21. *On a* New Eurypterid *from the* Belgian Coal Measures.

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[Plate LIII.]

Remains of *Eurypterus* are quite uncommon in the Coal Measures, and more especially in Belgium, where, until recently, none had been recorded. When studying, with R. P. G. Schmitz, the cores of one of the numerous trial-borings put down in the new Campine Coalfield of Northern Belgium, we found a beautiful specimen belonging, without any doubt, to this interesting genus of fossil Merostomata. We recorded this discovery some years ago (Schmitz & Stainier, 1910). Availing myself of the opportunity of examining the excellent material available in England, the classic country for fossil Crustacea, I now venture to publish a description of the new species.

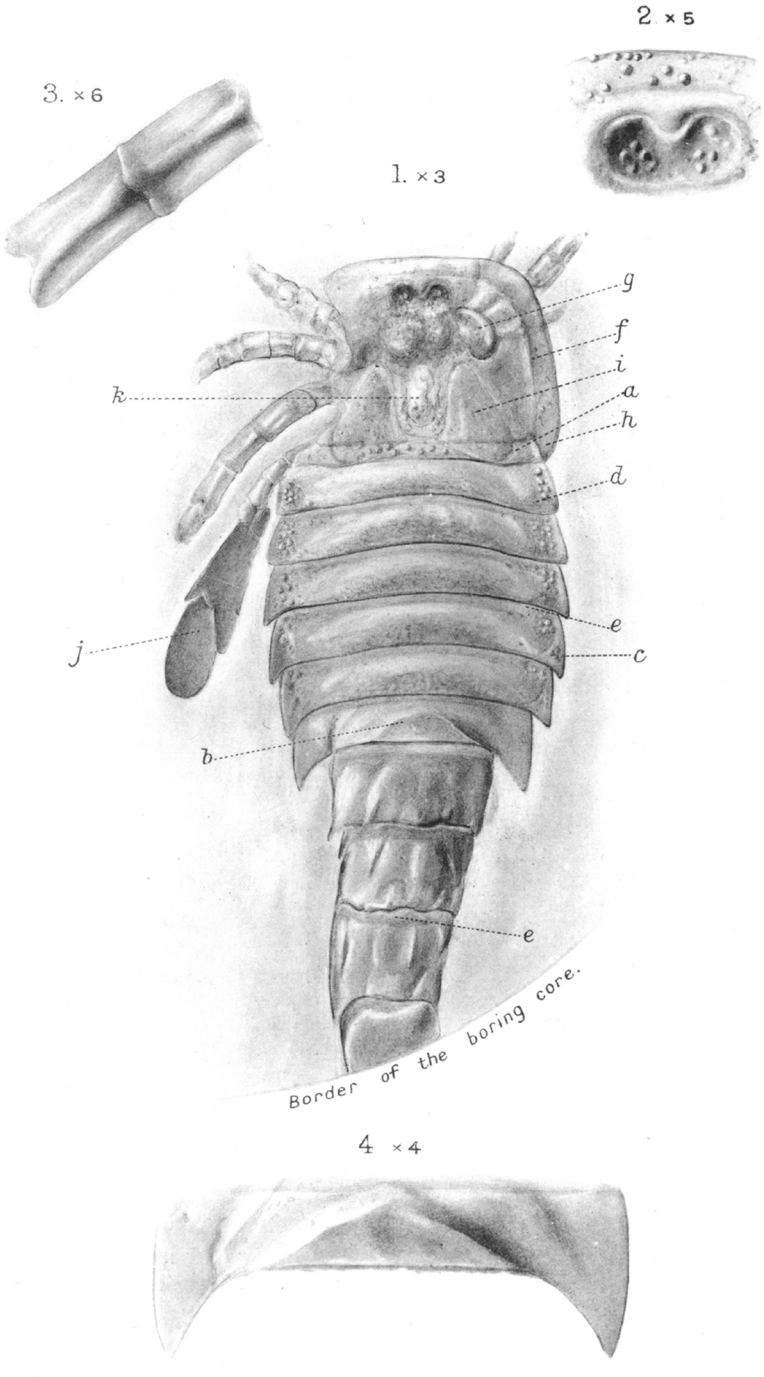
Description of the Fossil.

The splitting of the cores has disclosed the crustacean lying amid scattered remains of undeterminable plants on a fine-grained, greyish-brown, micaceous shale. The animal has the same dark coloration as the surrounding plants. Owing to a blow of the hammer, the counterpart of the fossil is fractured and incomplete, and therefore of little use for palæontological purposes. But, fortunately, the impression of the dorsal aspect is in an excellent condition. It is to be regretted that the fossil has been partly destroyed by the diamond drill, the consequence being that some portion of its abdomen and the entire telson are altogether wanting.

Dimensions:—This new species is one of the smallest Carboniferous Eurypterids known, its maximum length being only 33 millimetres and its maximum breadth 12 mm.

Cephalic shield.—Length=8 mm. Breadth at the posterior border=11 mm.

The head is not the best-preserved part of the fossil, and it is incomplete, its left portion adhering to the counterpart. But this last defect is not to be regretted, for, thanks to it, we are able to see the basal segments of four of the left appendages. The outline of the cephalic shield is hemi-ellipsoidal, and the angles of its posterior border are projected backwards so as to embrace closely the ends of the first postcephalic segment between its edges (Pl. LIII, fig. 1, *h*). The cheeks of the head disclose some hollows and bosses; but, owing to the bad condition of the head, it is uncertain whether some of these hollows and bosses have not been



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EURYPTERUS DUMONTI, sp. nov.

produced by rock-distortion. The right eye, although badly preserved, is plainly visible (Pl. LIII, fig. 1, *g*), reniform, not prominent, and very long. It is a little anteriorly placed, and its length is nearly a third of the total length of the shield. A slightly-raised ridge, separated from the border by a flat area, is to be seen all round the anterior and the lateral margins, and is especially well-marked on the front (Pl. LIII, fig. 1, *f*, & fig. 2). Behind this ridge, on the front, we observe an unusual hollow, which may be accidental. Close to the posterior border of the shield is an ellipsoidal boss or node, surrounded by a U-shaped ridge (Pl. LIII, fig. 1, *k*), on both sides of which is a triangular hollow with rounded edges, doubtless corresponding to the basal joints of the ectognaths (Pl. LIII, fig. 1, *i*). No trace of the median organ of the opercular plate can be detected beneath the first thoracic segments.

Thorax.—This is the best-preserved part of the fossil. Its outline is nearly quadrate, being 12 mm. long and 12 mm. in its maximum breadth. The broadest segment, the fourth one, is only 2 mm. broader than the first and the last segments. It is evident, therefore, that the thorax is not globular at all. The segments, except the first one, have their latero-posterior angles prolonged into spines, scarcely marked on the second segment, but becoming increasingly prominent and acute backwards, until they attain a length of 2 mm. on the seventh or last segment. All the segments have nearly the same depth, except the first, the depth of which is only half that of the others. This first segment is not only very different in size from the others, but it has also an extremely-peculiar outline, arched forward, while the others are markedly straight (Pl. LIII, fig. 1, *a*). Its ornamentation is very different from that seen in any other *Eurypterus*. Like the whole carapace, the thorax is slightly tumid in its centre and flat on the lateral margins. The intumescence, scarcely visible on the first postcephalic segment, becomes increasingly prominent backwards, until on the last segment it assumes the form of a triangular raised area, the base of which rests upon the posterior border of the segment, while both the other sides slope gently forward (Pl. LIII, fig. 1, *b*, & fig. 4).

The anterior border of each segment is depressed, so as to allow the overlapping of the segments one on the other. This depression, especially visible on the last segment, is called by James Hall (1884) 'articulating surface of the segments' (Pl. LIII, fig. 1, *e*).

Everywhere on the head and on the first five segments one may detect very minute granules, disposed without any order, but much more numerous on the margins. These granules do not appear to me to be the squamæ or scale-markings so conspicuous on all the fossil Merostomata. They look much more like the tubercles that are so characteristic of *Eurypterus scabrosus* (Woodward, 1887). After a careful study of those tubercles, Dr. Henry Woodward came to the conclusion that they are, in all probability,

calculi of calcite enclosed within the chitinous substance of the terga. Similar calculi are to be found, not only on many fossil crustacea, but on living ones also.

Abdomen.—Dimensions of the preserved part: Length = 13 mm. Maximum breadth = 6·5 mm.

There is a marked difference between the last thoracic segment and the first abdominal one, the latter being deeper but much narrower. Four only of the segments of the fossil are preserved. Sharp and slender spines, projected backwards, are to be seen only on the left latero-posterior angle of the first two segments; but the depressed articulating surface of the anterior border is everywhere clearly visible. The surface of the abdomen, absolutely flat, is covered with many irregular markings, which doubtless owe their origin to the foldings of a very thin carapace.

Appendages.—The five left appendages are all nearly fully visible, even as far as their coxal articulations, as the left part of the head has adhered to the counterpart. A very small portion of three right appendages is also preserved, but in a bad condition.

Left appendages.—Of the first appendage or antenna, only two badly-preserved articulations are to be seen. The second appendage or mandible, ending in a sharp and straight spine, is much better preserved, and shows six articulations. The third and fourth appendages or maxillæ are even in better condition, with six articulations, the terminal spine wanting. The fifth appendage or swimming-foot is fairly well preserved, with six articulations. The last appendage, being the terminal palette, is long and narrow, with a rounded extremity. No trace of spines or spinelets is to be found on any of the articulations, and these articulations present a perfectly rectangular outline, every one exhibiting along its posterior border a narrow but well-marked knob (Pl. LIII, fig. 3). Some of the articulations bear also a longitudinal and median ridge; but I am somewhat uncertain whether this ridge is not an accidental folding of the carapace.

Right appendages.—Only one or two articulations of the first three right appendages are preserved.

Comparison of the New *Eurypterus* with other Species.

Several Carboniferous Eurypterids have been described, ranging throughout the whole sequence of the period. To allow of comparison, I will first give short diagnoses of the known Carboniferous species; and, in order to illustrate their evolution in time, I propose to arrange these diagnoses according to the geological age of the fossils. Moreover, if one takes into account the characters of the various species, it becomes possible to draw three divisions in the series, corresponding closely with the geological range.

First division.—This division comprises the Lower Carboniferous Eurypterids. All, except the American species, are large Merostomata quite different from the other Carboniferous species, and much more closely allied to the Devonian Eurypterids.

1. *Eurypterus scouleri* (Woodward, 1872). A large and peculiar species. Head semicircular, smooth and uniform. Eyes exceedingly small. Thoracic body globular. Powerful swimming-foot with broad terminal palette. This, the oldest known Carboniferous Eurypterid, has been found in the freshwater limestone of Burdiehouse, near Edinburgh, Calciferous Series, Lower Carboniferous. It was also recorded by Salter (1863) from the Coal Measures of Port Hood, Cape Breton (Nova Scotia), without any precise indication of its geological level, but it may be of Lower Carboniferous age.

2. *Eurypterus scabrosus*. Also a large species. Head very scabrous. Appendages long and slender; articulations provided with long and sharp spines. First thoracic segment wider than the others. Third thoracic segment presenting two spines on each latero-posterior angle. From the Lower Carboniferous of Glencartholm, Eskdale (Woodward, 1887).

3. *Eurypterus pennsylvanicus*. A small species. Head with a marginal ridge close to the border. Eyes small. Ellipsoidal node close to the posterior and straight border of the head. Latero-posterior angles of the head provided with spines projected backwards and outwards. It has been discovered in the Pithole Shale, Venango County (Pennsylvania), and doubtless belongs to the same geological horizon as both the foregoing species (Hall, 1884). By its size and characters it is, however, more closely allied to the following division.

Second division.—Eurypterids from the Coal Measures (Westphalian). They are usually of small size. Their cephalic shield is more complicated and more richly ornamented, and the powerful terminal palette of the swimming-foot is reduced to a long and narrow paddle.

4. *Eurypterus mazonensis*. Large species. Thoracic segments perfectly straight, the last one displaying spines of a very special shape. No sudden change of width between the thorax and the abdomen. Posterior border of the terminal palette of the swimming-foot markedly indented; articulations of the appendages long and slender. It has been found in the Lower Productive Coal Measures of Grundy County (Illinois), U.S.A. (Meek & Worthen, 1868; Hall, 1884).

5. *Eurypterus dumonti*, sp. nov. In view of its geological horizon, the new Belgian Eurypterid should come in here. It has been found in the lowest beds of the Middle Coal Measures of the Campine Coalfield (Belgium).

6. *Eurypterus mansfieldi*. Small species, though of variable size. Head semi-oval, but broader than long. Thorax globular. Sudden change in width of the segments between the thorax

and the abdomen. Terminal palette of the swimming-foot narrow, long, and having a rounded end. Thoracic segments spiniferous, with margins showing distinct striæ (Hall, 1884). It comes from the shale below the Darlington Cannel-coal, Alleghany River Series, Cannelton, Beaver County (Pennsylvania).

7. *Eurypterus stylus*. Small species, globular, thoracic segments quite straight. Marginal processes of the thorax striated. Eyes very small. No spines on the latero-posterior angles of the cephalic shield (Hall, 1884). From the same horizon as the last-mentioned species.

8. *Eurypterus moyseyi*. Small and globular species, with a well-ornamented head. Eyes small. Thoracic body with very small spines or without any at all. Terminal palette of the swimming-foot long, narrow, and ending in a point (Woodward, 1907). From the Top-Hard coal, Middle Coal Measures, Ilkeston (Derbyshire).

9. *Eurypterus derbyensis*. Small species, not globular, but slender. Eyes small. No spines on the thoracic segments. A row of marginal spines along the posterior border of each abdominal segment (Woodward, 1907). From the same locality as the foregoing species.

It is difficult to ascertain the correlation of the geological horizons of all the foregoing species of the second division, but they all belong, I believe, to the Middle Coal Measures.

10. *Eurypterus wilsoni*. Large species, much resembling *E. mazonensis*. Thoracic segments remarkably straight, either displaying very small spines or none at all. Head and abdomen unknown (Woodward, 1888). Dr. Woodward gives no information concerning the geological level of the specimen, which is reported to have been found at Ludlow's Pit, Radstock. According to Mr. H. Bolton (1911), it is impossible to trace the precise horizon of the rocks of the Radstock Collieries, because the spoil-heap is a common dumping-ground for rock from several pits: this is especially the case with Ludlow's Pit. Moreover, that colliery, which began with working the Upper or Radstock Coal Measures, has since been sunk to the Lower or Farringdon Series. But it is possible that when the fossil was found, in 1888 or thereabouts, only the seams of the Upper Measures were being worked. At all events, this species belongs to the Upper Coal Measures (top of the Westphalian).

Third division.—This division comprises the two most recent Eurypterids known. Both have thoracic segments exhibiting curious double overlapping spines.

11. *Eurypterus granosus*. Small species. Thoracic segments arched, bearing double overlapping spines with rounded points. Anterior border of the abdominal segments showing a marked pad (Jordan & Von Meyer, 1856). It has been found in the Eisenbahn Shaft, near Jägersfreude, not far from Saarbrücken,

in the Middle Series of the Saarbrücken Coalfield. It belongs, therefore, to the lowest beds of the Stephanian or to the top of the Westphalian.

12. *Eurypterus imhofi*. Large species, with a peculiar ornamented cephalic shield. Eyes small. Only six thoracic segments, provided with the same doublé overlapping spines as *E. granosus*. Sudden change in width of the segments between the thorax and the abdomen. Last thoracic segment displaying the same triangular raised area as the new species (Reuss, 1855). Up to the present it is the youngest Eurypterid described, for it has been found in the Lindheim Colliery, near Wilkirchen, in the Pilsen Coalfield (Bohemia). The strata of this coalfield are still Carboniferous by their flora, but their higher animal organisms are of undoubtedly Permian character. We may assume them to lie at the junction of the Carboniferous with the Permian.

Undescribed and Fragmentary Remains.

1. Barbour has recorded the discovery in Nebraska of numerous well-preserved remains of Eurypterids in strata at the junction of the Carboniferous with the Permian, according to Meek. Unfortunately, they have never been fully described and figured. From Barbour's very short description they seem to be very different from any other *Eurypterus*, and it may be questioned whether they belong to the same genus (Barbour, 1912).

2. Mr. Pruvost has described a thoracic or abdominal segment of a *Eurypterus* from the coalfield of the North of France, Meurchin Colliery, roof of the St. Augustin seam (Pruvost, 1911).

3. Dr. Moysey has recorded the discovery of a single segment of an Arthropod, possibly belonging to a *Eurypterus* (Moysey, 1910). It came from Brindsley (Nottinghamshire).

4. James Hall described, under the name of *E. potens*, a fossil from Pennsylvania without any indication of origin or of geological horizon, and so badly preserved as to be quite undeterminable.

Comparison of the New Species with the other Carboniferous Eurypterids.

The Belgian species, which one might have expected to resemble the contemporary and neighbouring British species, is, on the contrary, much more closely allied to the group of species from Pennsylvania, such as *Eurypterus mansfieldi*, *E. stylus*, *E. pennsylvanicus*, and more especially to *E. mansfieldi*.[1] I will

[1] One may explain this resemblance between animals that lived in regions so far apart by the fact that *E. mansfieldi* existed, I believe, in England. Through the kindness of Dr. A. Smith Woodward, Keeper of the Geological Department of the Natural History Museum, I have been enabled to study the remains of Carboniferous Eurypterids preserved in that Museum. Three specimens, registered I. 16539, I. 16540, I. 16541, collected by Mr. Hemingway at Horbury, Yorkshire (Hartley Bank Colliery, Old Hards Coal), bear more or

now compare the new species with *E. mansfieldi*, the only one that could be confounded with it.

Resemblances.—The size and general aspect of both species are nearly the same, as is also the ornamentation of the cephalic shield. The abdomen is very similar, and many specimens of the American crustacean figured by Hall show thoracic segments with the same outline and the same median swelling as the Belgian one. There is a close resemblance in the form of the appendages, and more especially of the swimming-feet. The articulations of the appendages of both species have the same shape, with a pad on their posterior border.

Differences.—There are also many differences between the American *Eurypterus* and the Belgian one.

Head.—The head of *E. mansfieldi* is more trapezoidal and narrower towards the front, while in the Belgian specimen it has a more quadrate outline and a broad front. The marginal ridge on *E. mansfieldi* is close to the border, while on the other there is a flat margin between it and the border (see Pl. LIII, fig. 1, *f*, & fig. 2). The eyes of *E. mansfieldi* are smaller. The posterior border of the Belgian species is undulating; while it is perfectly straight in *E. mansfieldi*,[1] and does not embrace the first thoracic segment like in the specimen here described (Pl. LIII, fig. 1, *h*).

Thorax.—This is more slender in the Belgian fossil. If we judge by the plates illustrating Hall's paper, all the specimens represented (except that of pl. iv, fig. 2) have only six thoracic segments instead of the seven segments of the Belgian crustacean. No trace of the triangular ridge so conspicuous on the last segment of the new species (Pl. LIII, fig. 1, *b*, & fig. 4) can be detected on any specimen figured by Hall. The spines of the segments of *E. mansfieldi* are always projected backwards and outwards, while those of the Belgian Eurypterid are projected backwards only. The marginal processes of the thorax of *E. mansfieldi* show very distinct and peculiar striæ on every specimen represented by Hall, which is a proof that this is not a character of the adult or of the large individuals. These striæ are absolutely wanting in my specimen, like in any other *Eurypterus* (Pl. LIII, fig. 1, *c*). The first thoracic segment of the new species (Pl. LIII, fig. 1, *a*)

less resemblance to *Eurypterus*. One (I. 16541) displays an abdomen which seems to belong to *E. mansfieldi* and to bear a strong resemblance to the fossil represented in J. Hall's pl. v, fig. 3 (Hall, 1884). Its size is the same, and the segments are provided with similar long and remarkable spines projected backwards and outwards. The articulating surface of the segments is very broad, as in *E. mansfieldi*. Another specimen (I. 16540) shows the abdomen of another individual, the resemblance of which with the American species is not so well marked. The third specimen (I. 16539) seems to belong to another kind of crustacean.

[1] This is not true for the specimen of pl. v, fig. 3 (Hall, 1884), which seems to me very different from the other individuals of *E. mansfieldi*, even more different than *E. stylus* and *E. pennsylvanicus* are from *E. mansfieldi*.

is absolutely different from the corresponding one of the American species.

Appendages.—The knob or pad on the border of the articulations, which at first sight on small-scale drawings may seem very similar in both species, is a true knob in the Belgian fossil (Pl. LIII, fig. 3); while in *E. mansfieldi* it is but a row of small spiniferous nodes or spines, as we can see in the enlarged drawings of this knob given by Hall (pl. iv, figs. 3 & 4). The terminal palette of the swimming-foot of *E. mansfieldi*, even in the smallest individuals, shows on the posterior border a well-marked spine, which is wanting in our specimen (Pl. LIII, fig. 1, *j*).

Moreover, the Belgian fossil is very easy to distinguish from any of the other Carboniferous and Devonian Eurypterids. Therefore, I believe that all those differences from *E. mansfieldi* indicate that the Belgian fossil belongs to a new species, for which I propose the name *Eurypterus dumonti*. It seems to me a duty to give to the first new fossil described from the Campine Coalfield the name[1] of the eminent mining engineer and professor whose science and tenacity endowed Belgium with that new and rich coalfield.

E. dumonti was found in the cores of No. 32 boring, Mechelen-sur-Meuse, at the depth of 435 metres (1427 feet), above a thin seam of coal which belongs to the Middle Coal Measures, about midway in the 'great barren measures' ('grande stampe stérile') of the Campine Coalfield. According to the treatise that I have published on this coalfield (Stainier, 1911), this seam would be about 570 metres (1870 feet) above the top of the Millstone Grit.

Bibliography.

1912. E. H. Barbour.—'Notice of Newly-discovered Eurypterids in Nebraska' Science, n. s. vol. xxxvi, pp. 642–43.

1911. H. Bolton.—'Faunal Horizons in the Bristol Coalfield' Q. J. G. S. vol. lxvii, p. 322.

1884. J. Hall.—'Note on the Eurypteridæ of the Devonian and Carboniferous Formations of Pennsylvania' 2nd Geol. Surv. Pennsylvania, Rep. Progress 1884, PPP, pp. 23–39 & pls. iii–viii.

1854. H. Jordan & H. von Meyer.—'Ueber die Crustaceen der Steinkohlenformation von Saarbrücken' Palæontographica, vol. iv, pp. 1–15 & pls. i–ii.

1868. F. B. Meek & A. H. Worthen.—Geol. Surv. Illinois: vol. iii—Geology & Palæontology, p. 544 & 2 figs.

1911. L. Moysey.—'On some Rare Fossils from the Derbyshire & Nottinghamshire Coalfield' Rep. Brit. Assoc. (Sheffield, 1910) pp. 613–14.

1911. P. Pruvost.—'Note sur quelques Crustacés (*Prestwichia*, *Belinurus*. & *Eurypterus*) du Terrain Houiller du Nord de la France' Ann. Soc. Géol. Nord, vol. xl, pp. 295–302 & 1 pl.

1855. A. E. Reuss.—'Ueber eine neue Krusterspecies aus der Böhmischen Steinkohlenformation' Denkschr. K.-K. Akad. Wissensch. Wien, vol. x, pp. 81–83 & pls. iii–iv.

1863. J. W. Salter.—'On some Fossil Crustacea from the Coal Measures & Devonian Rocks of British North America' Q. J. G. S. vol. xix, pp. 75–80, figs.

[1] André Dumont, professor in the University of Louvain, is the son of the illustrious André Dumont, whose memory is always held in honour among Belgian geologists.

1910. G. Schmitz & X. Stainier.—'Découverte en Campine de Faunes Marines & d'un *Eurypterus* dans les Strates Inférieures du Houiller' Ann. Soc. géol. Belgique, vol. xxxvi, Bull. p. ccxciii.
1911. X. Stainier.—'Structure du Bassin Houiller de la Province d'Anvers' Bull. Soc. Belge de Géol. vol. xxv, Mém. p. 219.
1891. H. S. Williams.—'Correlation Papers: Devonian & Carboniferous' U.S. Geol. Surv. Bull. 80, pp. 206–208.
1872. H. Woodward.—'A Monograph of the British Fossil Crustacea of the Order Merostomata'—pt. iv, Monogr. Pal. Soc. pp. 121–80 & pls. xxi–xxx.
1887. H. Woodward.—'On a New Species of *Eurypterus* from the Lower Carboniferous Shales of Glencartholm (Eskdale), Scotland' Geol. Mag. dec. 3, vol. iv, pp. 481–84 & 1 pl.
1888. H. Woodward.—'Note on *Eurypterus* from the Carboniferous' Geol. Mag. dec. 3, vol. v, pp. 419–21 & 1 fig.
1907. H. Woodward.—'Two New Species of *Eurypterus* from the Coal Measures of Ilkeston (Derbyshire)' Geol. Mag. dec. 5, vol. iv, pp. 277–82 & 1 pl.

EXPLANATION OF PLATE LIII.

Fig. 1. (Enlarged 3 times.)
a = first thoracic segment; b = last thoracic segment, with its triangular upraised area; c = marginal spiniferous processes, without striæ, of the segment; d = granules on the carapace; e = articulating surface of the thoracic and abdominal segments; f = marginal ridge of the cephalic shield; g = right eye; h = protruded latero-posterior angles of the shield; i = hollows corresponding with the basal joints of the ectognaths; j = swimming-foot, showing the terminal palette with the rounded and regular outline of its end; k = U-shaped ridge.

2. (Enlarged 5 times.) Marginal ridge of the cephalic shield.
3. (Enlarged 6 times.) First appendage, to show the knob or pad on the posterior border of the articulation.
4. (Enlarged 4 times.) Triangular upraised area of the last thoracic segment as seen from the left, to show its slopes.