

ARTICLE IX.—*On a Fossil Scorpion from the Silurian rocks of America.* By R. P. WHITFIELD.

The discovery of the fossil remains of scorpions in the Silurian rocks of Sweden, was first made known to the Swedish Academy of Sciences on November 12th, 1884, and attracted much interest in as much as it apparently carried the history of air-breathing or land animals much further back in geological time than had hitherto been known. This discovery was no sooner made known than it was learned that a similar one had been made in Scotland. The first published statement of the Swedish find was made in the *Comptes rendus* of the French Academy, on December 1st, 1884, and that of the Scottish one in the *Glasgow Herald*, December 19th, 1884. The deep interest felt in these discoveries caused them to be published in many scientific and other journals, by which means they soon became widely known. On June 8th, of the present year, Mr. A. O. Osborne, of Waterville, N. Y., wrote me, and sent some "fossils of special interest from the Waterlime beds" near that place, on opening which I found among them a very nicely preserved scorpion of small size. The almost simultaneous discovery of rare and peculiar fossils at widely distant localities has often been remarked, and in this instance is quite peculiar on account of the small size of the objects. The dates of the discovery of the several scorpions are, for the Swedish specimen, although the first made known, June, 1884; that of the Scottish specimen, June, 1883, one year earlier; and that of the American specimen, November 10th, 1882, as shown by Mr. Osborne's diary. The value of it had not been recognized, however, until Mrs. Osborne saw the notice of the others in print.

CONDITION OF THE SPECIMEN.

The specimen is imbedded on the rock with the dorsal surface exposed, and is greatly compressed, as are all the fossils found in the same beds. Its thickness dorso-ventrally, is less than a twentieth of an inch; the crust being extremely thin and the foreign material between the dorsal and ventral plates almost inappreciable. The dorsal crust is preserved over about two-thirds of the surface, including all of the cephalothorax and more than half of the [Oct. 10th, 1885.]

preabdomen and a portion of each of the limbs and appendages of one side; while over the rest of the preabdomen and what remains of the postabdomen or tail, parts of the first five segments, the inside of the ventral crust is exposed. The posterior three-fourths of the fifth tail segment and the sixth or sting is missing. The absence of this latter portion is much to be regretted, a fact which I realized on first examining it, and more fully on further study. The fragment of stone on which the specimen lies has been chipped from a large block and this important part left behind. Search has been made for it, and also for fragments of other individuals, but without success.

GEOLOGICAL POSITION.

The *geological horizon* of the American scorpion is perhaps not very different from that of either of the other Silurian species. The bed in which it was found, the Waterlime rock, is at the extreme lower limit of the Lower Helderberg group, or below it. Prof. James Hall, in 1875,¹ appeared to consider it as a separate formation, lying between the Lower Helderberg and Niagara groups.² This would place it near the middle of the Upper Silurian. Profs. Thorell and Lindström state on pp. 4 and 5 of their Memoir,³ that the Swedish specimen was found at about the middle of the beds considered as the equivalents of the Upper Ludlow rocks of England, or the Lower Helderberg group of New York, and the Scottish specimen was derived from the uppermost limits of the Upper Ludlow beds.⁴ It is probably impossible to draw a line of strict parallelism between the different parts of the European Upper Silurian rocks and those of New York, as the representative fossils occur at relatively different parts of the formation in the different countries. But it would appear that the American form came from a somewhat lower horizon than either of the others. In each case they are associated with similar forms of fossil remains, as Eurypteris, Pterygotus, Ceraticaris, and Lepér-

¹ 27th Rept. State Cab. N. Y., pp. 127, 128.

² At several localities south of Schoharie, as at Kingston, N. Y., it is difficult if not impossible to draw a line between the Waterlime beds and the Tenaculite limestone, which is considered as a part of the Lower Helderberg group proper, the beds gradually passing into each other.

³ On a Silurian scorpion from Gothland, by T. Thorell and G. Lindström, Kongl. Svenska Vetenskaps-Akad. Handl. Bandet 21, No. 9.

⁴ On p. 16 of Thorell and Lindström's Memoir they state that their specimen comes from thin marly clay, probably belonging to the base of the Upper Ludlow series.

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ditia ; and these are restricted within a limited vertical range at each locality, but do not hold the same relative position in the formation. I am also inclined to consider the American form as more embryonic in its structure, or further removed from the living scorpions in some of its features as will be seen from the description.

ZOÖLOGICAL RELATIONS OF THE SPECIES.

On first studying the specimen, it appeared to me desirable to include it under the same genus with the other Silurian scorpions if possible, although recognizing the differences between them, as shown by the statements of characters given in *Nature*, *Science*, and other publications ; especially in the existence of double terminal claws on the walking limbs of the American specimen. At the time of writing the brief notice given in *Science* of July 31st, 1885, I had not seen the scheme of classification adopted by Profs. Thorell and Lindström ; but, when through the kindness of Mr. S. H. Scudder and afterward from a copy sent me by Prof. L., I was enabled to see this, I recognized at once the impracticability of including it under their genus *Palæophonus*. I therefore propose for it a new one under the name *Proscorpius*, with the following characters.

PROSCORPIUS, new genus.

Cephalothorax with large dorsal eye lobe, the eyes small, one on each side of the median line. Lateral eyes on ridges as in the living scorpions. Sixth ventral segment of the preabdomen, counting from behind, large, equal in length and breadth to the corresponding dorsal segment in the only species known. Anterior walking limb terminating in a bifid claw. Postabdomen not reversed as are those of the living scorpions. Type *P. Osborni*.

In S. H. Scudder's new classification of the Palæozoic scorpions, now printing for Vol. 2 of *Zittel's Manual of Palæontology*, he divides the Eoscorpionidæ into three sub-families, Proscorpionini, Eoscorpionini and Cyclophthalmini, the former embracing the following characters: "Dorsal eye tubercle of moderate size, situated mesially on the front margin of the cephalothorax, the eyes small. Lateral eyes in two rows on the antero-lateral border."

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By this arrangement the present form is classed with the Carboniferous Eoscorpions, rather than with the Silurian Palæophonus, on account of the bifid claws terminating the walking limbs. This species will therefore be arranged in the following manner :

Order **SCORPIONIDEA**, Sund.

Sub-order **ANTHRACOSCORPII**, T. & L.

Family **EOSCORPIOIDÆ**, Scudder.

Sub-family **PROSCORPIONINI**, Scudder.

Genus **PROSCORPIUS**, Whitf.

DESCRIPTION OF THE SPECIES.

Proscorpius Osborni,

PLATES 19 AND 20.

Palæophonus Osborni, Whitf.; *Science*, Vol. 6, p. 88, 1885.

Specimen with the dorsal surface exposed. Cephalothorax and preabdomen united measuring nearly nine-tenths of an inch in length, and the first four segments of the postabdomen, very slightly displaced and thereby shortened, are just half an inch in length; the fifth segment is imperfect, the sixth entirely absent. Surface smooth, without granules. Specimen probably a female.

Cephalothorax quadrangular, narrower than the first segment of the preabdomen, length and width equal, somewhat trilobed on the anterior margin from the projection of the eye tubercle on the anterior border. Eye tubercle subquadrate, one-third as wide as the head, slightly elevated and bearing a single eye on each side of the median line; eye spots small. Lateral eye lobes rounded on the margin and slightly extending beyond the line of the head behind; eyes on ridges near the antero-lateral borders. Posterior border of the cephalothorax forming a broad band, resembling a segment of the preabdomen but proportionally narrower.

Preabdomen elongate-elliptical in outline, gradually widening posteriorly to the fifth segment, and more rapidly narrowing backward from that point; the posterior plate being paraboloid in form and only half as wide on the posterior as on the anterior border. The other plates somewhat gradually increase in length antero-

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posteriorly, from the first or anterior one, to the last. On each of the dorsal plates there occurs a sharply elevated line or ridge, a little behind the anterior border and parallel to it, and is continued across the lateral ends to near the posterior margin; just as in many of the modern scorpions. No other ornamentation occurs on them, but a few wrinkles, probably from compression of the crust, are seen on the two posterior plates. The right-hand end and surface of the ventral plates of the preabdomen are shown over more than one-third of the area, exposing their inner surface. This is entirely smooth, but for a slight wrinkling here and there, and the evidence of a thickening near the lateral margin on the three last. There are six ventral plates showing, which appear to have been of rather larger size than the corresponding dorsals, the anterior one of the six being apparently both wider and longer than the second or corresponding dorsal. None of these plates show satisfactory evidence of stigmatic slits; the last but one, or the hindermost of the four stigmatic plates, as seen in the modern scorpions, bears a slight mark in the position occupied by the slit when present, but which is altogether too indistinct to afford satisfactory foundation for asserting the presence of stigma in this example. The evidence for the existence of these organs is more negative than positive. Along the left side of each of the four stigmatic segments in the position occupied by the chitinous integument which unites the dorsal and ventral plates in living scorpions, there occurs a depressed area, deepest near the anterior part of each segment, which in certain lights look as if they had been perforated. The nature of these depressions is not yet understood.

The *postabdomen* shows only the inside of the ventral or lower plates of the four anterior segments, and a little of the upper end of the fifth. The first is very slightly displaced in relation to the last segment of the preabdomen, and the second from that of the first, but not enough to materially change the form or direction of the whole. Each of the segments show two ridges (depressions on the specimen) converging toward the posterior end of the segment and widening out anteriorly, and also the sinuosities on the anterior end of each, filled by the chitinous membrane to accommodate the bending of the joints one upon the other; indicating

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that the bending of the tail would be downward and not upward over the back, as in the more recent and living scorpions.⁵

Of the appendages of the cephalothorax there are preserved parts of each of those of the left side, and a fragment of the mandible and of three, or perhaps four of the limbs of the right side. The following description of these appendages is taken from the left side entirely.

The *mandible* is proportionally large, and with the claw is ovate in form in its flattened condition. A slight mutilation across the middle of its length obscures the actual outline of the movable finger, but it is prolonged and pointed at the tip, while no actual dentition of the edge of either portion can be definitely asserted. From the flattened condition of this appendage it presents a somewhat different appearance under different lights, when examined under a high magnifying power. The figure 2 *a*, plate XX, represents its appearance with the light in one direction; figure 2 *b* represents it as seen with the light directed in the opposite line, when the tip of the fixed portion can be seen overlapping the other very slightly. In still another light, directed almost lengthwise of the mandible, the sutures and lines of junction are lost, or nearly so, while on the margin there appear lines, as if it were margined with hairs, as in figure 2 *c*. This may possibly be only an accidental character dependent on the fracture of the rock.

The *palpus*, which is nearly entire, being only broken through in one spot, is of moderate length but quite strong. The scapula is large and longer than wide and curved on the anterior edge; the humerus is nearly three times as long as wide; brachium short quadrate; hand moderate in size, bulbous near the base with a proportionately long immovable finger, slender, curved and smooth on the edge, movable finger slender and curved like the other.

The *walking limbs* differ from each other in size and proportions. The first is short and slender, the joints of nearly equal length; the last one proportionally the longest and terminated by

⁵ On examining this portion of some embryo scorpions which I took from the body of a female preserved in alcohol, I find the tail bent symmetrically under the body with the extremity placed among the walking limbs, and the concave surface of the joints placed against the body, not indicating in any way the reversed position assumed in the living stages. These embryos were too small to show the sting or to reveal its position or direction.

a double claw, very similar to the living forms.⁶ Of the second walking limb only parts of two joints are exposed by the breaking out of the surface above them. Of the third, the first joint seen (coxa?) is very short and close to the abdomen, the second is nearly twice and a half as long as wide, and the third has also been long. Of the posterior walking limb a very short first joint (coxa?) is visible, like that of the third limb, and a part only of the second.

Geological formation and locality.—The specimen is from the Waterlime beds at Waterville, N. Y., and was obtained November 10th, 1882, by A. O. Osborne, and has now become the property of the Museum.

GENERAL OBSERVATIONS AND COMPARISONS.

The general form and appearance of this American scorpion is more like that of the Scottish than of the Swedish Silurian scorpion, and resembles very much in general aspect many of the living forms, but differs in several particulars from all of them. One of these differences, readily observed, is the short cephalothorax, and the crowding forward of the limbs and appendages. In the Swedish fossil the posterior limbs are placed opposite the second abdominal segment, while here they are immediately opposite the first segment. Another and very important difference between this and all other forms, consists in the existence of six large ventral plates to the preabdomen. In all the living species which I have examined, and in the fossil forms so far as I can ascertain, particularly the Scottish Silurian form, the fifth preabdominal ventral plate, counting from behind forward, is rounded on the anterior margin and narrow, as in the living forms; while the sixth, to which the pectinated combs are articulated, is reduced to a very small size. On the contrary, in this specimen the sixth is fully as wide laterally, and as long in an antero-posterior direction as the corresponding, or second dorsal plate, as counted from the anterior end. This feature, if properly understood, is a very

⁶ Mr. S. H. Scudder, who has examined the specimen, differs somewhat from myself in regard to the details of this limb. The visible joints he reduces to three or four, and thinks there is a small spine at the outer end of the penultimate joint. On careful re-examination I cannot reduce the number of the joints except by calling that nearest the body a fracture, which I think doubtful, and I am entirely unable to find the spine. An outline drawn by Mr. Scudder to illustrate his idea is given on plate XX, figure 4.

important one and must require a great modification in the form and position of the organs corresponding to the pectinated combs of the other scorpions.⁷ What these modifications are is not known, as they are not seen, and only the end of the ventral plate for a length of rather less than a twelfth of an inch is visible on the specimen. A third important difference, at least between this



FIG. 2.—Fossil scorpion from the Silurian rocks of Gothland, Sweden, enlarged. (From *Nature*.)

and the living forms consists in the position of the tail or post-abdomen in its relations to the other part of the body. In the living forms this appendage is reversed in its mode of articulation,

⁷ In the embryo specimens mentioned in a foot note on a previous page, the small plate between the pectinated combs appears to be as small proportionally, or nearly so, as in the adults; and I can find only the five ventral plates occupying the preabdomen behind it.

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and is carried arched over the back of the animal ; consequently the sinuate side of the joints are above when the tail is straightened out from the body, and the straight line of the articulations is below. In this specimen it appears to have been directly the opposite, and from Thorell and Lindström's figure I judge the Swedish specimen was the same ; and I presume the reversed position of the tail was assumed by its descendants at a later period.

WAS IT AN AIR BREATHER ?

Concerning the terrestrial habits of these Silurian scorpions, the present specimen affords but little evidence, and what is afforded is rather of a negative character. Although there can be no doubt of its near zoölogical affinities with the true scorpions, I can find no sufficient reason for supposing it to have been an air-breather other than its general analogy with those which we know to be such. The absence of anything that can with probability be said to resemble a spiracle in any of the four ventral plates, and in the position where they should



FIG. 2.—Fossil scorpion from the Upper Silurian rocks of Lesmahagow, Lanarkshire, Scotland, found by Dr. Hunter, Carlisle; magnified two diameters. (From *Nature*.)

appear, is certainly not favorable to that theory. There is every reason to suppose, from geological shore-line phenomena, that land existed in the near vicinity of the locality where the fossil was found; at least in the Medina and Clinton epochs, and we can readily believe the Waterlime beds themselves to have been deposits from shallow waters; so there may have been opportunities for a land animal to be drifted out to sea. But the existence

of land near by cannot be taken as a proof of the air-breathing nature of an animal unless that animal affords some structural evidence of the fact. What the peculiar stigma-like spots occurring in the chitinous integument of the left side of the specimen may have been I am unable to say; possibly only a form of ornamentation; their position is altogether too anomalous, so far as I know, among animals of this group, to warrant the expression of an opinion as to their use. I am much more inclined to think, therefore, that the specimen was aquatic in its habits than otherwise, and that the terrestrial habits and air-breathing nature of the group was a feature developed in subsequent generations; and that we have here a link between the true aquatic forms like *Eurypterus* and *Pterygotus*, and the true air-breathing scorpions of subsequent periods.

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EXPLANATION OF PLATES.

PLATE XIX.

PROSCORPIUS OSBORNI.

These figures are from photographs of the specimen, natural size and enlarged.

PLATE XX.

Fig. 1. View of the specimen, enlarged four diameters. In this figure the line across the base of the head was made too distinct, and the eye tubercle too long behind, in tracing the figure. The line separating the fingers of the palpus extends too far down, and the spot representing the stigma-like mark on the fifth ventral segment is too distinct.

Fig. 2 a. The mandible further enlarged; *b* and *c* show it as seen in different lights.

Fig. 3. Outline sketch of the specimen, two diameters; 1, mandible; 2, palpus; 3, first walking limb; 4, 5 and 6, parts of the other limbs; *a*, the spot which may represent a spiracle; *b*, the additional ventral plate; *c*, one of the depressions in the integument which looks like a perforation.

Fig. 4. Outline representing Mr. S. H. Scudder's idea of the first walking limb.

PLATE XXI.

LITUITES BICKMOREANUS.

Fig. 1. Shows the form of the undulations on the dorsal surface.

Fig. 2. Lateral view of the specimen, showing the form of the aperture.

Fig. 3. Shows one of the septa.

PLATE XXII.

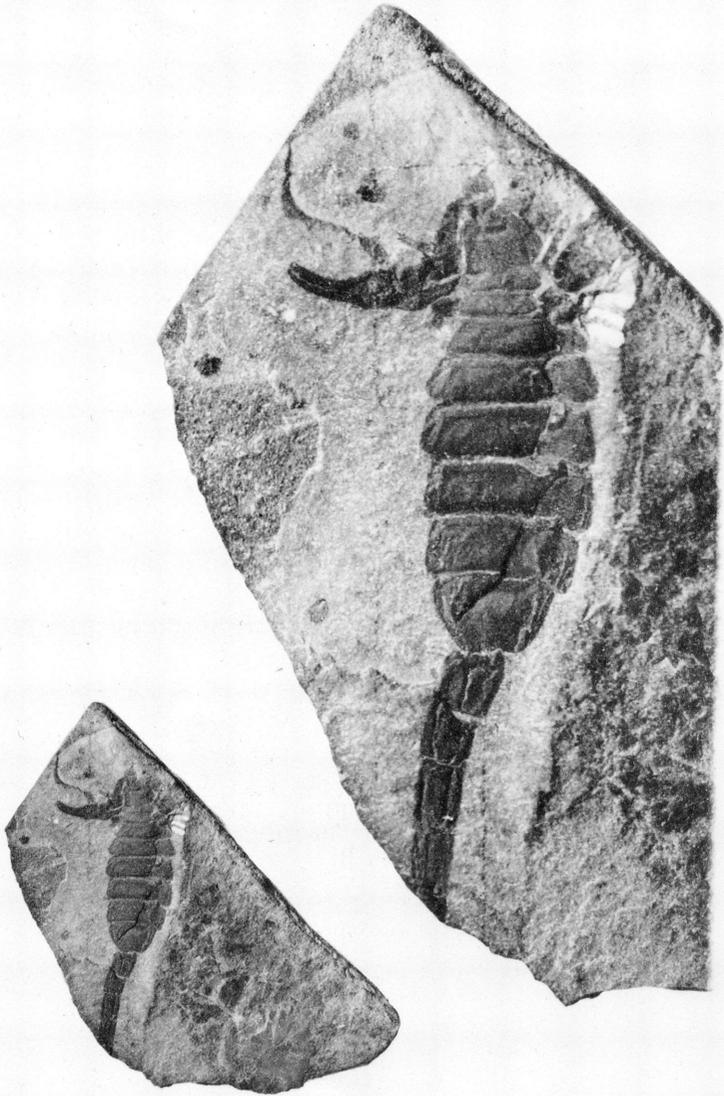
HOMALONOTUS MAJOR.

View of the specimen on which the species is founded.

PROSCORPIUS OSBORNI.

Bulletin A. M. N. H. No.6.

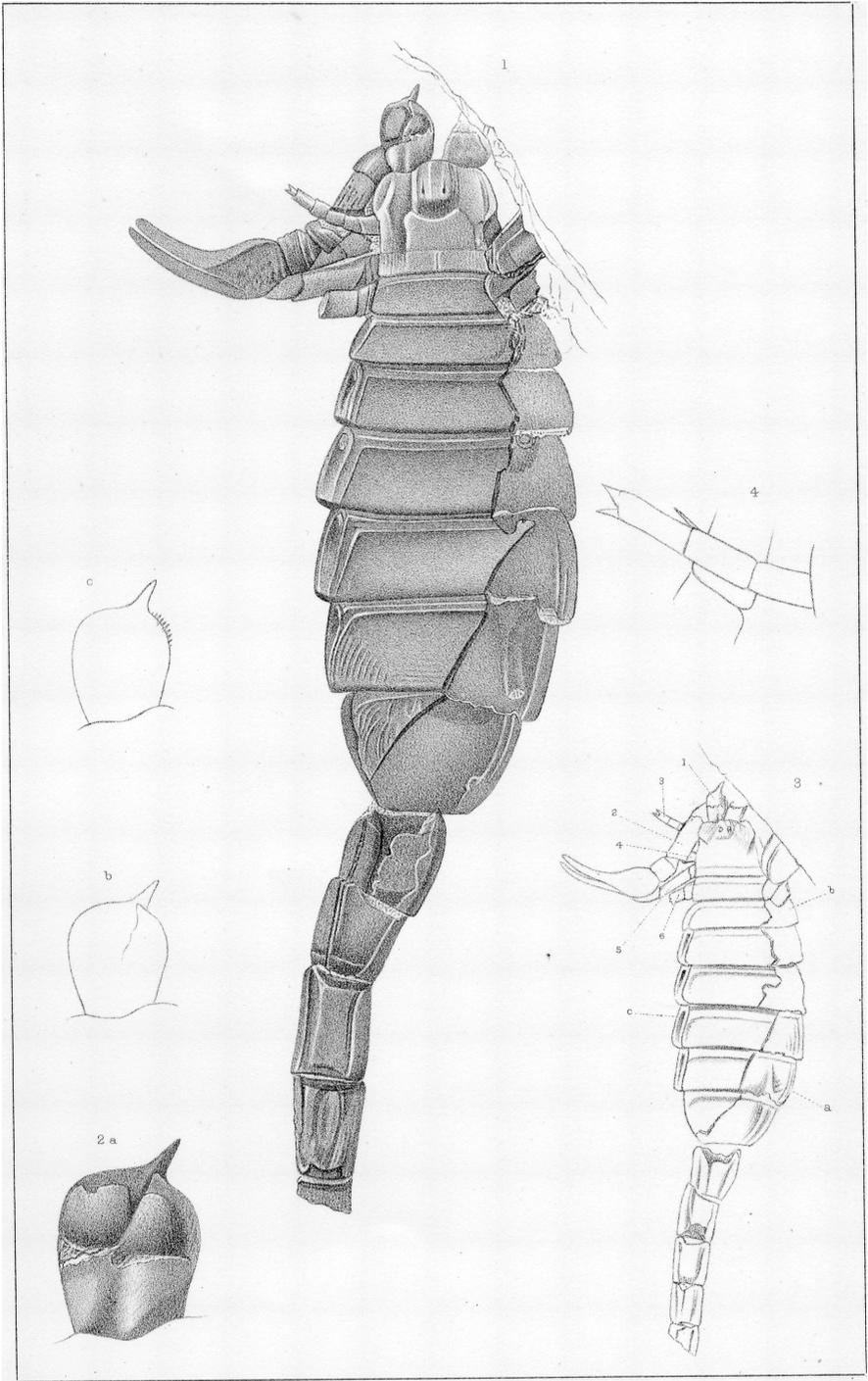
Vol. I. Plate XIX.



Artotype.

E. Bierstadt, N. Y.

FOSSIL SCORPION.



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