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**On some new Crustacea from the
Uppermost Silurian Rocks: With a Note on
the Structure and Affinities of
Himantopterus. by T. H. Huxley, Esq.,
F.R.S.**

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Notes

3. *On some new CRUSTACEA from the UPPERMOST SILURIAN ROCKS.* By J. W. SALTER, Esq., F.G.S. *With a Note on the STRUCTURE and AFFINITIES of HIMANTOPTERUS.* By T. H. HUXLEY, Esq., F.R.S.

THE occurrence of large *Crustacea* other than *Trilobites* in the older Palæozoic rocks is so rare, that we are scarcely prepared for the simultaneous discovery of five or six new forms, of dimensions equalling those of the crabs and lobsters of the present day.

Except the large *Pterygotus* of the Tilestone beds, and the *Ceratiocaris* from Westmoreland, scarcely any remains of these have yet been made out in Britain. But there have been sundry indications in the occurrence of large tail-spines and fragmentary carapaces, all of which have been most carefully treasured up to wait for further evidence, such as that now afforded by the discoveries of Mr. Slimon*. His admirable collection not only fully explains the meaning of much that was fragmentary before, as in the case of the *Ceratiocaris*, but gives us new forms of a group of which we knew very little, except that it contained the gigantic *Eurypterus* of De Kay and the *Pterygotus* of Agassiz, and was doubtfully referable to the *Pæcilopoda*.

Of the affinities of the *Eurypteridæ* I am not called upon to say much here, as we hope to fully describe these specimens in the publications of the Survey. The family has been regarded as a group of the *Palæade* by Burmeister; but their relation to the *Trilobites* seems more than doubtful. Since then Ferd. Römer† has suggested their affinity with *Limulus*, pointing out, however, the great differences in the feet. Prof. McCoy has adopted this view, and united *Pterygotus* and *Eurypterus* in the family *Eurypteridæ*, Burm., the principal character of which, as distinguished from the *Limuli*, is the very obvious one of the free-jointed rings of the abdomen. And in this association I should have been content to leave them, but for the suggestion of a much more complete affinity by Mr. Huxley, which will, I think, when he has worked it out for us, explain not only these forms, but also the group of *Ceratiocaris* and its allies above mentioned, which are far from uncommon in the Ludlow rocks. And it may, perhaps, include my Cambrian genus *Hymenocaris*, and thus relieve the *Phyllopoda* from the burden of these old and anomalous Palæozoic forms. As Mr. Huxley has promised to add a full note upon the subject, I will not enter further into it here.

The beautiful figure by Ferd. Römer of the *Eurypterus remipes*, and Eichwald's late discovery of the *E. tetragonophthalmus* in the Isle of Oesel‡, have furnished good materials for understanding that genus. The latter zoologist especially has been enabled to figure clearly the jointed feet and the sculpture of the rings of the body. And this sculpture is so exactly that of *Pterygotus* on a small scale,

* See the preceding paper, p. 15.

† *Palæontographica*, vol. i. p. 193.

‡ *Bulletin de la Soc. Imp. des Naturalistes de Moscou*, 1854, no. 1. p. 100. pl. 1.

as to suggest immediately an affinity between that large Crustacean, with strong didactyle pincer-like feet, and these with the principal feet, at least, adapted for swimming ("runderblättchen"). The entire form of *Pterygotus*, however, is so little known, that it is impossible to say it did not possess a pair of natatory feet*, and large pincer-like antennæ; and, on the other hand, the anterior pair in our fossils are chelate organs, and nearly all the figures of *Eurypterus* show something of the same kind. The affinity then with *Pterygotus* may be closer than we yet know of.

Eurypterus, De Kay, is a large and elongated Crustacean, with an entire semioval or subquadrate carapace, on which the large sessile eyes are placed, in the manner of those of *Limulus*, wide apart, but towards the middle of the head. The body is ovato-lanceolate, broad in front and attenuated behind, and terminated by a pointed or acuminate tail. There are 10 or 11 body-joints, exclusive of the tail-joint; and the hinder (abdominal) rings are subquadrate; the anterior (thoracic) rings widely transverse.

The limbs or appendages are three on each side, according to the very perfect figures given by Eichwald; the two anterior of which are simple appendages, of about five joints each, with small chelate tips. The hindermost pair are much broader and longer, consisting of five joints, of which the two terminal ones are rather suddenly dilated and form a long-oval palette.

HIMANTOPTERUS, gen. nov.

In the specimens here described, although the general form is much the same as that of *Eurypterus*, there is this essential difference, that the eyes are placed, not on the surface of the head, but on the anterior or antero-lateral margin, and quite at the edge. Together with this, the swimming feet are of a more linear form or rather thong-shaped. The name *Himantopterus*† may be therefore appropriate for the genus to which these specimens belong.

They are closely allied to *Eurypterus*, like which they have a comparatively small carapace, with the single pair of maxillary feet for swimming, but, so far as we yet know, with only one pair of antennæ. These latter organs are linear, narrower than the paddles, and consist of few joints; the last joint is strongly didactyle, with rather long chelæ. The accompanying woodcut (p. 28) shows the general characters of the genus.

A genus nearly allied to this has been described by H. von Meyer and Dr. Jordan, from imperfect specimens in the coal of Saarbrück‡. Von Meyer's genus differs at a glance from our fossils in the sudden reduction of width in the abdominal joints; there are

* Agassiz's figure of the principal limb (Poiss. Foss. Vieux Grès Rouge, tab. A) looks exactly like one of the swimming feet of *Himantopterus*: and the very large pincer-like limbs in that case must surely be antennæ.

† From the Greek *ἵμας*, *ἱμάριος*, a thong, and *πτερόν*, a wing.

‡ Dunker and Von Meyer's Palæontographica, vol. iv. pt. 1. p. 8. pl. 2. fig. 1.

six wide thoracic rings, somewhat falcate at their outer extremities ; but the number of joints of the abdomen, the position of the eyes,

Figs. 1-7.—*Diagrams of Himantopterus.*

1. *H. bilobus* ; half the nat. length ; position of the jaws, on the under side of the head, indicated at *a*.

2 *a*, one of the jaws and its scale-like markings ; 2 *b*, a portion magnified.

3. *H. maximus* ; part of the head, one-fifth the natural length.

4. *H. acuminatus* ; tail-joint, one-third the length.

5. *H. lanceolatus* ; last two joints, about one-half the natural size.

6. *H. perornatus* ; part of three thoracic rings, to show the fulcral point and the scale-like sculpturing on the forward half.

7. Scale-like appendages ; many of these lie loose on the surfaces of stone in which the fossils occur.

and the appendages are not known ; and we should not be justified therefore in uniting the two forms on such fragmentary evidence. From the figure I should suspect the eyes are lateral, as in *Himantopterus* ; the sculpture is like that of our fossils, and the size not less than that of our smallest species.

There are five species of *Himantopterus* in the Lanarkshire locality, and one from South Wales, already known.

1. *HIMANTOPTERUS ACUMINATUS*, sp. nov. Fig. 4.

H. pedalis et ultra, elongatus, articulis 12, quorum quinque ultimis subquadratis, penultimo oblongo; caudâ magnâ, ovatâ, et in apiculum serratum longum productâ.

Of this fine species, which must have been nearly 2 feet long, we have specimens which show the whole of the thoracic and abdominal segments united. The former are broader than, but not abruptly distinct from, those of the abdomen. They are transverse, a little produced at their posterior lateral edges, and have along the middle of the dorsal line either one or two (probably one) short spines projecting backwards.

The abdominal segments are but little broader than long. The penultimate, indeed, is quite as long as broad; and the terminal joint, of which we have specimens 5 inches long, is contracted and convex at the base, then rather suddenly expanded into an ovate form, and produced into a long apiculus (fig. 4). A keel runs the whole length of the segment, and the sides both of the expanded portion and of the apiculus are crenate (less strongly than in our figure).

We have but little of the carapace, and cannot be sure that the next described species does not belong to it. Of the limbs, there are the large swimming feet, consisting of a very large basal joint (coxa), and five others: the first narrow, the second irregular in shape, the third, where the backward bend of the limb takes place, subtriangular but rounded in front. The penultimate joint is much longer than broad, and deeply bilobed at the tip; the terminal one is an ovate palette, two and a half times as long as broad. The scaly sculpture occurs on all the joints of the limb.

With these limbs lie a pair of antennæ (?) of equal length. They consist of about five rather inflated joints, terminated by a small uncinate joint. They appear to be united at the base.

2. *H. MAXIMUS*, sp. nov. Fig. 3.

H. capite ferè 8 uncias longo, 5½ lato, oblongo, vix suburceolato, lateribus anticè contractis; fronte rotundato; oculis magnis, oblongis, ad angulos externos fixis; margine antico et laterali tuberculato-crenatis.

If we estimate the length of this species by taking the proportionate length of the head to the body, which we find in the *H. bilobus* (fig. 1), the entire creature must have been at least 3 feet long; or, if we suppose it to have had the same proportions as *H. acuminatus*, which has more elongated body-joints, the case would not be different.

We have two specimens of the head, and both present the same characters in the eyes, and in the rugoso-crenulate anterior margin.

3. *H. BILOBUS*, sp. nov. Fig. 1.

H. 6-7-uncialis, ovato-elongatus; articulis 11 vel 12, omnibus transversis, ultimo subquadrato; caudâ oblongâ, ad apicem profundè divisâ.

Of *H. bilobus*, which is the common species at Lesmahago, we have more materials for illustrating the generic characters than of any of the others. There are complete specimens with the head, five or six thoracic, and six abdominal rings, tail, swimming-feet, and antennæ all in their places; and several specimens show these various parts dissected. It is only in this species that we can see the maxillæ in their right position, with their serrate edges and broad foliaceous basal joints. The antennæ also (probably only one pair) are in their position, attached to the anterior part of the head. They are linear, of few joints, and are deeply chelate at the tip. The swimming-feet, attached to the posterior parts of the cephalic shield, are short; the portion which projects from beneath the carapace, and is directed backwards, being not above one-fourth the entire length of the body, and reaching to the fifth ring. The specimens being all nearly of a size, it is presumed we have the adult form.

The body, in our best specimens, is elongate-oval in front, and gradually attenuated into the abdomen, from which it is not easily distinguished. If we reckon the five* anterior rings for the thoracic ones, these are widely transverse, the length even of the last ring being not more than one-third its width. Their posterior angles are very slightly produced backwards. The six posterior rings are all much wider than long, except the penultimate joint, which approximates to square. Its hinder angles are produced to lap over the rounded anterior edges of the caudal joint. The latter is only two-thirds as wide as long, and fully double the length of the penultimate joint. It is widest behind, with the posterior angles rounded off, and is deeply cleft more than half way up. No median keel like that of *H. acuminatus* can be detected on any of the body-joints except the last but one; the upper part of the tail is keeled also for a short distance.

The carapace is half-oval, and only one-fifth wider than long. The position of the eyes is very forward on the sides, and they somewhat interrupt the general oval contour. They are broadly crescentic and convex; and their extreme length is rather more than half that of the head. No lenses can be seen on their smooth surface.

The maxillæ (or mandibles) occupy nearly all the under side of the head; they are 4-jointed; the basal joint greatly the largest, and somewhat of a spherical-triangular form; the second and third joints are narrow and wedge-shaped, and the terminal one short and

* Or six. There is some evidence of a narrow anterior segment in addition to the eleven body-rings; and, as three other species have the anterior segment narrow, and eleven rings behind it, it is probably the case here; and we have so represented it in the diagram (fig. 1, p. 28).

wide, with a strongly serrate edge. The whole surface is ornamented with scale-like sculpture. The hypostome, or anterior part of the under side of the head, is transverse, and from beneath it spring the linear but rather broad antennæ, which are considerably longer than the carapace.

The swimming-feet are formed of six joints, the basal or coxal joint very large; a second, third, and fourth of irregular shape; the angle of the bent limb being formed by the third (rather than the fourth, as in *H. acuminatus*); and the fifth and sixth are elongated, but not much wider than the rest; the penultimate joint is the larger of the two, and is notched to receive the terminal ovate palette. These swimming-feet always start exactly from the angle of the carapace, where it joins the first body-ring; and we are able hence to ascertain the true hinder edge of the carapace when it is otherwise obscured by pressure.

There are some flat appendages, of a cordate-ovate form, which are frequently associated with this species, but their nature is wholly unknown. It is possible they may be scale-like appendages at the base of the antennæ. One is figured in the woodcut (fig. 7).

4. *H. PERORNATUS*, sp. nov. Fig. 6.

H. magnus, pedalis et ultra 4 uncias latus; capite sublævi; thorace valdè sculpto, et ex segmentis 6 latissimis curvatis composito; segmento primo angusto lateribus rotundatis, secundo subfalcato, reliquis subparallelis; segmentis omnibus anticè squamulis minutis ornatis, posticè sublævibus; angulis capitis acutis; oculis anticis (minoribus?) granulatis.

Of all our specimens this one only shows the true consistence of the corneous crust, and the slight general convexity, which, it is probable, all the species possessed. The head is fully half a broad oval, and has the eyes rather forward, but small (in proportion to those of *H. bilobus*), and these show the lenses well.

The head is smooth, or at least shows none of the peculiar sculpture so visible on the thorax-rings; and these only show it on the anterior half and on the sides, the posterior half of each segment being smooth. The sculpture consists of short scaly markings, directed backwards like those of *Pterygotus*, but far smaller; and these are very prominent, though of small size, and rather irregular as to the amount of curvature. They are very like those on the *Eurypterus* figured by Eichwald, and above referred to. Probably this sculpture is characteristic of the whole family of the *Eurypteri*.

The fulcral point of these wide body-segments (fig. 6) is very near ($\frac{5}{8}$ ths of an inch in a segment 4 inches broad) to their ends, and the forward curve of the segment is changed at this point for a straight outward direction. One of these pleuræ, broken out from the specimen, showed that there was an incurved sculptured portion for a short distance on the under side, like that of the *Trilobite*.

5. *H. LANCEOLATUS*, sp. nov. Fig. 5.

H. elongatus, posticè attenuatus; articulis 12, quorum 10 transversis, penultimo oblongo, caudâ acutâ productâ.

This is the smallest of the *Lesmahago* species. It is elongate, attenuated behind, consisting of twelve body-rings, which are sculptured anteriorly, as in the last species, and are all transverse, except the penultimate, which is elongate-oblong. The tail-joint is a gradually pointed spine, longer than the preceding joint, and appears to be keeled along the middle. (Its base is less bulbous than it is in our figure.)

The swimming-feet are narrow, and extend back to the sixth body-joint.

Locality.—All the above are from the same locality,—*Lesmahago* in Lanarkshire; and were discovered in the uppermost Silurian rock by Mr. Slimon*.

Another species of the genus occurs in the Tilestone of Kington, Herefordshire, and has been for some time known to me. I propose to call it *H. Banksii*.

6. *H. BANKSII*, sp. nov.

H. parvulus, 2-3-uncialis; capite convexo, parabolico, ad frontem subangulato; oculis gibbis lateralibus, ad medium capitis, prominentibus; annulis trunci valdè transversis.

This small neat species, of which we have many specimens in the Museum of Practical Geology, occurs with *Pterygotus* and spines both of Crustaceans and of Fish, in the yellow tilestone beds of Kington, Herefordshire. It is there associated with the *Platyschisma? helicitæ* and *Lingula cornea*. These are the two species of shells which appear to accompany the fossils of Lanarkshire above described,—a good argument, therefore, even without other evidence, for regarding those beds as the uppermost portions of the Ludlow rock.

The head is $1\frac{1}{8}$ inch long, and fully as much broad; it is semioval, produced and angulated anteriorly, regularly convex, with a thick margin, on which the prominent oval eyes are placed rather more than half-way up the head. They are small in comparison with those of some of the other species. The posterior head-angles are retuse, and the hinder margin is quite plain and even, as in the other species. We do not possess the body, except imperfect portions of the first nine rings; and these agree in general form with those of the *H. lanceolatus*. Both have a close scale-like sculpturing on their forward margin, and together with them at Kington occur also tail-spines, scattered in the rock, which may possibly belong to them, and which are narrower than those of the Lanarkshire fossil. As

* See the preceding paper, by Sir R. I. Murchison.

we do not yet know the head of the latter, we must for the present keep the species distinct; and I propose to dedicate it to Mr. R. Banks of Kingston, who has lately been making discoveries amongst the tile-stones, and has sent good specimens of this and other fossils to London.

Phyllopoda?

Among the Lanarkshire specimens, so well collected by Mr. Slinn, are perfect forms of the genus *Ceratiocaris*, M'Coy*. Only the carapace has hitherto been discovered; but the occurrence of body-rings in the Dudley limestone has been for some time known; and in the Ludlow Museum I lately saw such body-segments connected with the long triple tail-spines now known under the name of *Leptochelest*†.

Fortunately these specimens from Lesmahago have all the parts in juxtaposition, and show the animal to have been a large *Apus*-like Crustacean, with a carapace bent sharply down the dorsal line, pointed anteriorly and truncated behind, and with an elongate abdomen of at least five, if not six, joints,—the hinder ones longest. The last joint is a thick striated spine, with a bulbous articulation, and has a pair of lateral spines or appendages at its base, nearly as long as itself.

Fig. 8.—*Diagram of Ceratiocaris, M'Coy, with body and tail-spines attached; from perfect specimens found in Lanarkshire.*

The resemblance to *Hymenocaris*, except in the presence of the strong caudal spines, is sufficiently clear from the accompanying woodcut (fig. 8).

Now that we know the entire structure of this genus, it must be removed from the *Limnadiadæ*.

It has a nearer resemblance to *Apus* and *Dithyrocaris*, but differs at once from the latter genus by the deflected sides of the carapace, and apparently too by the want of regularly-shaped smooth eyes, for

* Synopsis Brit. Pal. Foss. Cambridge Mus. fasc. 1. p. 137.

† M'Coy, Syn. Brit. Pal. Foss. Camb. Mus. fasc. 1. p. 175.

we have no evidence that the prominent spot (described by M'Coy) on the anterior portion, is an eye, though it is very probable that there are lenses at this point.

Perhaps there may be no true relation with the Phyllopods in this form any more than in *Himantopterus* with the Pœcilopods. It may be, as Mr. Huxley suggests, also one of the *Stomapoda*; and there are some indications of long antennæ, which may perhaps, with the apparent absence of abdominal appendages, help to connect it by analogy with some known forms of the group last mentioned.

In the meantime it is curious to see how gradually we have arrived at our present knowledge of its structure. The carapaces had been known for some time; but from their resemblance to bivalve shells had lain unnoticed in cabinets. Prof. M'Coy and myself both independently recognized their Crustacean structure, which he fully published in his work on the Cambridge fossils; and he discovered the eye, which I had not observed. In the meantime Prof. M'Coy and M. Barrande both recognized the Crustacean character of the tail-spines; the former distinguishing them from fish-defences*, with which they had been confounded; and the latter, from better specimens, making them out to be the tail, and not the pincers, of an unknown Crustacean.

In the Dudley limestone the carapace and some of the body-joints were found near together, by Mr. John Gray of that place; and in the Ludlow Museum, as above noted, are the joints of the abdomen connected with the terminal spines. Lastly, Mr. Slimon's specimens show the entire form, and give some hint as to the appendages. It is hoped ere long to illustrate them fully.

OBSERVATIONS on the STRUCTURE and AFFINITIES of HIMANTOPTERUS. By T. H. HUXLEY, Esq., F.R.S.

FROM what has been stated in the preceding pages, it would appear that the following propositions embody all that is at present certainly known with regard to the great structural features of the genus *Himantopterus*.

1. The body is composed of a comparatively small carapace, succeeded by eleven or twelve free segments, the last of which is bilobed, lanceolate, or wide anteriorly and acuminate posteriorly.

2. At the margin of the carapace on each side lies a rounded or oval eminence, which there is every reason to regard as an eye.

3. The free segments have no appendages. The cephalothorax presents three pairs: an anterior, probably chelate pair, occupying the position of antennæ; a middle pair of broad, short, foliaceous, serrated organs, which have the appearance of mandibles; a posterior pair of long flattened, jointed appendages, terminated by an oval palette, and not improbably having an articulated filamentous appendage attached to their penultimate or ante-penultimate joint.

* Quart. Journ. Geol. Soc. vol. ix. p. 13.