very near to *A. laticauda*, M.-E. (Hist. Nat. des Crust. iii. 259. 6), besides a small species nearly related to *Cymothoa* sens. str., which was collected by Professor Kröyer, in Feb. 1840, on a fish caught

in the Plata River, but of which the specific name was not determined. As this Isopod is apparently undescribed, and rather remarkable, I here insert its chief characteristics.

I propose to call this species *Artystone trysibia.* It reminds one somewhat both of *Urozeuctes* and of *Olencira*, but is easily distinguished from the other genera of the family by the striking contrast between the first six pairs of legs, which are short and hooked, and the seventh pair, which reach to the extremity of the tail and are slender, compressed, crawling legs with small, almost rudimentary, straight claw. The trunk is slightly vaulted, broadly elliptic, the fore part somewhat twisted to the left, the hind part twisted still more to the right. The head is small, resembling that of *Cymothoa œstrum* in all essential points; and the same holds good with regard to the antennæ and the organs of the mouth. The anterior corners of the first ring scarcely reach the eyes; the greatest breadth of the animal is between the fourth and the fifth ring, where it is about half the greatest length. All the rings of the trunk have a couple of small, triangular, irregular, lateral folds over the epimera, which latter are luniform, rounded before and behind, extending on the first four rings as far as about one-half of the lateral margin of the dorsal plate, on the fifth reaching almost the whole length of the margin, and on the sixth and seventh somewhat beyond the dorsal shield. The coxæ are even, without protuberance, the hooked legs small, almost of equal length, their claws very fine. The first five rings of the tail are very short, of uniform length, somewhat increasing in breadth behind, the first three covered by the seventh ring of the trunk; the last caudal ring is gradually narrowed from the base, obliquely triangular, of about equal length and breadth, rather high-arched, with rounded apex; the last pair of caudal legs reach not quite to the apex of the ring; the branches are of equal size, elongated elliptic, soft, naked. The total length is 13 millims. The colour is white; on the trunk very minute points of black pigment are observable on the side folds of the dorsal shields, on the last three pairs of epimera, and across the dorsal shields along their posterior margin; vestiges of similar points are seen in a streak along the tail and on the base of the last joint. The only specimen found is a female with ripe eggs; the opercula are as in *Cymothoa œstrum.*

This parasite seems to indicate even a more direct transition to the Bopyri than the twisted *Livonecæ.*

11. In Cymothoæ the organs of the mouth are adapted for sucking in the following manner. The labrum is elongated, transversely curved so as to form a semicylindrical duct, which

is turned perpendicularly downwards and on the sides joins the maxillary lobes of the second pair, which also are converted into a semicylindrical duct, and of which the ends are expanded into a sort of lip; the palpi of the maxillipeds sometimes also enter into the combination. Thus a short soft tube is produced, which, by means of fringes, warts, and small hooks round the aperture, is specially adapted for closing tightly against a surface. Inside this tube we find foremost a pair of instruments designed for stinging, clipping, cutting, gnawing, or scratching, and which are the transformed mandibles; and behind them, again, a pair of fine saws or rasps are seen, by means of which the wound made by the mandibles may be further extended, lacerated, or deepened; this second set of instruments is formed by the first pair of maxillæ.

As regards the mandibles, the conversion is effected in the following way:—the stem is elongated, its sliding articulation at the base disappears, and it becomes almost immoveable; the inner lobe disappears entirely; the outer lobe is twisted abruptly downwards and forwards, separating itself from the stem by a short neck, in which there is an imperfect membranaceous articulation, and penetrates at once, just at the bend, into the interior of the sucking-tube, slipping in from the side between the labrum and the expanded ends of the second pair of maxillæ; the lower part of this lobe, which consequently is inside the sucking-tube, assumes the shape either of a triangular, pointed, at the apex sharp and hooked scratching-instrument (*Æga*), or of a thin, triangular, pointed knife-blade (*Cymothoa*). Although the stem of the mandible, on account of its limited mobility, only requires small space for its own muscles, it nevertheless retains a considerable size, as it must accommodate not only the muscles of the palpus, but also those of the moveable lobe, of which, however, the muscles also combine with those belonging to the second pair of maxillæ. Upon the whole, it may be observed that the masticating muscles of Crustacea are, as is also the case in fishes, combined and coalescent with each other to that degree that it becomes difficult to distinguish between their different portions, and all the organs of the mouth are really moved collectively to a certain extent. The maxillæ of the first pair are reduced to slender stiff stylets, surrounded and hidden by those of the second pair, of which the lobes in front meet in the middle; the stylet is formed by the stem and the moveable middle lobe, which on the apex carries a number of pointed hooked thorns.

A more detailed description of the mouth in *Æga* and *Cymothoa* will serve to place this account in a clearer light.

12. When the mouth of *Æga* is examined from beneath,

the *maxillipeds* at once arrest the attention. The cardo (Pl. I. fig. 4 *b*, *c*) is expanded outwards and forwards into a large triangular plate, which covers the root of the second pair of maxillæ. The stem is very large, elongated, quadrangular (fig. 4 *b*, *s*), its underside slightly vaulted; but the lateral or outer portion is boldly arched upwards, so as to embrace the maxillæ of the second pair; and the upper surface of the stem has near the inner margin a thick longitudinal crest fitting so accurately into a depression on the corresponding side of the middle ridge of the sphenoid plate between this ridge and the maxillæ of the second pair, that the stem by these means is kept quite firmly in its position. On account of this crest, the stem appears rather thick when detached and viewed from the side of the inner margin, which latter is quite straight and even, so as to fit in exactly with the corresponding margin of the maxilliped on the opposite side, to which it lies close through the whole of its length.

The five-jointed *palpus of the maxillipeds* (*p*, fig. 4 *b*) is of about the same length as the stem. The first joint is very short, and is placed transversely in front of the fore end of the stem, whilst the four following joints form a bluntly pointed, inwardly curved, cup-shaped leaf, which rests on one edge, so that it inclines a little inwards. The upper (and outer) even edge of the leaf fits first into a narrow groove on the inner edge of the stem of the mandible, and then passes round the mandible and lays itself into the bend between the mandibular stem and lobe, whilst the front edge is curved inwards and embraces the corresponding side of the labrum. On the inferior margin of the palpus, near the end of the second joint, a couple of small soft hooks are implanted; and a greater number of such are distributed along the margin and along the outer side of the following joints. They do not, however, appear as hooks, except when viewed from the side, and particularly when the palpus is pressed flat; but from beneath or from the side, when the palpus is in its natural shape, they are seen fore-shortened, and then appear as a row of short thorns along the margin of the third joint, and as a lump of warts on each side of the labrum.

In this manner the two leaves formed by the palpi, placed on edge and bending towards each other, embracing some other parts of the mouth, constitute the sides of the sucking-tube. Nevertheless a slit remains between them; but this is filled up at the bottom by the two very short, conic, compressed, brevisetose lobes of the maxillipeds, and, further, in front by the inner lobes of the second pair of maxillæ, which will afterwards be described.

In front the oral tube is closed by the *labrum*, which hangs perpendicularly from the clypeus; this latter is itself in a perpendicular position, elongated and arched in front. The labrum is of semicircular outline, and edged by a thick, soft, membranaceous fringe, which is dotted over with small pointed warts.

When the maxillipeds are removed, we observe the short prosternum, and in front of it the sphenoid plate, on which an elevated ridge is conspicuous along its middle line, which becomes gradually thinner towards the apex, besides the sockets of the cardo and stem of the maxillipeds, and, finally, the *second pair of maxillæ*. As we have stated already, a depression is observed on either side between the latter and the middle ridge of the sphenoid plate, which is filled up by the longitudinal crest on the upper surface of the stems of the maxillipeds. The consequence is that the stems of the second pair of maxillæ are entirely covered in from beneath by the stems and the base of the palpi of the maxillipeds. The stems of the second pair of maxillæ present the shape of elongated, inverted-pyriform, thin and uneven saucers, somewhat narrowed and flattened towards their fore ends, which meet across the middle ridge of the sphenoid plate, just inside and above the second joint of the palpi of the maxillipeds. Their concavity is, of course, turned upwards towards the under surface of the skull; and in the space thus enclosed the maxillæ of the first pair are lodged, with sufficient spare room to insure their free movement. The maxillary lobes of the second pair are small, thin, of rounded outline, at the apex and along the inner margin armed with some small, rather soft, hooked spines. The rounded outline of the lobes, however, only appears when they are unfolded; for in their natural position their appearance is very different. The inner lobe is then observed (x^*, fig. 4 *b*) in the slit between the palpi of the maxillipeds, at the inner posterior corner of the second joint; but it is twisted round, so that it is seen foreshortened, and the hooks above mentioned seem in consequence to form altogether but one thick thorn. The whole anterior margin of the outer lobe, on the contrary, is turned back like a collar over the anterior margin of the second joint of the maxillipeds. The part played by the second pair of maxillæ in the construction of the sucking-apparatus is consequently this, that their stems are excavated into sheaths for the styliform first pair of maxillæ, and their lobes fill up the remaining gaps in the sucking-tube, of which the opening becomes a closed circle formed by different elements which can slide over each other and are armed with small hooks.

It remains to examine the structure of the bottom of the sucking-tube—that is, the region about the real mouth of the animal. We then find that the sphenoid plate reaches as far forward as the apex of the second joint of the palpi of the maxillipeds; here the ridge, already mentioned as running along the middle of the plate in question, bifurcates into two soft branches, lying close together, which coalesce with the lobes of the tongue, forming their thick inner margins, and presenting, with the open slit between them, the exact figure of a buttonhole. The two round, naked, soft, and slightly folded lobes of the tongue, which resemble flat cushions, fill entirely the small space between the sphenoid plate behind, the palpi of the maxillipeds on the sides, and the labrum in front, whilst their abruptly attenuated, short and conic ends are turned downwards and slung round the fore parts of the mandibles. The sucking-tube would thus be completely closed at the bottom, if the just-mentioned buttonhole-like slit between the lobes of the tongue did not remain; and this slit must therefore be considered the real sucking-orifice.

We have thus traced the ways in which all the necessary conditions for the hooking on and loosening, the contraction and extension, abbreviation and prolongation of the mouth-tube are supplied and combined into one collective whole, and we can now pretty well understand how this animal is enabled to suck. The mouth-tube itself is so constructed that it may serve as a sucking-cup; further in we meet the tongue with its buttonhole and nothing more, therefore, is required than swallow-movements of sufficient strength to cause a liquid to ascend into the œsophagus. It is indeed most probable that the anterior, pear-shaped part of the intestine, concerning which Rathke (*l. c.* p. 30–31, t. 11. figs. 16 & 17 *a*) expresses himself with some uncertainty, is of great importance in the act of sucking. It still remains to consider a little more closely the instruments by means of which the source of liquid is made to flow.

The stem of the *mandibles* (*s*, fig. 4 *c*) forms a very large, flat cone, with somewhat sinuated outline, slanting forwards and inwards, bearing the palpus near its posterior and exterior corner, and lying uncovered between the maxilliped and the labrum, as far as the place where it penetrates into the mouth-tube from the side. At this point it is immoveably adnate, and affords thus a firm lateral support for the mouth-tube; but immediately inside it is abruptly contracted and twisted half round with a downward bend; and here the membranaceous articulation of the stem with the mandibular lobe is situated; this latter consequently projects downwards inside the mouth-tube, just behind the labrum, and beneath the corresponding lobe of the tongue, which forms the bottom of the mouth-tube. The lobe of the mandible (*m*, fig. 4 *c*) is elongated triangular, gradually acuminated, with convex back and concave front, the sharp lateral edges meeting at the sharp-pointed hooked apex. The muscles of the lobe fill the greater part of the stem in front of the insertion of the palpus. This arrangement, in connexion with the corresponding great length of the stem, indicates great power and perseverance of movement, and explains how these lobes, in spite of their inconsiderable size, may be used with great effect. Their shape and position enables the animal to sink them into its victim, one from either side, in slanting converging directions, and then, by drawing them back simultaneously with sufficient strength, to tear out the piece which lies between them. That they are destined to work against each other and to be drawn back together is plain from the circumstance that their points are not quite uniform, the left hook being somewhat more bent than the right one, and at the same time a little twisted to the side, so that it can take hold round the other.

The sawing-styles, or *maxillæ of the first pair*, consist each of a shorter stem and a longer lobe, which joins the former evenly all round. They are hard, smooth, slightly flattened, and bent inwards, so that their ends project downwards in the mouth-tube, behind the mandibular lobes, under the tongue, and on either side of the buttonhole-shaped sucking-slit. The seven hooked spines at their apex are so placed as to form a curved group; and it is therefore difficult to make out their form and number except when the lobe is pressed. These sawing-styles are evidently intended to act as auxiliary instruments, for deepening, increasing, and lacerating the wounds made by the mandibular lobes.

The long and slender *mandibular palpi* (fig. 4 *a*) are, when at rest, placed firmly against the head in a groove on the underside of the skull, which runs at a little distance from the stem forwards between the forehead and the posterior antennæ, round the basal joint of which their pointed and sickle-shaped terminal joint coils itself. The palpi, being inserted so far behind and to the side that they have considerable room for play, are probably destined for cleaning the mouth-tube with the brush at their apex, and to comb away the fishy slime from the marginal hooks by means of the fine comb of spines implanted in the outer margin of the terminal joint.

The structure of the mouth in *Æga* may therefore be described in the following terms:—

Æga.

Os haustellatum.

Haustellum adversum clypeo labroque, aversum malis posterioribus palpisque pedum maxillarium confectum, malas mandibulares maxillaresque priores rasorias involvens.

Clypeus fornicatus pendulus.

Labrum semicirculatum, pendulum, fornicatum, margine membranaceo, fimbriate verruculoso.

Mandibulæ stipite amplo, falcato, basi palpigero, *mala interiore* nulla. *Mala exterior* sub labrum oblique inflexa, mobilis, in orificium haustelli deorsum eminens, triquetra, acuminata, intra concaviuscula, apice extremo hamato, acuto. *Palpus* gracilis, triarticulatus, articulo intermedio producto, terminali brevi, falcato, barbato, pectinato, basin antennæ secundæ amplectente.

Maxillæ priores stiliformes, *mala interiore* et *palpo* nullis. *Mala exterior* stipiti contigua, in orificium haustelli deorsum eminens, fasciculo armata terminali hamorum rasoriorum.

Maxillæ posteriores apice contiguæ, maxillas priores obvolventes, stipite lato, fornicato, *palpo* nullo. *Malæ* discretæ, breves, rotundatæ, margine minute hamulatæ, orificium haustelli post claudentes, supra marginem interiorem palporum pedum maxillarium reflexæ.

Pedes maxillares maxillas includentes, cardine maximo, obliquo, laminato, triangulo, mala minutissima, conica. *Stipites* contigui, recti, subquadrati, fornicati, supra carinati, hypostoma valde elongatum medio carinatum utrinque explentes. *Palpi* quinquearticulati, latissimi, foliacei, fornicati, infra minute hamulati, labia lateralia haustelli formantes.

Lingua rotundata, mollis, pulvinata, nuda, fissa lobis apice lingulatis, introrsum arcte contiguis, crasse marginatis, rimam suctoriam includentibus.

13. Having now described the structure of the mouth in *Æga* as minutely as seemed necessary in order to explain its composition and mode of action, we may, in respect of *Cymothoa* (fig. 6), content ourselves with a comparison between the two, pointing out and interpreting the differences.

The oral tube is built up of the same elements; but they enter into its composition in different proportions; and an important difference in this respect is to be noticed between the two sexes.

In the *male* the cardo of the *maxillipeds* is a large, transversely oval but very irregular plate. The stem is flat, ob-

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long, narrower in the fore part, with a small protuberance on the outer margin, which touches the stem of the mandibles, and is somewhat vaulted, but does not by any means cover in the stems of the second pair of maxillæ so completely as is the case in *Æga*. The stems of the two maxillipeds meet, as in *Æga*, with their even inner margins, and likewise fit in between the middle ridge of the sphenoid plate and the second pair of maxillæ, by means of a crest on their upper surface; but this is considerably narrower than in *Æga*. The palpus is small, pointed, biarticulate, slightly curved inwards, with a row of small hooked spines on the inner or lower edge of the terminal joint. The upper or outer margin of the palpus is also in *Cymothoa* arranged to fit into a groove in the stem of the mandible, and forms the side margins of the mouth-tube.

In the *female*, on the contrary, the maxillipeds are converted into a pair of thin lamellæ, which are almost entirely covered from beneath by the first pair of plates of the egg-bag, and which do not reach so far that the palpi can form part of the mouth-tube; the cardo, besides, has a foliaceous inward-turned prolongation; and, as the inner margins of the stems, moreover, are not quite rectilinear, the stems do not meet accurately along the middle line of the skull, and it is only on a short piece that they fit in above between the ridge of the sphenoid plate and the second pair of maxillæ. Each of the stems, besides, expands on the outer side into a large, thin, rounded leaf, which reaches forward a considerable distance beyond the small palpus, of which only the last joint has a few thorns at the apex.

In both sexes the maxillipeds are without lobes: the inner corner of the stems certainly presents a little eminence, which is particularly easily observed in the male; but it lacks setæ, and can consequently hardly be looked upon as a lobe.

Of course this great sexual difference in the structure of the mouth entails a corresponding difference in the part taken by the maxillæ of the second pair in the composition of the mouth-tube.

The peculiarity of the *second pair of maxillæ* in *Cymothoa* consists in this, that the lobes are neither separate lobules as in *Æga*, nor turned back in the shape of collars, but they coalesce with one another, are soft, swelling, and by slight longitudinal grooves divided into small oval cushions (three on each maxilla), which together form the posterior part of the orifice of the mouth-tube. The outermost cushion has on the outside and at the apex a scattered number of small pointed warts; the intermediate and innermost cushions have no warts except on the margins, but have besides in their fore part some few hooks—the middle one three, the innermost only one.

In the male *Cymothoa* the sides of the mouth-tube are, as we have stated, supplied by the maxilliped-palps, which reach as far as the labrum; and the maxillary lobes of the second pair have therefore here, as in *Æga*, no other duty than to fill up the slit between the maxilliped-palps, though certainly this opening is proportionally larger in *Cymothoa*, the palpi in question being smaller and the lobes of the maxillipeds wanting. But in the female *Cymothoa*, where the maxillipeds do not enter into the construction of the mouth-tube, this devolves entirely on the second pair of maxillæ (x^*, fig. 6 *a*; the maxillipeds are removed). These are therefore much broader than in the male; their stems meet in much greater extent, namely with the whole of their front halves, and the lobes form together a large curved lip, which, on the sides, joins the labrum.

Although this conversion of the maxillary lobes of the second pair into a kind of lip in all essential points makes up for the non-participation of the maxillipeds in the construction of the mouth-tube in the female, and their limited participation in the male, this expedient would, nevertheless, not be sufficient if the labrum in *Cymothoa* were not larger than in *Æga*. But whilst in this latter genus the labrum occupies only one-third of the circumference of the mouth-tube, it supplies in *Cymothoa* quite one-half. It is consequently much broader, much more considerably arched from the top downwards, so that it becomes like an inverted cup when the mouth-tube is contracted; a small undulation is then also observed in the middle of the margin, which latter is furnished with numerous minute warts. But when the mouth-tube is distended and examined from beneath, the margin appears undulated or crenate.

From all this it appears that the mouth-tube is, upon the whole, softer and less powerfully armed in *Cymothoa* than in *Æga*: instead of the almost fringe-like covering of warts on the labrum, the considerable bundle of hooked spines on the palpi of the maxillipeds, and the row of spines on the turned-over margin of the maxillary lobe of the second pair in *Æga*, we find in *Cymothoa* merely the very minute warts on the very edge of the labrum and on the cushion-like lobes of the second pair of maxillæ, and the very short row of hooked spines on the two innermost cushions of these lobes and on the margin of the terminal joint of the maxilliped-palpi in the male. But this weaker armature of the mouth in *Cymothoa* of course corresponds with the far greater development of the hooked limbs in that genus, to which we shall allude further on.

The *mandibular palpi* (*m*, fig. 6 *a*), on the contrary, enter into far closer connexion with the mouth-tube in *Cymothoa* than in *Æga*. Instead of being slender and furnished with a brush of bristles and a comb of spines as in *Æga*, they are short, thick, and conic, and they are inserted on the stem in such a manner that they become directed straight forward. They are accordingly applied to a different purpose, namely to the support of the mouth-tube, round which they lie closely, meeting in front of it and embracing it between them. In *Anilocra* (fig. 5) this destination of the mandibular palpi is still more apparent in their form, the joints of the palpi being so accurately fitted to the space between the antennæ and the labrum that they surround the mouth-tube as a kind of padding.

Excepting that the sawing-styles formed by the *first pair of maxillæ* (fig. 6 *b*) are less powerfully armed than in *Æga*, the difference in the inner machinery is confined to the structure of the *mandibular lobes* (*m*, fig. 6 *b*), which are thin, triangular, pointed lobules, with a sharp inner edge, and are doubtless used not merely for stinging, but also for the purpose of clipping, as they are capable of being crossed like the blades of a pair of scissors.

The formula for *Cymothoa* will consequently be the following:—

Cymothoa.

Os haustellatum.

Haustellum adversum clypeo labroque, aversum in fœmina malis posterioribus, in mare malis posterioribus palpisque pedum maxillarium confectum, malas mandibulares punctorias maxillaresque priores rasorias involvens.

Clypeus fornicatus, pendulus.

Labrum amplum, semicirculatum, pendulum, fornicatum, margine minute verruculoso.

Mandibulæ stipite quadrato, fixo, apice palpigero, mala interiore nulla. *Mala exterior* sub labrum oblique inflexa, mobilis, in orificium haustelli deorsum eminens, triangula, compressa, acuminata, cultriformis. *Palpus* labrum utrinque amplectens, triarticulatus, conicus, nudus; articulis sensim decrescentibus.

Maxillæ priores stiliformes, mala interiore et palpo nullis. *Mala exterior* stipiti contigua, in orificium haustelli deorsum eminens, fasciculo armata terminali hamorum rasoriorum.

Maxillæ posteriores fere totæ contiguæ, maxillas priores obvolventes, stipite lato fornicato, in fœmina latissimo, palpo nullo. *Malæ* concretæ, membranaceæ, pulvinatæ, minute hamulatæ, fornicatæ, in mare marginem interiorem palporum pedum maxillarium fulcientes, in fœmina orificium haustelli post claudentes.

Pedes maxillares maxillas tegentes, laminati, cardine maximo irregulari, mala nulla. *Stipites* planiusculi, in fœmina extrorsum dilatate foliacei, in mare contigui, hypostoma breviusculum, medio carinatum utrinque explentes. *Palpi* biarticulati, brevissimi, conici, depressi, apice minute hamulati, in mare labia lateralia haustelli formantes.

Lingua rotundata, mollis, pulvinata, nuda, fissa, lobis introrsum arcte contiguis, crasse marginatis, rimam suctoriam includentibus.

14. The fulness of the vegetative life in fishes expresses itself through the rich variety and size of their external parasites in comparison with the higher vertebrates. Amongst these parasites the Cymothoæ occupy a prominent place. Their stomach (Rathke, *l. c.* tab. vi. figs. 16*b* & 17*b*) is so large that when distended it almost fills the five last segments of the trunk (corresponding to the abdomen in Insects). Its contents are by the action of spirit of wine converted into a tough mass, which may be cut with a knife, and under the microscope shows a plentiful admixture of epithelial cells, in *Æga* sometimes also of blood-corpuscles. This lump when dried is easily taken out whole, particularly in *Æga*, and presents then a perfect cast of the interior of the stomach, in the shape of an oval bean, with a shining smooth surface; along the under surface a groove is observed, indicating the place where the stomach has pressed against the ventral cord of the nervous system; the colour is a light or dark amber, in *Æga* often dark brownish red. These animals have of course been well known to the cod-fishing inhabitants of the north from time immemorial; and the singular fact just alluded to has given rise to curious superstitions amongst the people, and not less curious mistakes on the part of the naturalists of former days. Whilst the fishermen regarded this "stone" as a powerful talisman, securing to its possessor, when rightly used, the fulfilment of his wishes, the medical men recommended it as an infallible remedy against sea-sickness amongst other things; and whilst some naturalists thought that it took the place of the internal organs altogether, others thought it to be the ovary, and O. Fabricius (Fauna Grœnl. p. 250, *Oniscus psora*) thought that it surrounded the intestine.

15. When leaving the pouch the young of *Cymothoa œstrum* have a sharp-edged forehead, well developed, oval, prominent black eyes, slender, setiform antennæ, the posterior pair so long that they reach as far as the middle of the tail, and slender limbs with long claws, which are hooked only at the point, and which, on those three pairs of legs which are directed forwards, assume the form of saws, owing to a row of powerful teeth on the underside. The tail is entirely free, not much shorter than the trunk, conical, its rings being very freely moveable. Its limbs possess long downy swimming-bristles; the last pair are almost as long as the first five rings of the tail, and point straight backwards, their branches being elongated, narrow, with long downy swimming-hairs at the end. The seventh pair of limbs are wanting as in other newborn young of Isopoda.

According to the classification hitherto current, these young Crustacea would rather be allied to *Cirolana* than to *Cymothoa*; but the facts demonstrated in the foregoing investigation needed scarcely this addition in order to prove that here, too, in our attempts at system we go astray in darkness when we neglect the light afforded by the structure of the mouth. If the young of *Cymothoa*, in the form of body, antennæ, and legs, more reminds one of *Cirolana* than of the adult *Cymothoa*, and if an *Æga* has less external similarity to *Cymothoa* than to *Cirolana*, then all these similarities belong entirely to the class of biological modifications, and are without any typical character at all. It is by marks of distinction of the same kind that *Bopyri* have been separated from the other Isopoda; but as their mouth is of the same construction as in *Cymothoa*, only far more reduced, they ought to be united with *Cymothoa*, *Æga*, and their related genera into one natural family—Cymothoæ. Not even in the characters of distinction now in use are transitions wanting; for there exist twisted species (not yet described) of the family of Cymothoæ, according to the definition of the family hitherto accepted, but which lack the last pair of caudal limbs. Upon the whole we may observe a striking parallelism between this present series of parasites on the one side and Siphonostomata on the other side, although it is not so extensive nor descends so low as the latter, at least according to our present knowledge. *Æga* corresponds to *Caligus*, *Cymothoa* to *Lernanthropus*, *Bopyrus* to *Chondracanthus*. It is the greater or smaller degree of locomotion which decides the shape of the frontal margin. In those parasites which are continually fixed it is blunted; in those which move about it is sharpened by the addition of the basal joint of the first pair of antennæ. In *Æga* these antennæ are still tolerably free, but joined by a notch and ledge to the second pair of antennæ, and, together with the latter, joined to the eye-margins, whereby a kind of imperfect sucking-cup is formed. In Caligini, on the other hand, the basal joint of the first pair of antennæ coalesces with the sucking-cup, now developing a pair of independent small suckers (*Caligus*), and now forming the so-called lamina frontalis. A vestige of the true front plate is, however, sometimes to be observed, namely the scar indicating the place of insertion of the detached organ of fixation.

EXPLANATION OF PLATE I.

Fig. 1. Head of *Sphæroma balticum*, n., from beneath.
Fig. 2 *a.* Head of *Serolis Orbignyana*, M.-E., from beneath: *o*, sockets of first pair of legs.
Fig. 2 *b.* Prosternum and sphenoid plate of the same, from beneath, with the lingua and the maxillæ of the first and second pairs on the right side: *o*, sockets of maxillipeds.
Fig. 3. Head of *Cirolana borealis*, Lilljeb., from beneath.
Fig. 4 *a.* Head of *Æga psora*, L., from beneath.
Fig. 4 *b.* The maxillipeds of the same in their connexion with other parts: *c*, cardo of maxillipeds; *s*, stem of ditto; *p*, palpus of ditto.
Fig. 4 *c.* Right mandible of the same, seen from the inner side: *s*, the stem; *m*, the lobe; *p*, the palp.
Fig. 5. Head of *Anilocra Leachii*, Kr., from beneath.
Fig. 6 *a.* Head of *Cymothoa œstrum*, E., ♀, from beneath. The maxillipeds are removed and the sucking-orifice distended: *o*, sockets of the maxillipeds.
Fig. 6 *b.* Right mandible of the same, from the inner side: *s*, stem; *m*, lobe; *p*, palpus.

In all the figures, where no other interpretation is given, the following is the signification of the letters:—*f*, forehead; *a*, antennæ of the first pair; *a**, antennæ of the second pair; *c*, clypeus; *l*, labrum; *l**, lingua; *m*, mandibles; *x*, first pair of maxillæ; *x**, second pair of maxillæ; *px*, maxillipeds; *h*, sphenoid plate; *s*, prosternum; *s**, mesosternum.

II.—*Notulæ Lichenologicæ.* No. XIX.

By the Rev. W. A. Leighton, B.A., F.L.S.

As Dr. Th. M. Fries's 'Lichenes Spitzbergenses' will in all probability be in the hands of few persons in this country, and as there is a possibility that some of his new species may occur in the northernmost portions of Great Britain, we here extract his descriptions of them.

1. *Lecanora coriacea*, Th. M. Fr.

Crusta crassa, contigua, torulosa l. verrucosa, luteo-albida (l. in roseum vergente), subnitida. K imbuta primum fulvescente, dein sanguinea; apotheciis non visis.