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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY,

(BEING A CONTINUATION OF THE 'MAGAZINE OF BOTANY AND ZOOLOGY,' AND OF  
LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

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Page 380, line 16 from the top, for *obstitis* read *obsito*.  
 for *mesosternum*, wherever the word occurs, read *postpectus*.

THE ANNALS  
 AND  
 MAGAZINE OF NATURAL HISTORY.

“..... per litora spargite muscum,  
 Naiades, et circum vitreos considite fontes;  
 Pollice virgineo teneros hic carpite flores;  
 Floribus et pictum, diva, 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 conchyliis succo.”  
*N. Parthenis Giannettasis* Ecl. 1.

No. 130. JULY 1847.

I.—*Biological Contributions*. By GEORGE J. ALLMAN, M.B.,  
 F.R.S.E., M.R.I.A., Professor of Botany in Trinity College,  
 Dublin, late Demonstrator of Anatomy and Conservator of the  
 Anatomical Museum, T.C.D.

[With two Plates.]

[Continued from vol. xix. p. 370.]

No. III. *Description of a new Genus and Species of Entomostraca*.\*

THE interesting little Crustacean which forms the subject of the present notice, though apparently extensively distributed, would seem to have hitherto received but little attention. The first record of its existence will be found in the ‘Athenæum’ review of the Thirteenth Meeting of the British Association for 1843, from which it will be seen that at that meeting, Mr. Patterson of Belfast mentioned the occurrence of a minute crustacean in the branchial sac of *Ascidia communis*. The fact then noticed by Mr. Patterson was at the time familiar to me, having previously obtained the crustacean in *Ascidia* dredged in the harbour of Glandore, county Cork, though I had not till a later period paid any attention to its structure.

In letters since received from Mr. Thompson of Belfast, to whom the little animal was well known, and from Mr. Patterson, I have obtained full information relative to the existence of the

\* Read before the Royal Irish Academy, April 12, 1847.

crustacean on the coast of the north of Ireland. The latter gentleman informs me that he procured it in great abundance in July 1840, while dredging off the coast of Bangor, county Down; he thinks that nine or ten *Ascidia* out of every twelve dredged up were inhabited by the parasite, the number in each varying from two to six or seven.

In March 1846 I again obtained specimens of the little crustacean in the branchial chamber of individuals of *Ascidia communis* cast upon the shore of Dublin Bay. A careful examination now convinced me that it had not yet obtained a name or place in our systems, and that it was generically distinct from all hitherto described forms, a fact which the more surprised me when I reflected on its apparently extensive distribution, and the circumstance that M. Edwards, our great authority on the Crustacea, had made certain forms of the *Ascidia* the subject of scarcely less elaborate and beautiful research. The following characters were accordingly at once drawn out, though their publication has been deferred up to the present time.

#### NOTODELPHYS\*.

GEN. CHAR. *Body* elongated. *Head* scutiform and bearing in front a solitary median eye. *Antennæ* two, filiform, multiarticulate. *Mouth* with a pair of mandibles, and surrounded by five additional pairs of appendages, of which the anterior as well as the last two pairs are prehensile. *Thorax* having but two rings distinct, the anterior one being confounded with the head. *Female* with a large dorsal ovigerous receptacle immediately behind the last distinct thoracic ring. *Locomotive feet* four pairs, biramous natatory. *Abdomen* of about five rings, the last of which is terminated by two setigerous appendages.

Species unica, *N. ascidicola*. Pl. I., II.

*Hab.* Swimming freely in the branchial sac of *Ascidia communis*. Belfast Bay, *Wm. Thompson* and *G. C. Hyndman, Esqrs.*; Bangor, co. Down, *R. Patterson, Esq.*; "found in *Ascidia* dredged from a muddy bottom at a depth of from fifteen to twenty fathoms in Strangford Lough, co. Down," *Wm. Thompson* and *G. C. Hyndman, Esqrs.*; in *Ascidia* dredged in Killery Bay, co. Galway, in 1840, *R. Ball* and *W. Thompson, Esqrs.*; Glandore Harbour, co. Cork, Dublin Bay, and Southampton water, *G. J. A.*

*Notodelphys ascidicola*, of which I have as yet found only females, measures somewhat less than a line in length and bears a considerable general resemblance to *Cyclops*. The cephalic segment is slightly prolonged anteriorly into a kind of beak, immediately below which is a pair of multiarticulate setigerous

\* From  $\nu\acute{o}\tau\omicron\varsigma$ , *tergum*, and  $\delta\epsilon\lambda\phi\upsilon\varsigma$ , *matris*.

antennæ followed by a pair of appendages (fig. 3) composed of four joints, the terminal joint presenting itself under the form of a hooked prehensile claw, and the basal bearing at its distal extremity a double plumose seta.

Situated at a short interval behind the last-mentioned pair of appendages and occupying a position near the centre of the under surface of the cephalic segment is the mouth, covered by a largely developed upper lip (fig. 4), and guarded on each side by a strong toothed mandible (fig. 5). External to the mandibles are the first and second pairs of maxillæ. Those of the first pair (fig. 6) consist each of a flattened peduncle bearing two jointed rami which are furnished with numerous plumose setæ; upon the external ramus, one of these setæ is very large, assuming the appearance of a flagelliform appendage, and a similar, though smaller one, springs from the internal edge of the peduncle. The second pair of maxillæ (fig. 7) does not differ essentially from the first, but is smaller and not furnished with such greatly developed flagelliform setæ.

The maxillæ are succeeded by two pairs of prehensile appendages (figs. 8 and 9): each consists of a large basal joint with a terminal articulatè stem; stiff setæ are carried upon the internal side of both peduncle and stem, and on the stem one or more of these becomes developed into a prehensile spine.

Behind the last-described appendages, the cephalic segment bears a pair of natatory feet resembling those which are borne upon the succeeding segments of the body.

There are altogether four pairs of natatory feet. The first of these, as just mentioned, is borne on the cephalic segment; the second and third are supported respectively on the two distinct rings which immediately follow; while the fourth is placed below the anterior end of the ovigerous region. Each of these natatory feet (fig. 10) consists of a basal lamina composed of two joints, and bearing on its distal edge two rami formed each of three flattened articulations which are copiously furnished upon their inner edge with plumose setæ; the setæ borne by the external edge are shorter and not plumose. The proximate joint of the basal lamina carries upon its inner edge a plumose spine, and it is connected with its fellow of the opposite side by an intermediate plate which renders it necessary that the motions of the basal joints of each pair of feet should be strictly in concert.

The abdomen is somewhat cylindrical, and composed of about five rings, the most posterior of which is prolonged, as in *Cyclops*, by two diverging cylindrical appendages, each of which carries upon its distal extremity four plumose setæ.

The external receptacle for the ova consists of a large dorsal sessile sac, situated between the last distinct thoracic ring and

the abdomen; it is slightly lobed posteriorly, and filled with ova of a deep olive-green colour, and in the angle between it and the upper surface of the abdomen is an aperture through which the ova escape at maturity (fig. 11). As will hereafter be seen, it must be viewed as formed by the confluence along the mesial line of two pieces originally distinct. The large size of this organ and the deep colour of the contained ova render it one of the most striking features in the physiognomy of the little animal, and the contrast which it presents with the surrounding lighter tissues of the Ascidian makes the detection of the parasite a matter of no difficulty.

In company with *N. ascidicola* and differing in several important particulars from the latter as just described, I have not unfrequently met with two little Crustaceans which deserve here some attention. My belief is that they are not specifically distinct from the subject of the present notice, but must rather be viewed as immature states of this animal. In one of them (fig. 12) the antennæ (fig. 13) are geniculated, and consist of a thick peduncle, from which the terminal portion, which is subulate, multiarticulate and setigerous, passes off abruptly at an angle. The cephalic segment carries no proper feet, and the thorax presents three distinct rings with a pair of natatory feet attached to each; the fourth pair is borne as in the adult, beneath the anterior extremity of the ovigerous sac, and at a short distance behind these last is a pair of small stiliform organs terminated by setæ. The last ring of the abdomen is bilobed, and is prolonged by a pair of cylindrical appendages. The ovigerous sac is disproportionately large, and the habits of the animal are peculiarly sluggish.

The other (figs. 14 and 15) differs still more from the adult than does that just described. The antennæ are short and thick, and not geniculated. The cephalic segment, as in the last, supports no locomotive feet, while four distinct rings may be demonstrated in the thorax, each bearing a pair of biramous natatory feet, and the abdomen would appear to be composed of five segments, the last terminated as usual by a pair of cylindrical appendages. The external receptacle for the ova presents itself in this little animal as two hollow organs perfectly distinct from one another except at their origin. They appear to arise immediately behind the fourth thoracic ring, and are thence continued backwards, embracing the sides of the abdomen.

The mouth is provided with a very large labrum (fig. 16), which is prolonged anteriorly by means of a conical projection between the bases of the antennæ. The labrum conceals two strong denticulated mandibles (fig. 17), and the oral apparatus is completed by two pairs of maxillæ and three additional pairs of appendages (figs. 18—20) as in the adult; of these last, that which im-

mediately succeeds the maxillæ (fig. 19) is well-developed and didactyle, the next (fig. 20) is rudimentary.

The proper feet (fig. 21) carry two slightly developed rami, the external of which bears some short stiff spines, and the internal is furnished with two or three remarkably long setæ not plumose, with a few short ones at their base.

The internal ovaries may be traced throughout the whole of the thoracic and a considerable portion of the abdominal region, and may already be seen forming a kind of hernia into each of the external receptacles (fig. 15).

While engaged in the examination of the first of the forms just described as immature conditions of *Notodelphys ascidicola*, I happened to witness the escape from the ovigerous receptacle of ova which were expelled through the opening already mentioned as existing in the postero-inferior part of this organ. Through the delicate transparent covering of the expelled ova, the form and motions of the embryo could be seen within, and indeed it required in many cases but a few minutes to elapse between the expulsion of the egg and the rupture of its shell by the struggles of the imprisoned embryo. The little larva (fig. 22) thus set free presented itself under the form of an exceedingly active, natatory, arachnoid animalcule with six biramous feet furnished with a pencil of setæ at the extremity of each ramus; the eye-mass, which was of a bright ruby colour, was well-developed, and had the appearance of being formed by the confluence of four distinct ocelli, and the little creature presented altogether a close resemblance to the young of *Cyclops*.

If I am correct in my opinion as to the nature of the different forms now described, we have, during the progress of development of *N. ascidicola* from the first rupture of the egg, four distinct phases; that a greater number exist there can be little doubt, but at least four well-defined forms can with certainty be demonstrated.

The first (fig. 22) is characterized by an absence of distinct segmental division; only three pairs of feet have as yet appeared; these exhibit no appearance of the lamellar character, so striking in the more advanced phases; and the intermediate plate not being yet developed, there would seem to be no mechanical obstacle to the feet of opposite sides acting independently of each other. The eyes are well-developed and already confluent, there is no trace of antennæ, and we have altogether a form which strongly suggests the *acaridan* type of the *Arachnida*.

Between this first stage of the larva and the next in point of development which I have had an opportunity of witnessing, a most striking progress has taken place. It is however almost certain that there are intermediate stages which I have not yet



succeeded in detecting. Be this as it may, the creature has now (figs. 14—21) assumed the essential form of the adult, the division of the body into segments is complete, the antennæ have appeared, the mouth with its lip, mandibles, maxillæ and accessory appendages, have acquired nearly their mature condition, and four pairs of true feet are present, the head is quite distinct from the thorax, which presents four distinct rings; and the abdomen exhibits five rings and the terminal appendages. The internal ovaries are developed, and the external receptacles are present, but as yet distinct, showing no tendency to coalescence except at their origin. The true feet have assumed a lamellar condition, the rami however are but slightly developed, and the pencil of long bristles with which the internal ramus is furnished suggest to us the feet of certain *annelides*. As the intercoxal plates have begun to develop themselves, the legs of opposite sides must now act simultaneously. The habits of the animal are remarkably sluggish, and all its motions, as well indeed as its general physiognomy, remind us strongly of an *annelidan*.

In the next stage (figs. 12, 13), the progress of *consolidation* has become manifest, thus presenting us in this respect with a retrocession towards the early condition of the larva. The head continues distinct from the thorax, but the fourth thoracic ring is confounded with the posterior region of the body. The ovigerous receptacles have now become united along the mesial line, and are loaded with ova. The motions are still sluggish.

In the final stage (figs. 1—11) the progress of consolidation has still further advanced, the head has become inseparably united with the first thoracic ring, so that but two segments are now distinct in the thorax. The creature is natatory, and eminently active.

The high development of the reproductive system in the second and third of the phases just described may appear opposed to the opinion here expressed, that these are animals in an immature condition. The objection however will lose all its validity when we recollect that innumerable recent observations go to prove that the exercise of the generative function is by no means necessarily confined to the adult state. Whether however we do or do not admit the specific identity of all the forms now described, it is certain that they present us with a series of phases in progressive development; and the light thus thrown upon the morphology of *Notodelphys ascidicola* is almost entirely the same, whether we view them as different ages of a single species, or as permanent or transitory conditions of several species.

#### General Considerations.

As to the exact zoological position of our little crustacean, it

is manifest that it possesses very marked affinities with *Cyclops*, while the dorsal situation of the receptacle for the ova presents an analogy not to be overlooked with the other entomostracan forms of *Daphnia*, *Cypris* and their allies. Its parasitical habits, and the form of the appendages which immediately succeed to the antennæ, as well as its general conformation, would seem to approximate it to Nordman's genus *Ergasilus*. From this suctorial parasite, however, the structure of its mouth will widely separate it. Indeed it is perhaps hardly just to consider *N. ascidicola* as truly a parasite; its habits in this respect would seem to bear to those of other Entomostraca the same relation which is found to subsist between the habits of *Pinnotheres* and those of the generality of Decapods.

The condition of the external receptacle for the ova I believe to be one of the most remarkable peculiarities of the present genus, and to be much more interesting than it may at first sight appear. To this conclusion I have arrived from the conviction, that the organ in question is of a totally different nature from the external egg-bearing pouches in *Cyclops* and its kindred forms; that while such pouches are only a portion of the membrane of the true ovaries pushed outwards by the ova in the act of extrusion, and finally allowing the escape of these by rupture, the ovigerous receptacle in *Notodelphys* is the result of a certain development of the superior arch of one or more of the posterior thoracic rings expanded posteriorly and laterally so as to form a kind of carapace destined for the protection of the eggs. I believe it to be in every respect the representative of the singular elytroid dorsal appendages to the thorax in *Anthosoma*, *Cecrops*, and certain other suctorial crustacea. In one of the early stages of our Entomostracan, indeed, we may see at each side the true ovarian pouches (the real representatives of these appendages in *Cyclops*) projecting under cover of the organ we are now considering; the pouches then either continue to increase by gradual protrusion till they fill the entire chamber prepared for their reception, or else, becoming soon ruptured, discharge their contained ova into the surrounding space, from which, after having undergone there during a limited period a certain incubatory action, these ova finally escape through the definite opening already mentioned, without in any degree necessitating the rupture of the walls of the ovigerous chamber, such as must unavoidably occur in the closed pouches of *Cyclops*, &c.

It is not easy to determine with certainty the exact elements which enter into the composition of the ovigerous receptacle, whether the whole of the dorsal arch is to be found in it or only a part. From an examination however of what I look upon as the corresponding organs in the suctorial Crustacea, I am of opinion

that it is composed exclusively of the epimeræ, which in consequence of the non-development of the tergum become confluent in the mesial line of the back, presenting in one of the early phases, as we have already seen, their original distinctness.

The genus *Notodelphys* thus presents us with a most interesting transitional form between the true *Entomostraca* and the suctorial *Crustacea*. Its perfect mandibulate mouth will at once place it with the former, a position indeed which its highly developed natatory feet and active habits as well as its general physiognomy would in the first instance suggest. The form, on the other hand, of the accessory oral organs or maxillary feet, which are here constructed so as to constitute organs of attachment, as well as the singular development of the dorsal arch of the posterior thoracic ring, and the connection of the feet of opposite sides through the intervention of a large intercoxal plate—a striking feature in the greater number of the suctorial *Crustacea* and not found in the *Entomostraca*—unite with the semiparasitical habits of *Notodelphys* in indicating an affinity not to be mistaken with the true suctorial tribes.

In the whole of the description now given it has been thought most convenient to adhere to the terminology in ordinary use, though the researches of Erichson (*Entomographien*) have in many particulars altogether disproved its correctness. The thorax, for instance, according to the philosophic views of this naturalist, consist throughout the three classes of *Insecta*, *Arachnida* and *Crustacea*, invariably of three segments and no more, but these often so consolidated with one another and with the neighbouring segments, as to render it necessary to have recourse to indirect indications in order to determine the real composition of the part. Erichson has moreover shown that the true abdomen among the *Crustacea* includes several segments, hitherto incorrectly supposed to belong to the thorax, and that it is for the most part divisible into two very distinct regions, an anterior and a posterior. To reduce the *Entomostraca* to the type of *Insecta* is believed by Erichson to be one of the most difficult problems in zoology. In attempting its solution he maintains the consolidation of the head with the thorax, and adopts the singular though apparently correct opinion, that the anterior pair of thoracic legs is invariably placed before the mouth.

In applying these original and philosophic views to the determination of the true import of the various parts in the *Entomostracan* which forms the subject of the present paper, we will have the first pair of thoracic legs represented by the prehensile appendages which immediately succeed the antennæ; behind these is the mouth with its mandibles and first and second pair of maxillæ, and then come two pairs of prehensile appendages, which are the second and third pairs of thoracic legs; all the

three thoracic segments therefore are here blended with the head, but we likewise find the cephalic region supporting a pair of true locomotive feet, which are the first pair of abdominal appendages; the first abdominal ring therefore is also in the present instance inseparably united with the head. The next two distinct rings are the second and third of the abdomen, each with its pair of natatory feet; the fourth abdominal ring carries also a pair of natatory feet, but becomes indistinct at its posterior margin. Here commences the great ovarian chamber, behind which is the posterior region of the abdomen with its five distinct rings and terminal setigerous appendages.

## EXPLANATION OF PLATES I., II.

## PLATE I.

## NOTODELPHYS ASCIDICOLA.

- Fig. 1. *Notodelphys ascidicola* magnified and viewed from above.  
 Fig. 2. The same viewed in profile.  
 Fig. 3. Accessory oral appendage of the first pair.  
 Fig. 4. Labrum.  
 Fig. 5. Mandible.  
 Fig. 6. Accessory oral appendage of the second pair (*maxilla* of the first pair).  
 Fig. 7. Accessory oral appendage of the third pair (*maxilla* of the second pair).  
 Fig. 8. Accessory oral appendage of the fourth pair.  
 Fig. 9. Accessory oral appendage of the fifth pair.  
 Fig. 10. One of the natatory feet.  
 Fig. 11. Oviparous chamber viewed from below in order to show the aperture for the escape of the ova.  
 Fig. 12. One of the immature phases of *N. ascidicola*.  
 Fig. 13. Antenna of this phase.  
 Fig. 14. *N. ascidicola* in a still earlier stage of development.

## PLATE II.

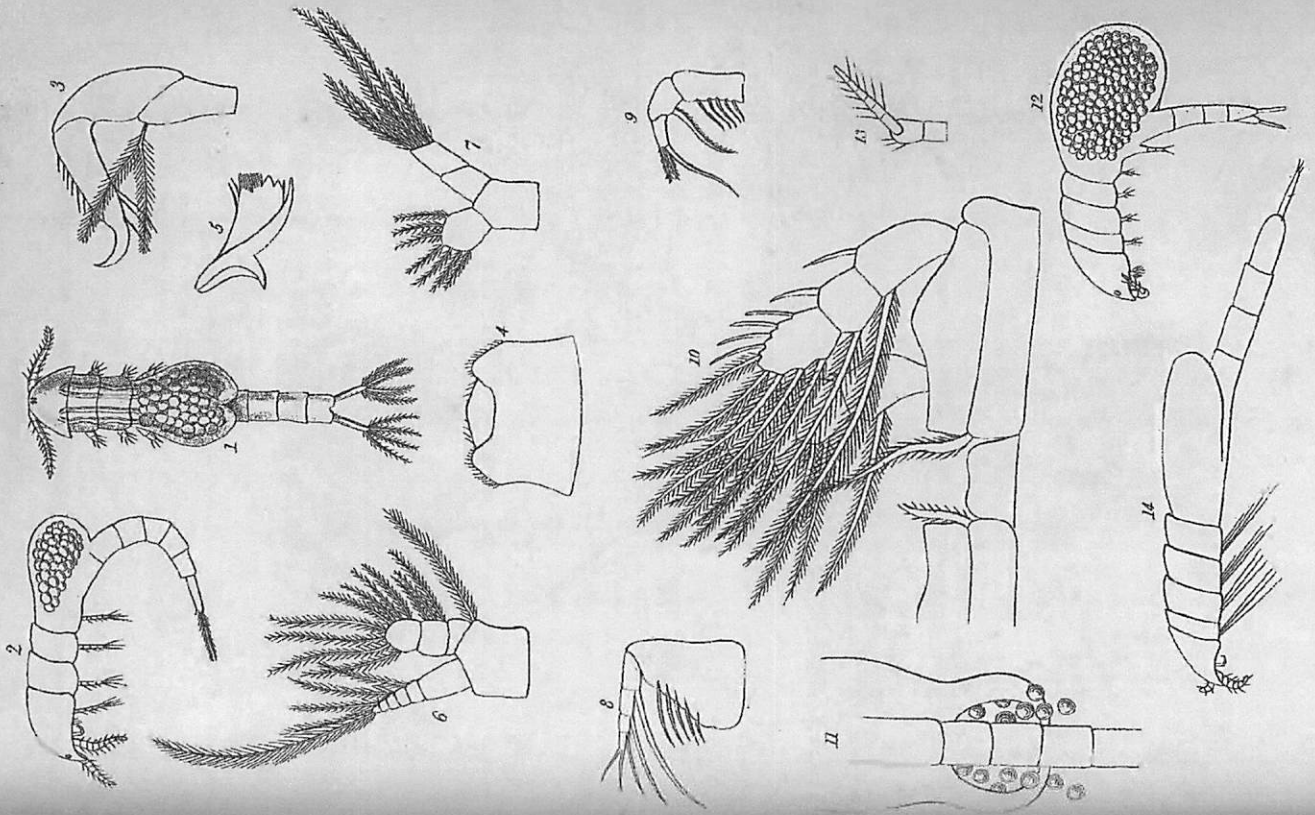
- Fig. 15. The same viewed from above.  
 Fig. 16. Its labrum.  
 Fig. 17. One of its mandibles.  
 Fig. 18. One of the appendages immediately succeeding the antennæ.  
 Fig. 19. One of the penultimate pair of accessory oral appendages.  
 Fig. 20. One of the last pair of accessory oral appendages.  
 Fig. 21. A pair of true feet in this stage.  
 Fig. 22. Larva as it appears on escaping from the ova of fig. 12.

II.—On *Conjugation in the Diatomaceæ*. By G. H. K. THWAITES, Lecturer on Botany and Vegetable Physiology at the Bristol Medical School.

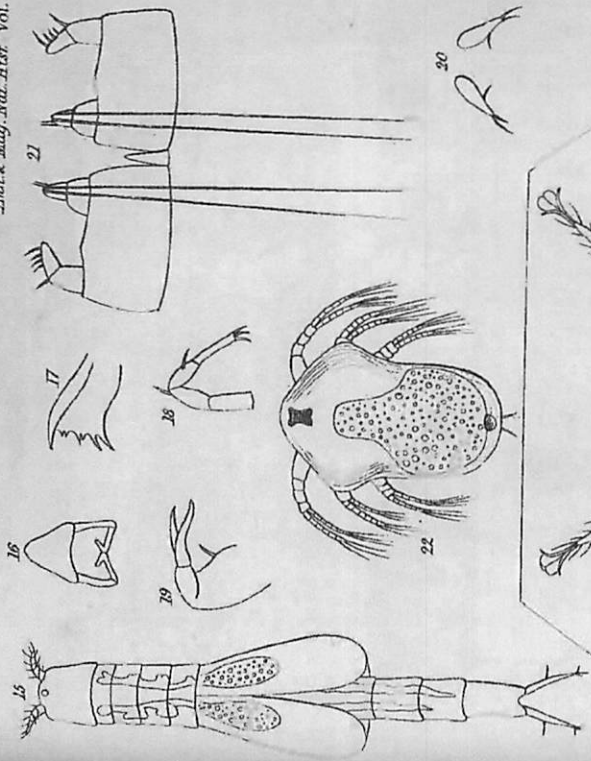
[With a Plate.]

To the Editors of the *Annals of Natural History*.

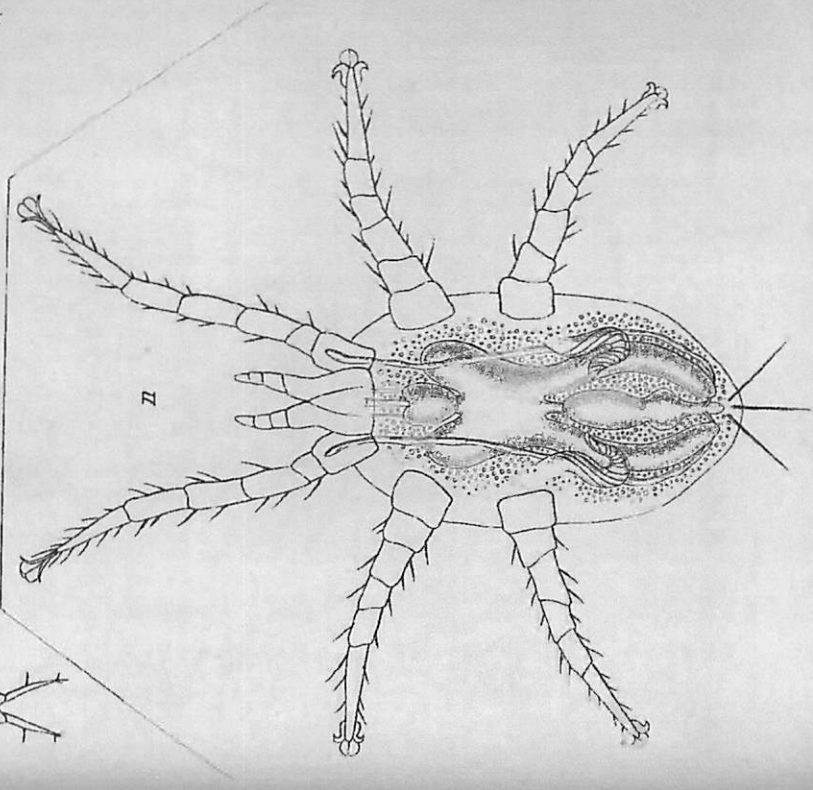
GENTLEMEN, 2 Kingsdown Parade, Bristol, May 11th, 1847.  
 It gives me great pleasure to be able to announce through the medium of your valuable journal the very interesting discovery







RA



*Larva of Halarudine Halichari.*