Memoirs ... Figures and descriptions illustrative of British organic remains. Decade II [VII and XI. Trilobites, with descriptions by J.W. Salter].

Contributors

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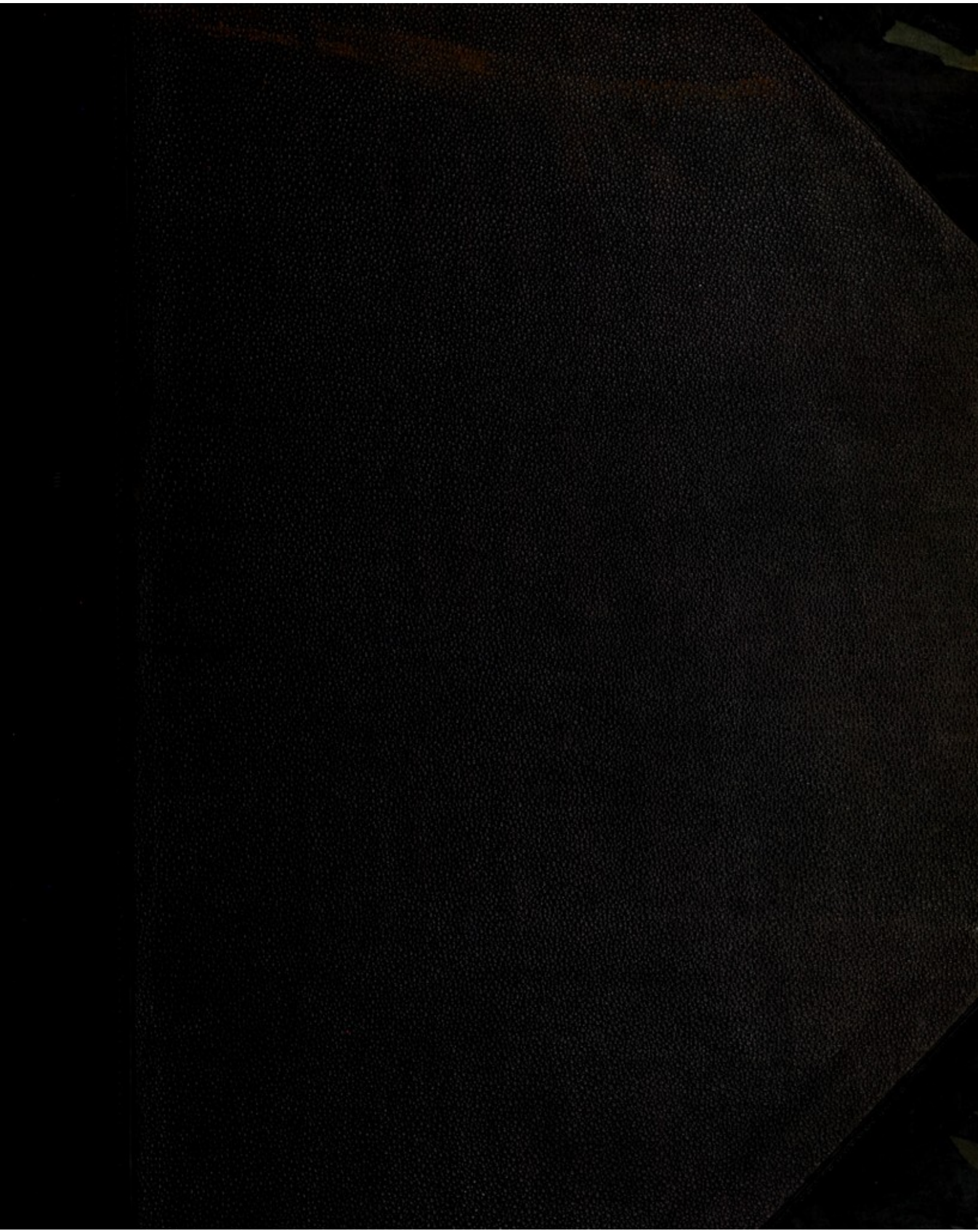

E. J. Chesterton
1883

MEMOIRS

OF THE

GEOLOGICAL SURVEY

OF

THE UNITED KINGDOM.

Figures and Descriptions

ILLUSTRATIVE OF

BRITISH ORGANIC REMAINS.

DECADE II.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF HER MAJESTY'S TREASURY.

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NOTICE.

PALÆONTOLOGICAL researches forming so essential a part of geological investigations, such as those now in progress by the Geological Survey of the United Kingdom, the accompanying plates and descriptions of British Fossils have been prepared as part of the Geological Memoirs. They constitute a needful portion of the publications of the Geological Survey, and are taken from specimens in the public collections, or lent to the Survey by those anxious to advance this branch of the public service. Although numerous drawings had previously been made, and engravings from them considerably advanced, it was not thought expedient to commence their publication until the large collections of the Survey could be well examined, which a want of the needful space has, until the present time, considerably retarded. This impediment to progress is now being removed, and when the collections can be properly displayed in the New Museum of Practical Geology, in Jermyn Street, it is hoped that the public will have an opportunity of gradually obtaining, in a convenient manner and at small cost, a work illustrating some of the more important forms of animal and vegetable life there preserved, and which have been entombed during the lapse of geological time in the area occupied by the British islands.

The plan proposed to be followed in the work, of which the two Decades now published form a part, is as follows:—

To figure in elaborate detail, as completely as possible, a selection of fossils, illustrative of the genera and more remarkable species of all

classes of animals and plants the remains of which are contained in British rocks; to select especially such as require an amount of illustration which, to be carried out by private enterprise, would require a large outlay of money, with little prospect of a return, and a long time to accomplish, but which, by means of the staff and appliances necessarily employed on the Geological Survey, can be effected at small cost, and with a rapidity demanded by the publication of the Maps and Memoirs of the Survey; thus, it is hoped, affording an aid to those engaged in the sciences with which this work is connected, that they might not otherwise have possessed, and which may materially promote the progress of individual research.

H. T. De la Beche,
Director-General.

Geological Survey Office,
18*th July*, 1849.

BRITISH FOSSILS.

DECADE THE SECOND.

The second Decade of representations of British Fossils contains illustrations of the genera and species of Trilobites.

These remarkable animals, belonging to a group of Crustacea, of which we find no traces in strata formed subsequently to the Palæozoic period, were first observed in British rocks. Nevertheless, the investigation of those species found in our country is as yet far from complete. Our recorded knowledge of them is chiefly contained in the works of Sir Roderick Murchison and of Lieut.-Colonel Portlock. In the "Silurian System," only are figures to be found of our commoner species, and in the "Report on the Geology of Londonderry, Tyrone, and Fermanagh," is the only systematic dissertation on their arrangement, which has yet been published in Britain.

During the progress of the Geological Survey through the Silurian districts of Wales and the bordering counties, much new and important material has been collected towards the elucidation of the structure, affinities, and distribution of Trilobites. The following figures and descriptions consequently contain much that has not been before noticed respecting these animals, and new light will be found thrown on several features of their organization.

The Trilobites selected as subjects for this Decade are species of the genera *Phacops*, *Illænus*, *Asaphus*, *Ogygia*, *Calymene*, and *Ampyx*. Some of them are renowned and characteristic forms, such as *Phacops* (*Dalmannia*) *caudatus*, *Illænus* (*Bumastus*) *Barriensis*, *Asaphus tyrannus*, and *Ogygia Buchii*, which, whilst they furnish excellent typical figures illustrating generic or sub-generic groups, acquire an additional

value on account of the abundant details of structure, which, through our extensive collections, we are enabled to delineate; others, as *Ogygia Portlockii*, *Calymene tuberculosa*, and *Ampyx nudus*, are critical species, the history of which has been hitherto imperfectly known; and a third class consists of entirely new forms, such as *Illænus Davisii* and *Olenus micrurus*; the last mentioned trilobite has great interest, having been found in the most ancient fossiliferous strata of the Silurian System, whilst at the same time it constitutes a good representative of the numerous forms of the genus *Olenus*, which occur in the oldest rocks of the Continent.

The description of all the species, with the exception of *Ampyx nudus*, have been drawn up by Mr. Salter, whose attention has for some time been specially directed to Trilobites.

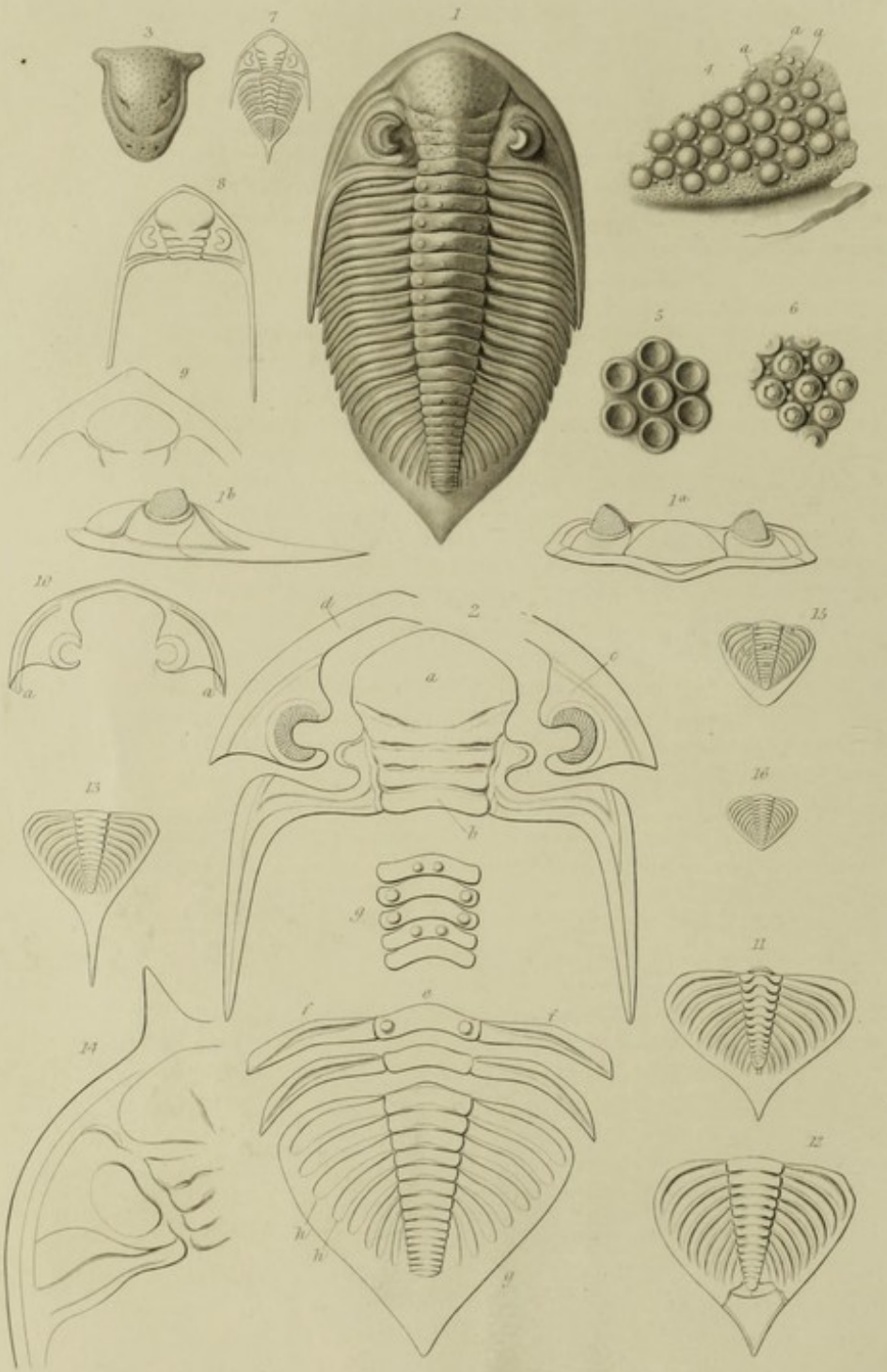
Illustrations of the other British genera of Trilobites are in preparation.

EDWARD FORBES.

July, 1849.

Geological Survey of the United Kingdom.

PHACOPS
(Silurian)



PHACOPS (DALMANNIA) CAUDATUS ____ *Brünnich*

W.H. Baily del. E. Forbes direx.t J.W. Lowry lith.

BRITISH FOSSILS.

Decade II. Plate I.

PHACOPS CAUDATUS.

[Genus PHACOPS. Emmerich. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Eyes largely facetted; facial suture ending on the outer margin; thorax 11 jointed.]

[Sub-genus *Dalmannia*. Depressed; pleuræ pointed and bent back at a distant fulcrum; glabella not inflated, with three lateral lobes; facial suture within the edge in front; head angles long-spined; hypostome obtusely pointed; tail with a many-jointed axis, and without lateral spines.]

Diagnosis. *P. (Dalmannia) fronte angulato; oculis maximis pyramidatis, e sulco glabellari basali ad tertium et supra extensis; pleuris recurvis, fulcro ad dimidium; caudæ apice mucronato, axi* 11–12 *annulato, costis lateralibus* 7, *rarius* 6, *arcuatis, duplicatis, ad marginem lævem abrupte terminatis.*

Synonyms.—Var. *α. Vulgaris.—Fronte capitis angulato; apice caudæ brevimucronato.*—Plate I., figs. 1 to 12, and fig. 15.

Trilobus caudatus, Brunnich (1781), Kjobenh. Sellsk. Skrifter. Nye Samml., vol. i., p. 392. *Asaphus caud.*, Brongniart (1822), Crust. Foss., t. 2, f. 4 (not 3, f. 9). *Trilob. caud.*, Schlotheim (1823), Nachtrage, 35. 11. *Asaphus caud.*, Dalman (1826), Palead., t. 2, f. 4. Green (1832), Monogr. Trilob. N. Amer., cast 17. Buckland (1836), Bridgw. Treat., pl. XLV., f. 9–11. Murchison (1837), Sil. Syst., pl. 7, fig. 8 *a*. *A. tuberculato-caudatus, ib.*, fig. 8 *b*. *A. caud.* and *A. tuberculato-caud.*, Milne Edwards (1840), Crust. 3, 308. *P. caud.*, Burmeister, Org. Tril., t. 4, f. 9. Ray edition (1846).

Var. *β. Longicaudatus.*—Plate I., figs. 13, 14.—*Axi angustiori, fronte capitis caudâque longimucronatis.*

Trilobite with caudal process, Parkinson (1811), Organic Remains, vol. iii., t. 17, f. 17. *Asaphus longicaudatus*, Murchison, Sil. Syst., pl. 14, figs. 11 to 14. Milne Edwards, Crust. 3, 308. *Phacops mucronatus*, Burmeister, Org. Tril., 113 (exclude all synonyms except Murch.). Ray edit., 95. [*Phac. longicaud.*, Rouallt (1847), Bull. Soc. Geol. Fr., 2nd Ser., 4, 320?].

Description of Var. α.—Four or five inches long; ovate; length as to width varying from 10·6 to 8½·6; thorax longer than either head or tail; the latter about equal to the head, excluding the produced mucro;

axis of the whole body considerably narrower than the sides. Head finely granular all over, semicircular, without the slightly produced snout, or the long, stout, posterior horns, which are broad at the base, and reach the seventh or eighth thoracic ring. Glabella coarsely tubercular, widened above, more than one-third the width of head, the forehead lobe a transverse rhomb, separated by deep, broad, oblique furrows which nearly meet, from the upper side lobes; three lateral lobes and neck lobe all nearly equal in width, and together equalling the forehead lobe, the first and second lie straight across, and leave but a narrow ridge down the middle: strong axal furrows separate the glabella from the triangular cheeks, of the surface of which the large pyramidal eyes occupy a variable proportion; a lunate depression surrounds their outer edge, and this is sometimes extended over more than half the width of the cheek, sometimes barely half, giving a considerable difference in appearance. The length of the eye, which is sharply curved, is uniformly from the first basal furrow to the middle of the upper one; eyelid with a deep concentric groove; lentiferous surface considerably broader forwards, lenses about 240*, 8 or 10 in a vertical row. In the cast, which represents the crystalline layer behind the lenses, the surface is covered with close-set, circular pits, with narrow distinct borders (Fig. 5); in these hollows the moderately convex lenses are set, and in most specimens we see no cornea over them. In two perfectly preserved eyes from Ledbury (Fig. 4), the cornea is, however, present, and contrary to Professor Burmeister's prediction, is distinctly convex over each lens, the intermediate portions being ornamented with tubercles and granules, so as to leave no doubt of its being the true exterior; it is, too, continuous with the other portions of the preserved shell. The cornea does not rise, as in some other species, into elevated ridges between the lenses, but is flat, or in other specimens (Fig. 6), it sinks down between them. In Fig. 4 a lens or two is seen to be undeveloped and very small, among other perfect ones. The facial suture exactly circumscribes the glabella in front, falls perpendicularly to the eye, and arches outwards and upwards from its lower angle to the outer margin of the head, on the lower face of which it extends along the margin further back than on the upper surface (*see* Fig. 10 *a*). The cheek-pieces are united in one (as in all the genus) across the front, and there is no extra piece inserted between them above the hypostome. The latter (Fig. 3) is parabolic, obtusely pointed, the sides a little waved, and the base of attachment extended; a transverse furrow, within the tip, is connected with a marginal longitudinal one on each side, a pair of lateral strong indentations indicate a second furrow

* Buckland, Bridgw. Treat., p. 399, reckons 400. This was probably intended for both eyes.

above. Round the head a strong furrow separates the broad margin, stops at the base of the spines, and there nearly meets the equally strong neck furrow, which is arched down at its end. The margin in front more or less produced into an obtuse point. Thorax with the central lobe not separated by any strong furrow from the pleuræ, which, in English specimens, are half as wide again as the axis; the axis is a little fusiform, not broader than the base of the glabella, and either has the rings smooth, tubercled at their outer edges, or with two tubercles on the central prominent part:—all these variations occur on the same thorax. The front pleuræ are flat for the first half, then gently curved down, and a little back, at the obscure fulcrum; they are divided by a moderately strong curved furrow for most of the length, and their edge sharpened anteriorly (the flat surface not crossing the furrow as in true *Phacops*) for bending. The extremities are truncate, and pointed at the hinder corner; posterior pleuræ with the fulcrum at less than half, much more curved back, and strongly pointed, overlapping the upper corners of the tail. Whole surface of thorax finely granular. Tail with the sides meeting below at nearly a right angle, and produced more or less to a sharp point beyond this; axis not much raised, and gently tapering, ending a little abruptly at some distance from the point; it has 11 or 12 ribs, which are accidentally tubercular, like the thorax, sometimes much so; the sides have six, seven, or sometimes eight narrow ribs, strongly arched down at their ends, where they abut suddenly on the smooth margin; each rib is sharply defined behind, and duplicated on its forward edge by a fine rib, running parallel to it along its whole length. The number of the ribs on the tail appears to be as great in the young animal, judging from the beautiful specimen, Fig. 7, from Mr. J. Gray's collection.

Variations.—The tail margin varies much in width. In fig. 15 it is very narrow, and the apex little produced. Most of the specimens of var. α, in shale or mud (Fig. 11), have the axis of the head and tail narrower than those in limestone (Fig. 12), and the tail itself broader and more mucronate. From Ludlow we have specimens of this form, with all degrees of attenuation in the mucro. The larger head of var. β (Fig. 14), has the outer margin more expanded than in any limestone one yet seen.

Sex.—Some differences are very observable between individuals of this species, as well as of other species and genera, which are possibly referable to sex. We find the male in insects distinguished by large and prominent eyes, extra length of spines, and narrowness or depression of the body; the latter character is sexual in the crustacea. It is natural to look for some sexual distinctions in animals with such marked forms as trilobites have, but an examination of *Serolis*, the external

characters of which, at least, imitate best those of trilobites, does not help out the case. The differences pointed out there by Milne Edwards and Audouin reside in the feet and appendages, not in any general shape, prominence of eyes, or sculpture, and we can, therefore, only surmise from general analogy, that certain individuals with the glabella flattened so as to leave the eyes projecting, the body more depressed, and the spines of the front and sides of the head, or the mucro of the tail more developed, may be males; while greater general convexity, more convex glabella rising nearly as high as the eyes, and a tail not attenuated into the mucro, but simply pointed, may mark the other sex. Fig. 1 we think a female, and in this the eyes seen in front view (Fig. 1 *a*) do not rise much above the glabella, and the body is convex, the tail simply pointed; but in others the glabella is depressed, especially behind, and the front produced. In Fig. 9, supposed to be a male, the produced angular front is shown. Fig. 8 shows the great length the spines of the head sometimes assume.

If *P. longicaudatus*, our var. β, be identical with this species, and it differs in nothing except the greater development of the processes, the probability of this difference being sexual is confirmed, for there occur in the same slabs individuals exactly alike, some with long spines to head and tail, and others without them.

Affinities.—But one European species is sufficiently like ours to render a close comparison necessary. We refer to the *Asaphus mucronatus* (Brongn.), which Professor Burmeister identifies with our var. β; however, he had not seen specimens, and we have them before us. The head of that is regularly convex, the axal and glabellar furrows not deep, the eyes placed further forwards, the margin narrow. The tail is like, but the ribs do not imbricate posteriorly, and the intermediate furrow divides them more equally. The mucro, too, is recurved, as in *P. proevus*, with which, without being identical, it is closely allied. *Asaph. pleuroptyx* (Green, cast 18), has 11 or 12 lateral ribs to the tail, extending below the very narrow axis; but with *P. limulurus* (Green, cast 16), from the Niagara shale, there are so many points of resemblance, that we can hardly persuade ourselves they are distinct. Specimens in the cabinets of Sir C. Lyell and Dr. Bigsby show that the form is more elongate, the pleuræ shorter, the glabella contracted at the base, and the eyes perhaps smaller; the tail narrow, its lateral ribs faint and but little arched, while the extremity of the axis is more prominent. The head wants the strong marginal furrow, and the posterior spines extend but a little way down (to the fifth rib, Hall). While avoiding the risk of a doubtful synonym, we cannot value these mere proportional characters as specific, and believe that a larger series will unite the above and *P. Wetherilli* (Green, cast 20), to the English species.

History.—When Brongniart made the first scientific attempt to classify trilobites, his genus *Asaphus* confessedly stood as debateable land between *Calymene* and *Ogygia*, but he clearly pointed out that the type of the genus, when restricted, should be *Asaphus cornigerus*, a species possessing smooth eyes and eight joints to the thorax. The characters "Tubercules oculiformes reticulès" were drawn from the present species, and the figures also from Dudley specimens. Dalman followed, without much improving this classification, but Quenstedt, in 1837, clearly separated the group of trilobites with facetted eyes, (meaning thereby with large prominent facets), and Emmerich named it *Phacops*. In the treatise on the "Morphology, Classification, &c., of Trilobites," published 1845, in Leonhard and Bronn's "Neues Jahrbuch," Emmerich pointed out the subdivision *Dalmannia*, making *Ph. caudatus* (Brünn.), its type. Burmeister, however, has thought fit to retain all under *Phacops*, and the characters of one group pass so gradually into those of another, that we prefer following his plan, though in the Memoirs of the Geol. Survey, just published, we have adopted the genus (vol. ii., part 1, page 337.) Sir R. I. Murchison, in 1837, gave figures of the ordinary and the tuberculated forms, and there was quite sufficient to justify him in making the var. *longicaudatus* a species. After observation of many intermediate forms, however, we unite them without much doubt of the propriety of so doing. Green, in 1832, did some service by publishing his casts, and he would have done better had he not permitted them to be carved to make them more plain. Milne Edwards adopted the previously published species in his excellent work on recent crustacea. Professor Burmeister confused the synonyms of this species, by too hastily uniting *P. mucronatus* with our var. β; Dalman had well separated the two in 1826. In uniting, as we have done, the var. β to the typical form, we believe we shall be justified by most naturalists, when the numerous varieties common in every collection are examined with a view to this. The combination of characters is the same in both, and variation in isolated points should always be suspected. The reference of such differences to sex is merely speculative, and will require much observation to confirm.

British Localities and Geological Range.—Distributed throughout the Silurian districts, from the lower LLANDEILO FLAGS TO UPPER LUDLOW ROCK. The shales of Kirkcudbright, Scotland (J. W. S.); rarely in the Coniston limestone, Westmoreland; quoted also by Prof. Sedgwick, from Coldwell, ditto (Geological Journal); this is a mistake, as is also the quotation in the list of fossils, *ib.*, vol. i., p. 20. Upper Silurians of Denbighshire (J. W. S.). Near St. Clairs and Narberth, in Llandeilo flags. Marloes Bay, Pembrokeshire (Phillips). Dynevor Park, and numerous localities south and west of Llandeilo; also Rhiw-rhwych and

Cefn Llwydlo, north of Llandovery (J. W. S.) Everywhere in upper Silurian rocks, Herefordshire and Shropshire (Murchison, "Sil. Syst.") Especially abundant in Dudley limestone and shales. Usk, Monmouthshire; in Ludlow and Wenlock rocks (J. W. S.) Horse-shoe Farm, Tortworth; Huntly-hill, Gloucestershire; Caradoc sandstone; Woolhope limestone and upper Silurians of Woolhope, Abberley, and Malvern districts. (Geol. Surv.) Not yet found in Ireland.

Var. β.—Marloes Bay, and St. Ishmael's, Pembrokeshire (Phillips). Cwmdwr, Brecknockshire (J. W. S.). Brindgwood Chase, in Ludlow rocks; Burrington, in Wenlock shale; near Ludlow, Aymestry, and Nash Scar, Herefordshire ("Sil. Syst.") Usk, Monmouthshire, from Wenlock shale to upper Ludlow rock; Abberley and Malvern (Phillips).

Foreign Distribution.—In Gottland, upper Silurian, rare (Dalman and Hisinger.) Ripley, Ohio (Green;—the localities quoted from Canada are erroneous, Dr. Bigsby's specimens being of quite different species, but one, which is probably the true species, was found by him at Gaspè, Gulf of St. Lawrence).

Explanation of Plate I.

Fig. 1. Perfect specimen, in Mr. Tennant's cabinet, probably from Dudley.

Fig. 1 *a*. Front view of head; 1 *b*, side view.

Fig. 2. Same, dissected; *a*, front lobe or forehead; *b*, spira or neck lobe; *c*, cheek or wing; *d*, margin; *e*, axis of body ring; *f*, fulcrum of ditto; *g*, part of the axis of a tuberculated specimen; *h*, intermediate ribs of the tail. (These are the indications of separation between the segments.) The *g* at the tail margin should be omitted.

Fig. 3. Hypostome from Ledbury.

Fig. 4. Magnified view of surface of eye, the cornea tuberculate between the convex portions which cover the lenses. At (*a a*), some small abortive lenses are seen. Ledbury.

Fig. 5. A cast of the interior of the eye, the cornea having been removed, and the lenses fallen out. Vinnal Hill, Ludlow.

Fig. 6. An eye, with very prominent lenses, which are partly visible, where the cornea has been broken away. Ledbury.

Fig. 7. A fine young specimen, with rather prolonged tail. Dudley, Cabinet of Mr. John Gray.

Fig. 8. Specimen, with vastly prolonged head spines. Dudley Museum.

Fig. 9. Head, with produced front (male?) Bodenham, Woolhope.

Fig. 10. Cheeks united across the front, and separated from the rest of the head along the facial suture. The course of the suture beneath (at *a*) is rather different from that of the upper side. Vinnal Hill, Ludlow, a rich locality.

Fig. 11. Tail, with the axis narrow and the point prolonged. Intermediate between *P. caudatus* and the var. *longicaudatus*. Vinnal Hill.

Fig. 12. Tail of ordinary form. From Wenlock limestone of Clincher's Hill, South Malvern.

Fig. 13. Tail of var. β, *longicaudatus*. Craig-y-Garcyd, Usk, in Wenlock shale.

Fig. 14. Head of same variety. Burrington, Ludlow.

Fig. 15. Tuberculated (diseased?) tail, with very narrow border. Rock Farm, May Hill.

Fig. 16. Accidentally introduced; it belongs to the species next described. Long's Quarry, Tortworth.

Other British Species of Phacops, of the Section Dalmannia.

1. *P.* ——— *sp.* [fig. 16 in Pl. I.]

P. lævis, capite quam in P. caudato, nisi lobis glabellæ tumidioribus;—caudâ triangulari, ferè æquilatera, convexa, apice acuto haud mucronato, axi 13–16 *annulato, costis lateralibus* 10–12, *simplicibus, vix curvatis, ad marginem æqualem angustum abruptè terminatis.*

Length of tail 1½ inches. There are but imperfect heads in the collections of the Geological Society and Geological Survey. The characters of the tail distinguish it from *P. caudatus;* it has much more numerous ribs, which are but little curved, and not duplicate; the margin, too, is equal all round, not expanded or mucronate at the end. Young specimens have not the full number of ribs, and a few of the upper ones are slightly divided. The most prominent analogy is with *P. Hausmanni*, Brongn.; but that is strongly tuberculate, almost spinous, all over. *P. pleuroptyx* (Green), is also like, but has the lateral ribs duplicate. The species of this group so closely resemble each other, that we dare not give a name. Should it prove new, it might be called *P. Weaveri.*

Localities.—Caradoc sandstone of Long's Quarry, Damory Bridge, and Charfield Green, Tortworth, Gloucestershire; (all small); Woodford Green, ditto; (large).

2. *P. obtusicaudatus.*

P. capite quam in P. caudato, sed latiore;—caudâ brevi, lato, subtriangulari, apice angulato, obtuso; axi lato, convexo, 11–12 *annulato, obtuso; costis lateralibus* 9, *duplicatis, rectis, ad marginem angustum æqualem abruptè terminatis.*

We merely note this curious species here; it will be figured and described in Prof. Sedgwick's work on Westmoreland.

Locality.—Coldwell, in flags above the Coniston limestone, Westmoreland.

3. *P. truncato-caudatus,* Portlock, Geol. Rep. Tyrone, &c., pl. 2, f. 1–4, and *Paradoxides? Bucephali* var., pl. 1, f. 8 (hypostome).

P. granulatus, capite antice truncato, oculis maximis subdepressis; pleuris obtusis, fulcro ab axi valde remoto; caudæ axi 18-*annulato, angusto, costis lateralibus* 14–16, *apice emarginato.*

This interesting species, while in the large eyes and strong head spines, numerous joints of the tail, and general depressed form, it is nearly allied to the other *Dalmanniæ*,—yet indicates more than any other the close affinity of this section with *Phacops*, for the facial suture is only just within the margin, the tail rather rounded than produced, the pleuræ have their furrows strong and curved forwards at their obtuse ends, and they are bent down at the distant fulcrum, so as to be much better fitted for rolling up than is usual in *Dalmannia.* For the first half of the thorax they are scarcely at all bent back from the fulcrum; the posterior pleuræ are more in the usual way. The hypostome is very much extended at its base, is pointed, and has two pair of oblique furrows.

Localities.—Lower Silurian. Tyrone, Ireland. Coniston, Westmoreland. Horderly, Shropshire.

Var. β *affinis. Caudæ axi latiore—Dalmannia affinis,* Salter, in Memoirs of the Geol. Survey, vol. ii., part 1, pl. 5, f. 5.

It is to be feared there are not sufficient grounds for separating this species, founded only on caudal shields. A tolerably perfect tail in Mr. D. Sharpe's collection, and an imperfect one in the Survey Collection, have the axis considerably wider than in Portlock's originals. Specimens, however, in Sir R. I. Murchison's cabinet, show intermediate characters.

Localities.—Lower Silurian. Llandowror, Caermarthenshire. Coniston, Westmoreland.

Phacops is a widely distributed genus or group of trilobites, remarkable for the large facets of the eyes,—the distinct trilobation of head, thorax, and tail, the furrows separating

the lobes being strong and deep,—and for possessing eleven joints in the thorax, a number apparently never deviated from. Besides these, in a large part of the genus the convex form of head and tail, the curvature of the segments of the thorax, and the sharpening of their anterior margins, eminently fit the animal for rolling up into a compact ball; for this purpose it is as completely constructed as *Calymene*, while it has the advantage over the latter genus in its large organs of sight. It may be considered as the very type of a Trilobite, possessing all the characteristics of the tribe, with a compact and elegant form. And while the whole group is so bound together by common characters as to render it difficult to separate it into distinct genera, there is a great variation of form among the numerous species. Quenstedt, and after him Emmerich, united them all, and Professor Burmeister has not ventured to dismember the genus. Subgenera, however, have been frequently pointed out, and the groups so formed are very natural. We have—

1st. Convex species, with the pleuræ rounded at the end, and sharpened for rolling; the glabella inflated, and with but one lobe at the base; the facial suture beneath the margin of the head in front; the head angles rounded, the tail of few joints.—*Portlockia*, M'Coy.

2nd. Moderately convex, with the pleuræ rounded; the glabella not inflated, but with (3) distinct lateral lobes; facial suture marginal in front; head angles rounded, or variously produced, tail few (less than 11) jointed, rounded or pointed.—*Phacops*, Emmerich.

3rd. Characters as given above.—*Dalmannia*, Emmerich.

4th. Flattened; pleuræ pointed, or even mucronate; glabella and facial suture as in Dalmannia; head angles long-spinous; tail many-jointed, the margin produced into spines.—*Cryphæus*, Green; *Pleuracanthus*, Milne Edw.

Odontochile, Corda, is synonymous with *Dalmannia*, and his *Asteropyge* and *Metacanthus* apparently with *Cryphæus*.

The genus is found in all Silurian strata, and existed till the commencement of the Carboniferous system. The distribution of the various subgenera in Britain is as follows:—

Portlockia is found in all the above strata. *P. Stokesii*, Milne Edw., and *P. sublævis*, M'Coy, Silurian. *P. Latreillii*, Steininger, *P. granulata* and *P. lævis*, Munster, Devonian and lower carboniferous rocks, Devonshire and Cornwall.

Phacops is Silurian. *P. Odini*, Eichwald, *P. Brongniartii*, *P. Dalmannii*, *P. Jamesii*, Portlock, Lower Silurian. *P. Downingiæ*, Murchison, Upper and Lower Silurian.

Dalmannia, Upper and Lower Silurian.

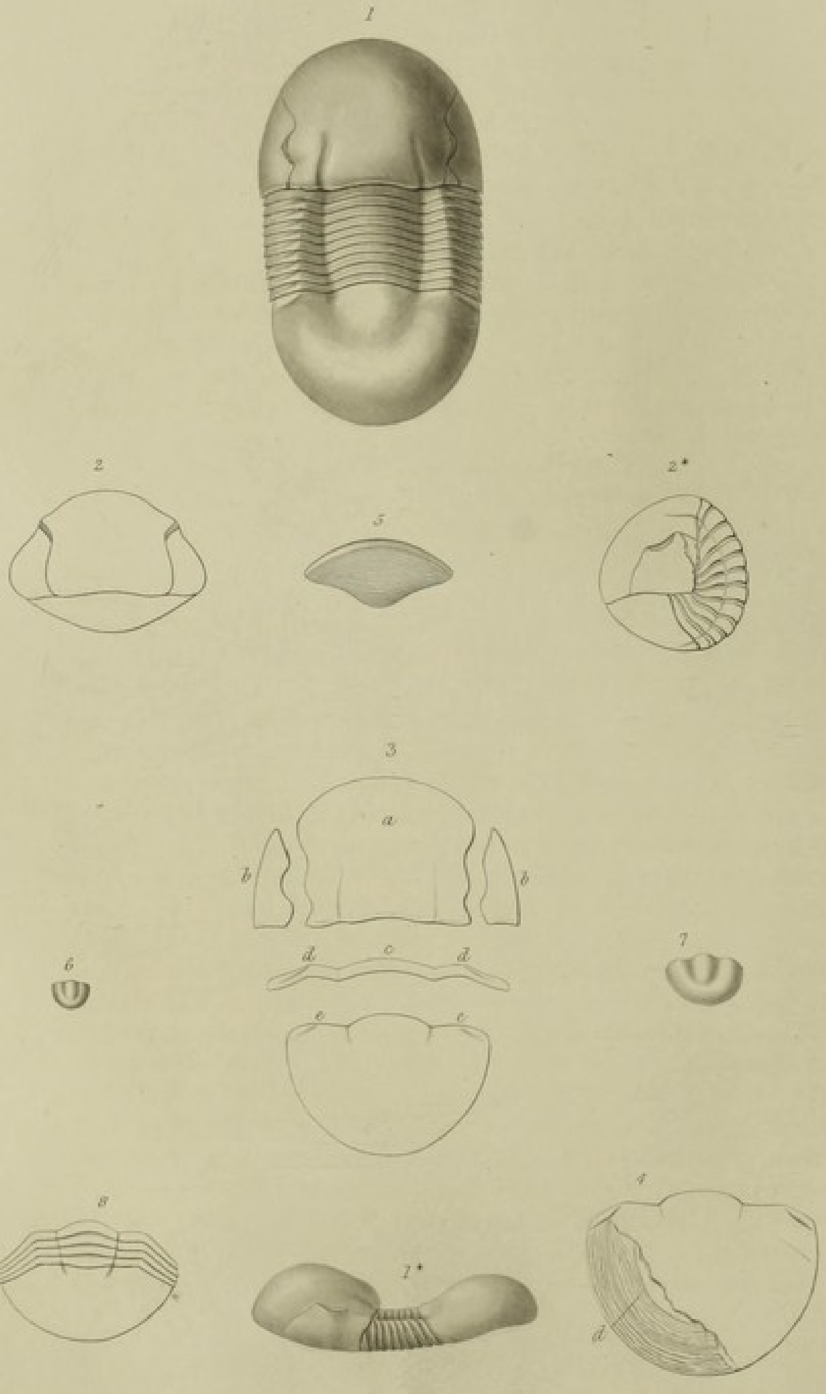
Cryphæus, Green [*C. callitelus*, &c., so named before the definition of Milne Edwards' genus, *Pleuracanthus*], Devonian. A specimen of *C. arachnoides*, Goldfuss, found at Torquay, Devonshire, is in the collection of Mr. D. Sharpe.

J. W. Salter.

June, 1849.

Geological Survey of the United Kingdom.

ILLÆNUS
(Silurian)



ILLÆNUS DAVISII ____ *Salter.*

W. H. Baily del. E. Forbes direx^{t} J. W. Lowry sc.

BRITISH FOSSILS.

Decade II. Plate II.

ILLÆNUS DAVISII.

[Genus ILLÆNUS. Dalman. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Head about a quarter of a sphere; eyes smooth, remote; facial suture ending on the posterior margin behind the eye, marginal or submarginal in front; hypostome entire, separated from the facial suture by a transverse rostral shield; thorax segments 9 or 10.]

[Subgenus *Illænus*. Axis of thorax separated from the pleuræ by distinct furrows; fulcrum not close to the axis.]

Diagnosis. *I. capite pygidioque æqualibus; oculis parvis prope sulcos axales, a margine occipitali diametrum et plus distantibus; thorace segmentis* 10, *axi pleuris æquali; fulcro in segmento primo ad axin approximato, in postremo dimidium pleuræ vix attingente.*

Synonyms. *I. Bowmanni* [Specimens from Rhiwlas only], Salter (1845), in Geol. Journ., vol. i., p. 20; also p. 8. *Illænus crassicauda*, Sharpe (1848), Geol. Journ., vol. iv., p. 149.

Description.—Length 2½ to 3 inches. General form oval, very convex; length to width 17 : 10; the head and tail nearly equal in length; the thorax about two-thirds the length of either, and strongly trilobate; the axal furrows are carried less than half way up the head, and but a very little way into the tail: head a quarter of a sphere, and regularly convex, not peculiarly gibbous behind, where it is divided into three nearly equal parts by the slightly converging axal furrows; these curve out again opposite the eye. The eye is of moderate size, gently lunate, placed much nearer the furrow than the outer edge, and fully its own length or more from the posterior margin. There is no internal ridge at the place of the neck furrow. Facial suture divergent above the eye, and slightly so below it, so as to cut the margin beneath the most prominent curve of that organ. Rostral shield shuttle-shaped, covered by transverse, close, sharp lines, the lower edge a little produced and overhanging. Hypostome .....? Thorax of 10 narrow segments, the axis strongly marked, convex, and subfusiform; wider than the pleuræ in the forward segments, in the last only equal to them. The fulcrum is very near the axis in the first segment, and in the last one is placed less than half way along the pleuræ, which are sharpened anteriorly beyond

this point. The anterior segments are bent down slightly, and also a little backward at the fulcrum, while the posterior ones are only bent downwards. Tail semicircular and moderately convex; the axis indistinctly marked out by two deep impressions, which sometimes form short rapidly-converging furrows; the upper corners are bent sharply down beyond the fulcrum, in order to pass freely under the thorax-rings in rolling; the incurved under portion is concentrically striate as usual, not broad nor indented by the termination of the abdominal axis.* General surface of the head not well known; a few wandering lines appear on one specimen near the margins of the cheeks; the thorax rings are unornamented: the general aspect is smooth.

Variations.—The axis in some specimens is narrower in proportion to the pleuræ (fig. 7).

Affinities.—This species requires close examination to distinguish it from several others. *I. Bowmanni* has only nine rings to the very short thorax. The *Ill. crassicauda* has a head very gibbous behind, and longer than the tail; the eyes placed at less than their own length from the neck margin, and remotely from the axal furrows; the tail, which has the axis distinctly marked all round, is scarcely longer than the thorax, and the latter has its axis broader and flatter than in our species; the fulcrum of the pleuræ not close in front, and at a full half behind; the incurved under portion of the tail is far broader and less concave, and its lines of growth meet at an angle in the middle; this last portion is, however, not always visible for the purpose of comparison. The whole surface, too, is covered with strong, sharp lines, which are certainly not conspicuous upon *Ill. Davisii*, though the latter is not quite smooth. *Ill. perovalis* (Murch.) is a more elongate oblong species; the axis of the tail is very narrow, more so than in our narrowest variety, extends one-third down its length, and is circumscribed; the incurved portion of the tail is broad. It is not at present justifiable to connect even this latter with *Ill. crassicauda*, although it agrees more nearly with it than with any other species.

History.—Apparently it was not known till Professor Sedgwick and myself collected it at Bala, in what was then considered a peculiar band of limestone, and it was too hastily identified with the *Ill. Bowmanni* (Mem. Geol. Surv., vol. ii., part 1, pl. 8, figs. 1, 2, 3), and as such published in the list of Welsh fossils given in the 1st volume of the Geol. Journ., p. 20: the Rhiwlas locality belongs to the present species. Mr. D. Sharpe, in noticing the probable occurrence of *Ill. crassicauda* in America, states that this fossil is found at Rhiwlas; the present species only is intended, and Mr. Sharpe differs with me as to its specific value.

* This indentation is frequently to be seen in *Asaphus;* it is strong in *Illænus crassicauda*, Dalm.

British Localities and Geological Range—Llandeilo Flags only.—Abundant in the Bala limestone at Rhiwlas, at the foot of the lake, and also at other localities in the immediate neighbourhood both north and east of the lake (Coll. of Geol. Survey). It appears, however, to be but local, and its place is taken through many other parts of North Wales, and all through South Wales, by the *Ill. Bowmanni*. It probably occurs in the lower Silurian limestone of Wrae, near Broughton, Peebleshire; some fragments were found there by Mr. James Nicol (Geol. Journ., vol. iv., p. 206), which are with doubt referred to this species, as also is another portion of thorax found in the limestone of the Stincher river, Ayrshire, by Mr. Carrick Moore (*ib.*, vol. v., p. 13).

Explanation of Plate II.

Fig. 1. Nearly perfect specimen. Rhiwlas, Bala; in which locality all, except figs. 6, 7, were found. Fig. 1*, side view of ditto.

Figs. 2, 2*. Front and side views of a rolled-up specimen; the want of gibbosity in the head is shown in the side view.

Fig. 3. Dissected figure. *a*, central lobe; *b b*, wings, upper side; they extend further inward on the under side; *c*, axis of a middle thorax segment; *d d*, fulcra; *e e*, fulcra of tail.

Fig. 4. A separate tail, showing the incurved under portion, *d*, where the upper crust is broken off.

Fig. 5. Rostral shield, often found separate.

Figs. 6, 7. Tails of young specimens, showing the further extension of the furrows at that age. Llechwedd ddu, Bala.

Fig. 8. Variety with narrow axis. The tail has been compressed from below, and appears too small. Rhiwlas.

British species of *Illænus* proper.

* With 9 body-rings.

1. *I. Bowmanni*, Salter, Mem. Geol. Survey (June, 1848), vol. ii., part 1, pl. 8, f. 1–3; *I. centrotus*, Portlock (1843), Geol. Rep., pl. 10, f. 3–6, and probably f. 9.

I. capite magno, angulis posterioribus obtusis; oculis remotis, ad marginem occipitalem approximatis; thorace caudâ breviore.

Locality.—Llandeilo flags, North and South Wales; Kildare, Ireland.

** With 10 body rings.

2. *I. Davisii*, as defined in our preceding description.

3. *I. Portlockii*, Salter; *I. crassicauda*, Portlock (1843), Geol. Rep. Tyrone, &c., pl. 10, f. 7, 8 [*Thaleops ovatus*, Conrad; Hall, Paleont. New York (1848), pl. 67, f. 6 *b*.?

I. capite magno, cauda parva, subtrigona; oculis remotis [prominulis?]; thorace segmentis 10, *axi lato, pleuris abrupte deflexis et reflexis ad fulcrum, quod ad dimidium pleuræ uniusquisque positum est; caudâ depressa, subtriangulari, angulis extremis latè truncatis.*

That this neat species is not *I. crassicauda* is very clear; the shape of the tail, and the abrupt backward bend of the pleuræ, almost at right angles, distinguish it easily; the fulcrum is as far outward in the first segment as the last, an unusual character. We have not seen specimens of *I. ovatus* (Conrad); Hall's figure of that species (loc. cit., pl. 67, f. 6 *b*) much resembles ours in the tail; but if his two specimens be correctly drawn, he

must have figured two species under the name. We cannot therefore identify the Irish fossil with his, especially as the decided bend in the pleuræ is not given in his figure; and we dedicate the species to Col. Portlock, who has so well elucidated the trilobites of Ireland. Our description is drawn from his specimen.

Locality.—Lower Silurian rocks of Tyrone, Ireland.

4. *I. perovalis*, Murchison, Sil. Syst. (1839) t. 23, f. 7.

I. capite gibboso, oculis remotis; thorace quam caudâ longiore, segmentis 10, *axi angusto; pleuris paulo reflexis ad fulcrum, quod pleurarum ferè omnium ad tertium positum est, caudæ axi angustissimo, circumscripto.*

In the young specimen figured the eyes are not seen, but they must be nearly as distant from the axal furrow as the width of the central lobe; the axis of the thorax is much narrower than the pleuræ—this is maintained in the adult; the fulcrum at about one-third in the first segment, in the next a little farther out, and from thence at an equal distance in all the segments. Tail in youth more than a semi-circle, shorter than the thorax, with the axis very narrow, circumscribed, and reaching about half-way down; in the older state it forms about a semi-circle, is flattened, and the axis does not reach so far. The end of the axis does not indent the broadish incurved margin of the inferior side; it does so in *I. crassicauda*, which has a shorter and subtruncate convex tail, a much broader axis to the thorax, and the eyes not nearly so remote. We have not specimens perfect enough to characterize *I. perovalis* fully, but enough to show that it ought not at present to be connected with the Swedish species.

Locality.—Llandeilo flags of the Corndon Mountain, Shropshire.

5. *I. ocularis,—n. sp.*

I. capite semicirculari, utraque acutangulo, lobo centrali angusto; oculis magnis, approximatis, a cervice vix dimidium diametri remotis: thoracis axi pleuris æquali, his ad fulcrum deflexis et paulum reflexis; pygidio —— ?

A species so remarkable among the trilobed division of *Illænus*, for the size of the eye, that we have ventured to name it—we cannot recognize it among published species.

Locality.—Llandeilo flags, county Kildare, Ireland.

6. *I. Murchisoni*, Salter. *I. Rosenbergii*, ib., Mem. Geol. Surv., vol. ii., pt. 1, pl. 5, f. 6–8.

I. capite caudâque magnis, thorace brevi, anterius contracto; capite utrâque acutangulo, oculis ad sulcos approximatis, diametrum suum a cervice remotis; thorace axi latissimo distincto, pleuris anterioribus brevissimis.

A species connecting the true *Illæni* with *Bumastus*, having a very wide axis and very narrow front pleuræ. The axis, however, is really distinct, and the fulcrum not close to it. There is reason to believe that the *I. Rosenbergii*, to which these specimens were referred before, is a very large specimen of *I. crassicauda:* as Pander and Burmeister have previously stated. This fine *Illænus*, from near the classic town of Llandeilo, we dedicate to Sir R. I. Murchison.

Locality.—Llandeilo flags of Llandeilo, South Wales.

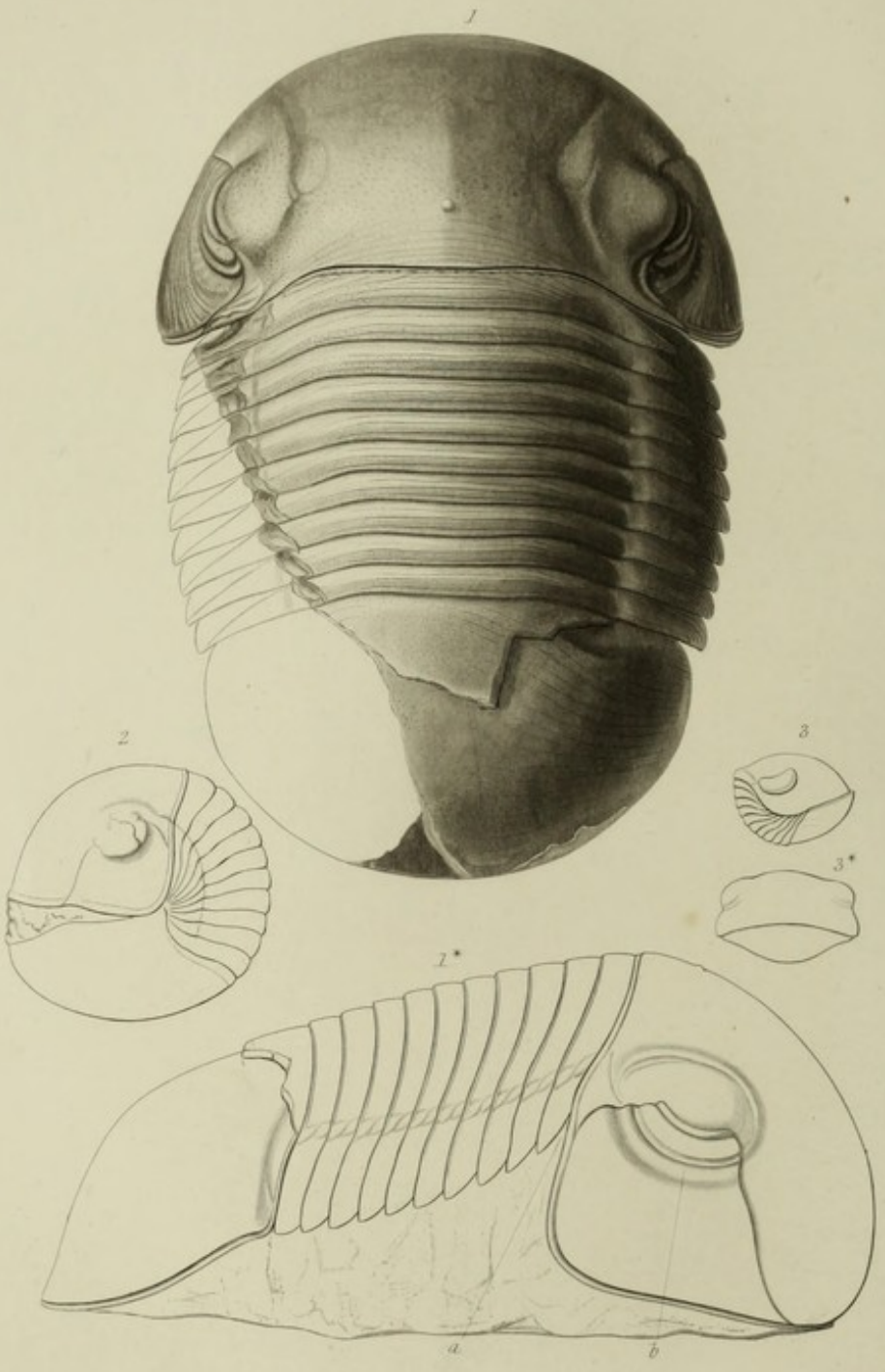
Notwithstanding its great similarity in external characters to *Nileus*, *Illænus* is essentially distinguished by the possession of a rostral shield, a portion so designated by Burmeister, and peculiar to *Illænus* and *Calymene*. This shield appears to be a plate inserted between the two cheek-pieces, and separates the hypostome, or labrum, from the facial suture. In *Asaphus* the cheek-pieces are united across, or in some divided merely by a vertical suture. *Ill. centrotus* (Dalman) has long head-spines, and in this differs from most species of the genus, though some others are angular at the corners. Pander, and after him Sars, described the hypostome; it is simply oval, and by no means notched, as in *Asaphus*.

The genus commenced in the Llandeilo flags, and continued to the end of the Silurian system. We think there is not good evidence of its longer duration, though Munster cites one or two species from Devonian rocks in Germany.

June, 1849. J. W. Salter.

Geological Survey of the United Kingdom.

ILLÆNUS
(Silurian)

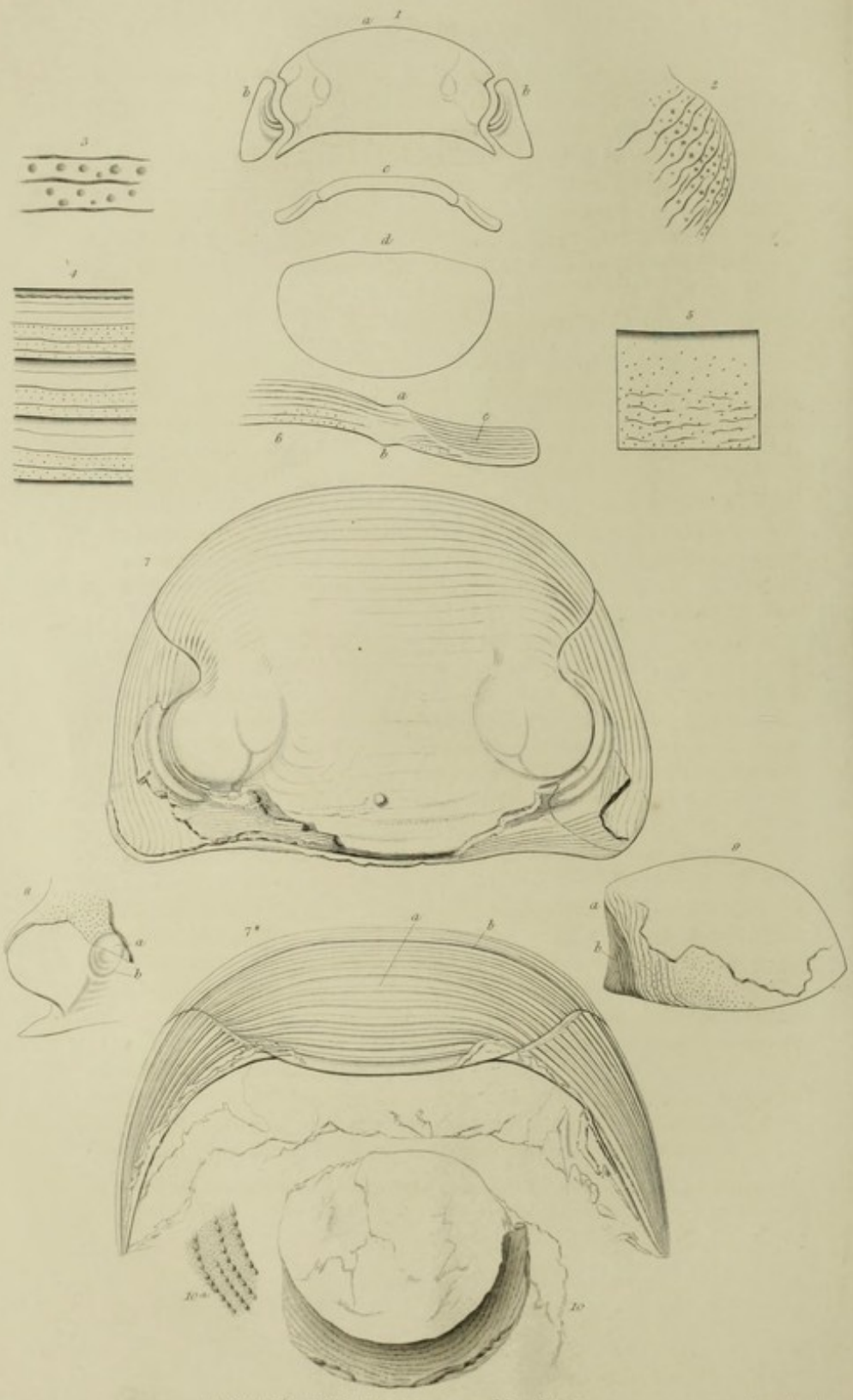


ILLÆNUS (BUMASTUS) BARRIENSIS ——— *Murchison*

W.H.Baily del.t E.Forbes direx.t J.W.Lowry f.

Geological Survey of the United Kingdom.

ILLÆNUS
(Silurian)



ILLÆNUS (BUMASTUS) BARRIENSIS ... *Murchison.*

BRITISH FOSSILS.

Decade II. Plates III. and IV.

ILLÆNUS BARRIENSIS.

[Genus ILLÆNUS. Dalman. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Head about a quarter of a sphere; eyes smooth, remote; facial suture ending on the posterior margin behind the eye, marginal or submarginal in front; hypostome entire, separated from the facial suture by a transverse rostral shield; thorax rings 9 or 10.]

[Sub-genus *Bumastus*. Thorax with 10 rings, not trilobate; the axis very broad, reaching to the fulcrum.]

Diagnosis. *I. (Bumastus) ovali-oblongus, valde convexus, crustâ crassa; capitis sulcis axalibus remotis; oculo magno prominente, vix dimidium longitudinis suæ a cervice remoto, palpebra* valde convexâ; thorace articulis* 10, *haud trilobato.*

Synonyms. "A new species of Trilobite," F. Jukes (1829), in Ann. Mag. Nat. Hist., vol. ii., p. 41, figs. 8, 9, 10; "*probably Isotelus*," J. D. C. Sowerby, *ib.*, p. 45; Silliman, Amer. Journ. of Science (1832), vol. xxiii., 1, p. 203. *Bumastus Barriensis*, Murchison (1839), Sil. Syst., pl. VII. *bis.*, fig. 3; *ib.* XIV., f. 7; Emmerich (1839), Dissert. 33. *Nileus?* (*Bumastus*) *Barriensis*, Milne Edwards (1840), Crust., vol. iii., p. 295. *Ill.* (*Bumastus*) *Barriensis*, Burmeister (1842), Org. Tril., 120; Ray edition (1846), 104 *Bu. Barriensis*, Hall (1843), Geol. Report, New York, No. 10, f. 4; No. 19, f. 2. [*Nileus glomerinus*, Dalman, Arsberätt. (1828), p. 136; Hisinger (1837), Leth. Suec. 16?]

Description.—Oblong-oval and very convex; the three divisions, head, thorax, and abdomen, nearly equal. Head a quarter of a sphere, more pointed in front in the young specimen than in the adult, in which it becomes obtuse. The surface of the head is even, and but slightly marked by short converging distant axal furrows into glabella and cheeks. Terminating these short furrows, and immediately above the prominent upper eyelid (*palpebra*) is an oval space, sometimes flat or depressed, and sometimes a little convex, where the crust is thickened interiorly, and on which the puncta that occur so commonly on the other portions of the crust are absent in some specimens,—its nature

* Dalman uses the term "*lobus palpebralis*" for the covering plate or eyelid: its variations are often characteristic.

we do not know. Eye strongly lunate, long, narrow, smooth, and supported by a very strong fold of the cheek, which forms a sort of lower eyelid, and is most developed in age. Cornea apparently thick. The facial suture in front of the eye runs S-shaped outwards and upwards, turns a little beneath the margin, and then runs straight across above the rostral shield; it bends out sharply beneath the eye, and cuts the margin beneath the most prominent curve of that organ. Rostral shield a long transverse piece, deeply striate, and overhanging with a sort of pouting lip the attachment of the hypostome. This last piece is yet undiscovered.* Cheeks with rounded angles posteriorly, and curving over the lower side of the head; they are separated by the wide rostral shield.

Thorax of 10 segments arched back, especially the forward ones, and having the three lobes just indicated by a very slight furrow where the fulcrum is placed, the subfusiform axis occupying more than two-thirds the entire width. The fulcrum is far outwards, and is formed by a short forward bend of each pleura, which then continues in the general direction, is sharpened anteriorly for rolling, and curves forward at its blunt end; the foremost pleuræ are rapidly shortened, the whole of the cheeks projecting beyond them (plate 3, f. 1**a*).

Tail in the young about three-fourths of a hemisphere; in the adult more than half. The upper corners are truncated and turned down, but there are no indications of the axal lobe. Incurved portion of the tail not broad, but thick, deeply concave, and marked concentrically on both surfaces by elevated lines of dots (pl. 4, f. 10, 10*a*). The whole surface of the animal is more or less punctate, and marked with wavy imbricate lines; they appear to vary very much in number and position, abound near the edges of the head, but less so on its most convex portion; run across the thorax parallel to the course of the rings, and on the tail are most abundant on its forward margin. On all the articulating surfaces the lines are doubly close, but the puncta absent. On the somewhat depressed space immediately over the fulcral points in the head and thorax-rings, both lines and puncta vanish. These latter, which most probably indicate the bases of short pile, are often wide and deep (pl. 4, f. 3), and are present on the posterior surface of the tail, where the lines are absent. The inferior eyelid (pl. 3, f. 1**b*), if so it may be called, is deeply punctate in our specimen, but without any of the wavy lines.

Variations.—Though numerous specimens are extant, there are so few perfect ones, that we are not able to detect any considerable variety in the proportions. Certain Dudley specimens appear more elongate.

* Mr. John Gray of Dudley possesses an entire transverse labrum, with two tubercles, which very likely belongs to it.

Affinities.—But one is published which belongs to this section of the genus besides our own, the *Illænus trentonensis* of Emmons (Geol. New York, 2nd district), and through the kindness of Dr. Bigsby, the well-known explorer of the Canadian frontier, we have seen a specimen as large as our largest individuals of *I. Barriensis*, from Little Manitoulin Island, on Lake Huron. It differs, at a glance, from ours, in the angularity of the posterior angle of the head, and its strongly converging and lengthened axal furrows. Whether Dalman's *Nileus glomerinus*, described in 1828, be this species, as Burmeister thinks it may, we have no means of deciding at present.

History.—The earliest notice of the British fossil was given under the name of "A new Trilobite from Dudley," by Mr. Frederic Jukes, who communicated drawings and casts, and a note by Mr. J. de C. Sowerby, to Loudon's "Magazine of Natural History;" the specimens were obtained from near Barr Beacon, Staffordshire. Mr. Jukes also communicated casts soon after to Silliman, for his "American Journal," and it is there stated that Mr. Sowerby had referred it to a genus found at Trenton Falls, the *Isotelus* of Dekay. Professor Green, however, would not admit the identity of the two genera, and denied the existence of the English type in America. This was quite true at the time, but it is singular enough that the Trenton limestone should afford afterwards another and almost identical species. Sir R. I. Murchison, as is well known, founded his genus *Bumastus* on this Wenlock fossil. Milne Edwards did not adopt it, and considered it closely related to *Nileus;* while, however, he referred the other species of *Illænus* to Dekay's genus *Isotelus*. Burmeister, in 1842, placed it in its present position as a section of *Illænus;* while the species of *Nileus*, which Dalman distinguished from all trilobites (not knowing our species) by their want of trilobation, have fallen into their true position among the large group of *Asaphus*.

British Localities and Geological Range.—Silurian Rocks; Woolhope limestone to Wenlock limestone. Wenlock formations of Hay Head, near Barr, Staffordshire (Sir R. I. Murchison). Dudley, Staffordshire. Haven, near Aymestry, Herefordshire (Rev. T. T. Lewis). Woolhope limestone of Littlehope, Woolhope; and also of Nash Scar, Presteign, Herefordshire. Wenlock limestone of Ledbury, Malvern (Coll. Geol. Survey.)

Foreign Distribution.—Niagara group of New York (Hall). A species very like it was found near Hohenholm, by Eichwald (Urwelt, Russland, Heft, 2, 59), but it is not quoted from Norway or Sweden.

Explanation of Plate III.

Fig. 1. Old individual from Barr, in the possession of Miss Jukes, of Birmingham.

Fig. 1*. Side view of the same, showing the shortened foremost pleuræ (*a*), and the inferior eyelid (*b*).

Fig. 2. Side view from a fine coiled specimen in the cabinet of John Gray, Esq., Dudley.

Figs. 3, 3*. Two views of a young one; in the cabinet of Augustus Lewis, Esq.

Plate IV.

Fig. 1. The dissected figure. *a*, head; *b b*, cheeks; *c*, thorax segments; *d*, tail.

Fig. 2. Portion of surface above the eye, showing the wavy lines and puncta.

Fig. 3. Ditto, with puncta larger than usual.

Fig. 4. Magnified pleuræ, with lines and puncta.

Fig. 5. Part of tail, the puncta only present over the hinder portion of it.

Fig. 6. Pleura magnified, showing the fulcrum *a*, the backward bend at *b*, the sharpened forward edge *c*.

Fig. 7. Large head from Littlehope.

Fig. 7*. The same, lower side. *a*, rostral shield; *b*, rostral suture (Burmeister).

Fig. 8. Shows the thickened portion of shell just above the eyelid at *a*; impression of it on the stone beneath at *b*. (In this specimen it is destitute of puncta.)

Fig. 9. Side view of part of tail; at *a*, the fulcral point; *b*, the articulating surface, with lines, but not puncta.

Fig. 10. Incurved portion of tail; the inward surface with elevated granulate lines.

Fig. 11. A ditto, magnified.

The specimens figured in this plate are in the Geological Survey Collection.

The section *Bumastus* is related to the more typical species of *Illænus*, just as *Nileus*, of Dalman, is to his *Asaphus palpebrosus*. The distinct trilobation has vanished, and the axis is so wide as to reach the fulcral point, and be nearly coincident with it. There is a slight backward bend of each pleura just before the fulcrum, which serves to steady the articulation of the piece behind by overhanging it a little, while this piece, in turn, overhangs the preceding at the fulcrum, precisely as in the articulation of the abdomen of the lobster and cray-fish. Beyond the fulcral point the pleura is always more or less sharpened, to pass under the preceding joint in the act of bending; and, as in this operation, the back is lengthened, and the soft parts of the axis would be exposed by the separation of the segments, a convex articular portion is added on the forward edge of each segment, which fills the gap, and retires beneath the preceding joint, when the animal is extended. This is the structure of all trilobites which have been observed to bend or roll, and it is similar to that met with in recent crustacea.

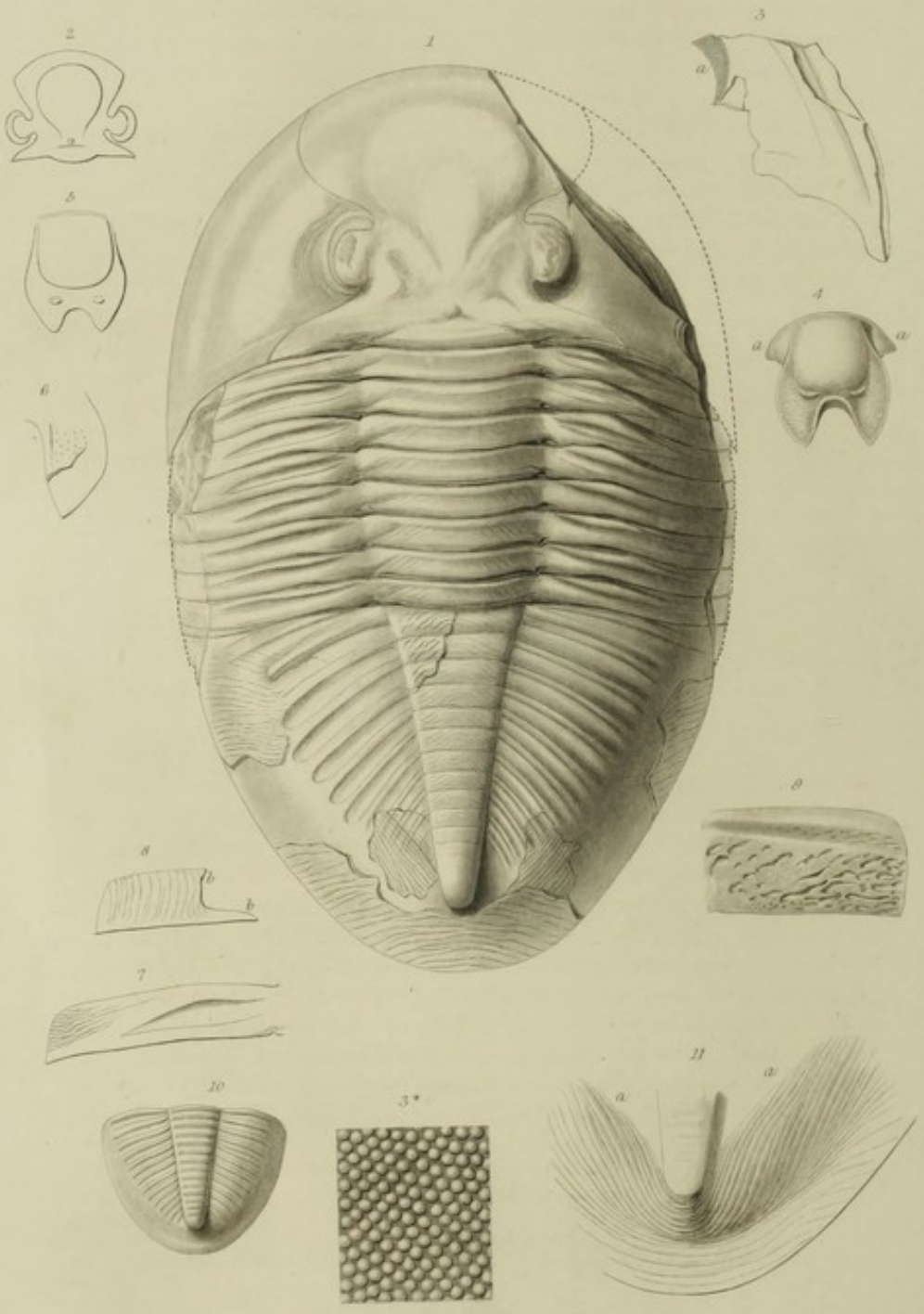
The subgenus is known in the Lower Silurian rocks of America, and the Upper Silurian of Britain.

J. W. Salter.

June, 1849.

Geological Survey of the United Kingdom.

ASAPHUS
(Silurian)



ASAPHUS TYRANNUS — *Murchison*

C.R.Bone del. E.Forbes direx. J.W.Lowry fc.

BRITISH FOSSILS.

Decade II. Plate V.

ASAPHUS TYRANNUS.

[Genus ASAPHUS. Brongniart. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Eyes large, smooth. Facial suture marginal or supramarginal in front, and ending on the posterior margin. No rostral shield. Hypostome strongly bilobed. Body rings 8.]

[Subgenus *Basilicus*, Salter. Facial suture marginal in front; head but slightly lobed; pleuræ furrowed transversely; tail large, with axal and lateral furrows.

Diagnosis.—*A.* (*Basilicus*) *ovalis; capite semicirculari, angulis in spinas breves productis; cauda parabolicâ, latè marginatâ, regulariter convexa, apice rotundato nec acuto; axi distincto, sublineari, angusto, multicostato, apice abrupto; lateribus multicostatis.*

Synonyms. *Asaphus Tyrannus*, Murchison, Silurian Syst. (1837), pl. xxiv. and pl. xxv., f. 1. *Ogygia Tyrannus*, Emmerich, Dissert. (1839), 29. *Asaphus Tyrannus*, Milne Edwards, Crust. (1840), 3, 310. Emmerich, Leonhard and Bronn's Neues Jahrbuch 1845 (translated in 'Scientific Memoirs,' vol. iv. (1845), 273). [not of Burmeister, Organ. Trilob. (1843), t. 5, f. 4. Ray edition (1846), 108.]

A remarkably perfect specimen in the cabinet of W. Day, Esq., of Hadlow near Uckfield, and specimens in the Geol. Survey collections displaying the parts of the mouth, enable us to present a complete description of this famous, but apparently local trilobite.

Description.—Length 11 inches; breadth 6¾ inches. General form nearly a true oval, moderately convex; the head semicircular, the tail longer and parabolic. Head smooth, with a slight concavity marking off the margin, produced at the angles into short spines which reach the third thoracic segment. Glabella clavate, defined in front only; the forehead lobe large, protuberant, and nearly round: beneath it, and at the level of the front of the eye, is the uppermost of three obscure oblique furrows. There is at the base of the glabella a tubercle, and beneath it an impression marking the place of the neck furrow. Eyes rather large, much arched, placed behind the middle of the head, and close to the glabella; the base of the eyelid is constricted, the lentiferous surface is broad and smooth, and beneath the cornea there are very

numerous lenses,* not quite closely set. Facial suture ending on the posterior margin, at the inner third of the width of the cheek, and in front of the eye turned outwards in a sigmoid curve; it cuts the front margin beyond the parallel of the eye, and continues exactly along the edge of the shield.

The hypostome is semicircular at its base, which is moderately broad; it has a squarish tumid centre surrounded by a strong furrow, and is deeply divided at the apex into two ovate-lanceolate forks, between which the shelly plate turns strongly inwards: there is an oval circumscribed tubercle at the origin of each, most distinct on the inner surface.

Thorax of eight moderately arched rings, the axis not strongly marked and as broad as the pleuræ; these latter are furrowed for three-fourths of their length, and are curved down, but scarcely bent backward, at the obscure fulcrum, which in the hinder rings is placed at about one-third away from the axis, but much nearer to it in the forward rings; the anterior edge of each pleura is sharpened, and its termination square.

Tail parabolic, its width at the broader end one-fourth greater than the length (it appears nearly equal), regularly convex, not sunk in the middle; axis flattened forwards and prominent behind, terminating abruptly at four-fifths the length of the tail, and ribbed throughout by about 15 furrows. The sides are furrowed for about half their width by 12 or 13 oblique parallel sulci, which end abruptly at the edge of the broad concave margin; the uppermost furrow is much stronger than the rest. The incurved lower surface of the tail occupies rather more than the breadth of the smooth upper border, and folds round the end of the axis which indents it. The fine lines on this incurved border are not truly concentric with the edge, but appear to branch from an imaginary line along the middle or most concave part. The space left between the upper and lower borders is shallow. On the upper crust of the tail the wavy lines are interrupted and inosculate; they arch over the axis with the convexity of the curve forwards: on the lateral lobes the curve is reversed.† The same arrangement is seen on the thorax rings,—at the ends of the pleuræ they turn upwards, and fig. 8 shows the longitudinal disposition of these lines on their under sides. On the head similar lines occur, but we have not specimens to show it well; the hypostome has them obliquely on the forks (fig. 4).

* On a specimen lent by Mr. Day, which presents only the lower half of the eye, the number and arrangement is such, that judging from analogy with *A. Powisii*, the eye of which is very much like this, there must have been 6000 lenses, or probably more.

† Burmeister has figured a good example of this arrangement of the sculptural lines on the tail of an *Asaphus* in his "Zeitung fur Zoologie," &c., 1 Band, 1848, t. 1, f. 19.

Variations.—Some individuals (perhaps females) are much more convex than others; in some the margin is abruptly concave; our figured specimen is depressed. The number of lateral ribs to the tail varies considerably, they do not seem to become more numerous by age. The forks of the hypostome are long or short. The ornamental lines which are so conspicuous in the external cast (Pl. 24, Sil. Syst.) exist, though less deeply sculptured, in all; the internal cast, which is more commonly found than perfect specimens, does not show them distinctly.

Affinities.—The specimen figured in Burmeister's work appears by his description to have been from a "boulder of red limestone," and hence it is very probably a worn specimen of *A. heros* (Dalman), from the red limestone of Kinnekülle, Gothland. It is unfortunate that the author should have transferred the sculpture of *A. tyrannus* to this figure, for the axis is constricted in the middle and depressed, and the lateral ribs long; it is in fact a pretty good figure of *A. heros*, except in the rounded tail; in Swedish specimens the tail is pointed and the axis percurrent. There is also a species in the lowest Silurian limestone of New York so like ours, that we do not know how it is distinguished; there are, however, but seven or eight distinct ribs on the axis, and those on the sides are said to be duplicate; we refer to *A. marginalis* (Hall), described in the Palæontol. New York. This is the more interesting, as the *Asaphi* of North America belong generally to the group *Isotelus*.* The species which most nearly resembles *A. tyrannus*, and which I referred to it in Prof. Sedgwick's papers in the "Geological Journal," is the *A. Powisii*, very common in the slates of North Wales. The specimen of this latter species figured in the "Sil. Syst." is much compressed, for the species is really more convex than that here described, with deeper furrows on the pleuræ, which are arched forward at their ends; and the tail axis is wide above, rapidly contracting in width and becoming quite indistinct, its end only prominent; the surface seems smooth; the sides of the tail have a very strong uppermost furrow; the remaining furrows are faint. Fine specimens of *A. Powisii*, in the collections of the Geol. Survey and of Mr. Sharpe, show very numerous lenses (about 7000) on each eye.

History.—It appears not to have attracted the notice of Llhwyd, although it is quite as common at Llandeilo as the *Ogygia Buchii*, of which he figured specimens; nor does it seem to have been noticed by any writer on trilobites previously to the publication of Sir R. I. Murchison's work. Emmerich, in his Dissertation, showed how close he considered its affinities to be with *Ogygia*, by transferring it to that

* The young animals of even this group, according to Hall's figure, are trilobed and ribbed in the tail; but that can only be in a very young state.

genus. In 1845, however, he restored it to *Asaphus*, though he evidently had not observed the characteristic labrum. Burmeister appears not to have been acquainted with the species, since in both editions he confounds it with what we believe to be a specimen of *A. heros*, and even suggests, in his Appendix, that Murchison's smaller figure might prove to be *A. extenuatus*. He notes that it appears anomalous for *Asaphus* to have such distinct ribs on the tail; and indeed this peculiarity is one of the indications of its affinity to *Ogygia*, which we think confirmed by the course of the facial suture.

Localities and Geological Position in Britain.—Llandeilo Flags.—Limestone of Wrae, Peebleshire? (Geol. Society's Coll.). Coniston limestone, Westmoreland? Craig-y-Glyn, Berwyn Mountains, in Bala limestone (Sedgwick); Meadow Town; Shelve, &c., in the Longmynd, Shropshire; Carneddau Hill, Builth, Radnorshire [J. W. S.]; Llandeilo, and many neighbouring localities in Caermarthenshire; Llampeter Felfry, Pembrokeshire [Murchison]; Narberth; Mydrim; Sholeshook; Lann Mill, Pembrokeshire (Phillips). It is remarkable that it does not occur in Ireland.

Foreign Distribution.—It is quoted by Sir R. I. Murchison from Northern Europe [Quart. Geol. Journal], but with the understanding that *A. heros*, Dalm., was intended. *A. marginalis*, Hall [Palæont. New York, pl. 4, *bis*, f. 15], may be the same as our species.

Explanation of Plate V.

Fig. 1. Perfect specimen. Llandeilo. (Collection of W. Day, Esq.)

Fig. 2. Outline of central portion of head, showing the constricted eyelids. Lann Mill.

Fig. 3. Portion of head, with the base of the eye, *a*. Llandeilo (Mr. Day's Collection).

Fig. 3*. Magnified portion of a cast from the same, which would represent the surface of the eye when the smooth cornea is removed.

Fig. 4. Perfect hypostome, with the upper processes (*a a*). Lann Mill.

Fig. 5. Variety of the hypostome, with shorter forks. Golden Grove.

Fig. 6. Punctate exterior surface of part of hypostome; the lineated surface is shown in fig. 4.

Fig. 7. Upper surface of a thorax joint. St. Clears.

Fig. 8. Under surface of ditto, showing the extent of the incurved portion *b*, *b*.

Fig. 9. Part of thorax of a large individual, with deep sculpture. Golden Grove, Llandeilo.

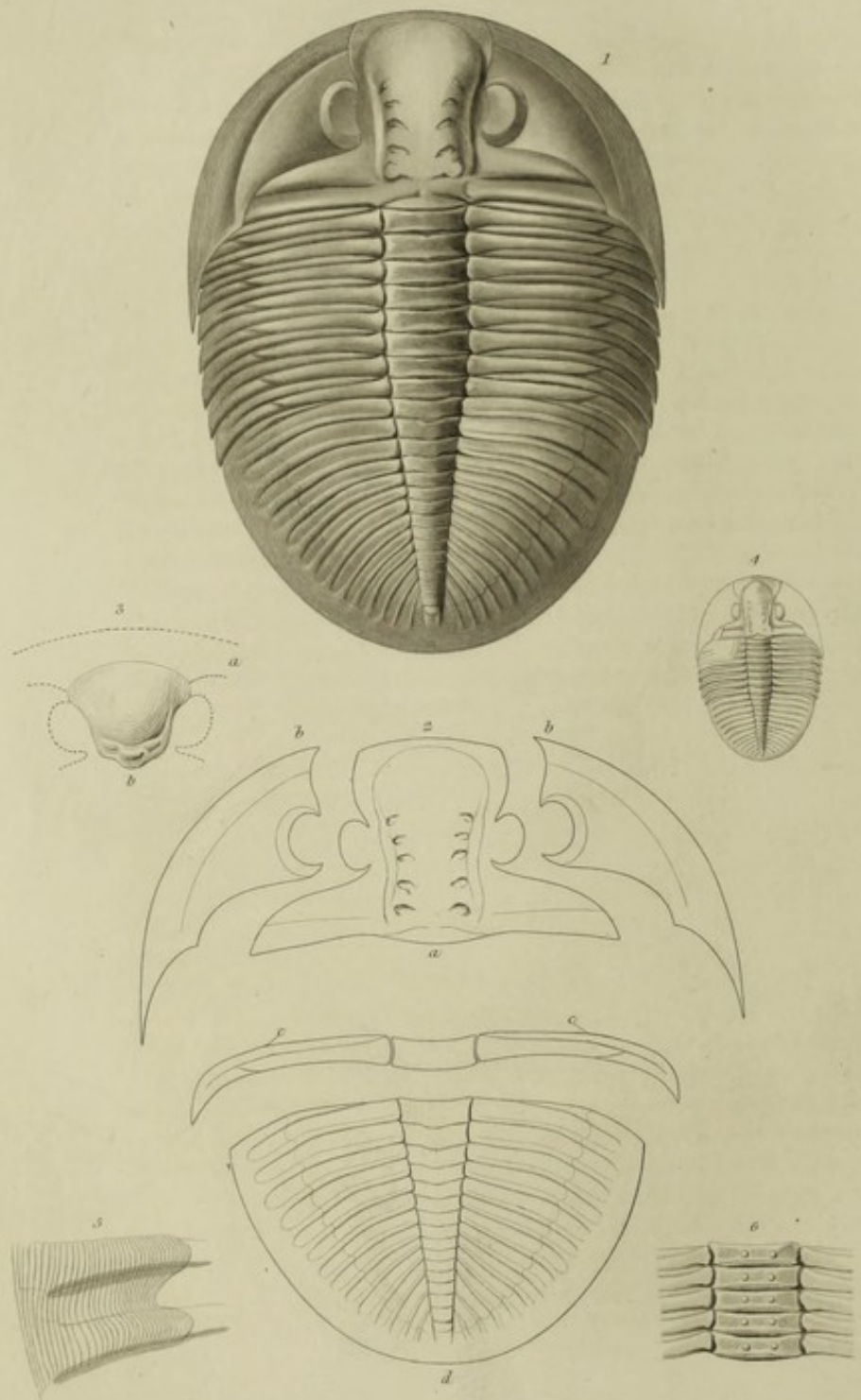
Fig. 10. Tail of young individual. Llandeilo.

Fig. 11. Incurved part, under side of the tail, bounded by the lines *a*, *a*, and deeply indented by the axis. Clog-y-frain. (Sir R. I. Murchison's Cabinet.)

June, 1849. J. W. Salter.

Geological Survey of the United Kingdom.

OCYGIA
(Silurian)



OCYGIA BUCHII — *Brongniart.*

C.B.Rose del. E.Forbes direct. J.W.Lowry fc.

BRITISH FOSSILS.

Decade II. Plate VI.

OGYGIA BUCHII.

[Genus OGYGIA. Brongniart. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Eyes large, smooth; facial suture cutting the posterior margin; no rostral shield or vertical suture; hypostome entire; body rings 8; tail large.]

Diagnosis. *O. ovalis, glabellâ angustâ utrinque quinquesulcatâ; oculis ad medium capitis; suturâ faciali ad frontem marginali; spinis posticis brevibus; hypostomate obtusè acuminato; thoracis axi bis pleurâ angustiore; caudæ axi longo abrupto; sulcis lateralibus* 12 *duplicatis, prope marginem angulatim deflexis.*

Synonyms. Llhwyd (1698), Philosoph. Transact., vol. xx., 279, tab. addit., f. 15. *Buglossa curta strigosa*, ib., Ichnograph. Brit. (1690), Epist. 1, t. 22, f. 2. Trilobite from Llanelly, Parkinson, Organ. Rem. (1811), v. iii., t. 17, f. 13. *Asaphus De Buchii*, Brongniart, Crust. Foss. (1822), t. 2, f. 2. *Trilob. De Buchii*, Schlotheim, Nachtr. (1823), ii., 34 (excl. the locality, "Norway.") *Asaph. Buchii*, Dalm. Palead. (1826), 68. J. D. C. Sowerby, in Loudon's Mag. Nat. Hist., 1829, vol. ii., f. 27. Buckland (1836), Bridgwater Treatise, t. 46, f. 7. Murchison (1837), Sil. Syst., t. 25, f. 2. Quenstedt, Wiegm. Archiv. (1837), vol. iii., 1, 346. Emmerich, Dissert. (1839), 28. Milne Edwards, Crust. (1840), 3, 309. Burmeister, *Org. Trilob.* (1843), t. 1, f. 2, [facial suture wrongly figured.] Ray edition (1846), p. 59. Corda, Böhm. Tril. (1847), t. 4, f. 39 [bad.]

——Junior. *Trinucleus? asaphoides*, Murchison, Sil. Syst., t. 23, f. 6. Milne Edwards, Crust., v. iii., 333.

Description.—Length occasionally near seven inches, generally three or four; proportion of length to breadth from 6 : 5 to 6 : 4, a considerable variation. General form a broad depressed oval, the head nearly semicircular and as long as the thorax, the tail semi-elliptical and longer than either; glabella at its base occupying one-fourth or less of the width of the head, broader and more convex above, and a little pointed in front; it extends nearly to the front margin, and is marked, a little within each side, by a longitudinal depression, which is curved with the convex side inwards. Along this hollow lie five pits, which represent the glabella furrows; the basal one is the neck furrow, that

above is placed near the centre of the glabella, the other three recede more, the uppermost coming just above the eye. Eyelid large, semicircular, and not touching the glabella. The facial suture above the eye is curved outwards a little to reach the margin, along which it runs for some distance; beneath the eye it curves largely outwards, and cuts the posterior edge just within the border. The latter is wide and striate, more or less concave, and marked off by a distinct marginal furrow. Eye placed halfway up the head, smooth, the lentiferous surface broad, its minute structure is not yet known. Head angles not produced below the fourth body segment. Hypostome broad above, narrowing below, where it is suddenly and obtusely pointed; the centre is gently raised, and a furrow runs down each side; there are two transverse furrows near the apex, with compressed tubercles between them. Thorax with the axis gently convex, variable in proportion, but seldom more than half the width of the pleuræ. These are flattened, furrowed along the upper margin as far as the fulcrum, at which there is an obtuse bend (fig. 2, *c*, *c*), the furrow diverges from the margin here, and does not quite reach the recurved and pointed extremity; it becomes widest immediately beneath the fulcrum, and from the lower margin of the pleuræ at this point a narrow ridge runs obliquely upwards, and meets it. Tail varying from little more than a semicircle to a half-ellipse, very gently convex; the axis gently tapering, ribbed by about 13 or 14 furrows, which have a downward bend in the middle; its obtuse tip projecting. Lateral furrows at nearly right angles to the axis, angularly bent downwards at the place of the fulcrum,* interlined all the way by fainter furrows, and leaving but a narrow flat margin. Incurved under portion of the tail narrow, closely striate, not indented by the axis; the upper side has a striate band of the same width, which is indented by every rib of the tail. The inferior striated band is continued (of the same width) along the ends of the pleuræ, and the striæ run in the same direction, while, on the upper surface, they are transverse, and reach further inwards. Numerous fine striæ, arched upwards, cover the axis. The cheeks appear to be nearly smooth, but the glabella is covered by fine, short, broken, almost microscopic lines. The hypostome is strongly and concentrically striate.

Variations.—It varies in convexity, proportionate length, and in the width of the axis; this latter is sometimes, though very rarely, more than half the breadth of the pleuræ—generally half, frequently less than half. A pair of tubercles on each segment of the axis is present; they are distinct and strong in some specimens (fig. 6), and faint in others.

* The tail, consisting of anchylosed segments, preserves traces of nearly all the characters of the thorax; the strong furrows are analogous to the furrows of the pleuræ, the fainter lines between them to the joints.

Affinities.—From *O. Guettardi* it is known by its less elongate and more oval shape, and greater width of pleuræ in proportion to the axis; in *O. Guettardi* they are but once and a-half the width. The axis of the tail is longer, and has 13 instead of 9 ribs, and is abrupt, not attenuated at the tip;—in *O. Guettardi* it extends but three-quarters the length. It has, also, duplicate, bent, and more numerous side furrows; the other has but eight or nine straight simple ones; the hypostome also is subconical, not dilated laterally. *O. dilatata*, Brunnich (not of Portlock), which seems to have been frequently held as a variety of *O. Buchii*, has the glabella short, with its lobes crowded down towards the lower part, and the eyes remote. The facial suture behind the eyes appears much less arched in Sars' figure. He also describes the tail as with 10 ribs, separated by *broad* furrows. The labrum of *O. dilatata*, according to Sars' figure, is but slightly different from that of the British species; but an important difference resides in the facial suture, which, in *O. dilatata*, is within the front margin on the upper side, but in *O. Buchii* is along the edge itself, as in *Asaphus Tyrannus*.

History.—The earliest mention we can find of Trilobites is concerning this species, and is that which all writers on these fossils have quoted. Mr. Edward Llhwyd, in a letter to Dr. Martin Lister, of the Royal Society (1698) writes "concerning several regularly figured stones lately found by him." "The 15th," he says, "we found near the Lhan Deilo*, in Caermardhinshire, in great plenty, it must, doubtless, be referred to the sceleton of some flat fish;" but, a few lines after, "Not that these, or any other marine terrestrial bodies were really parts of exuviæ of animals, but they bear the same relation to them as fossil shells to marine ones," &c. This latter opinion he takes care to maintain in his "Lithophylacii Brittanici Ichnographia" (1699), where he again says, the specimen represents only the skeleton of a sole fish, and wants the tail, and he marvels that the "Piscis Icon" should be raised above the surface of the stone, "ac si verus piscis esset." It is curious that Brongniart should have placed this species in his heterogenous group *Asaphus*, at the very time he was founding *Ogygia*, as he appears to have recognized the latter genus more by its marked habit than by any positive characters. He probably meant to unite *A. dilatatus* with *A. Buchii*. Dalman distinguished them, but with doubt, in 1826, and gave a figure of the Norwegian fossil from a plaster cast; and had not Sars, in 1835, given a complete description, and a good figure of

* Fig. 9, of the same communication, is often quoted as belonging to *Trinucleus*. We have no doubt it is *T. Caractaci*, as that is the common species there (*T. fimbriatus* is found at Builth) besides, the distinct dots in the fringe identify it with the former species. Fig. 8 appears never to have been quoted, yet it is a tolerable representation of *Cybele verrucosa*, Dalman, and it has been figured again without a name by Brongniart, plate 4, f. 11, from the same locality, where it abounds, and is the only species of the genus there.

the head, the identity might still have been maintained. The hypostome of this species was first represented in Sir R. I. Murchison's figures. We have ascertained, by personal inspection, that the *Trinucleus Asaphoides* of his work is the young of *O. Buchii*. Quenstedt, 1837, unfortunately got hold of two specimens with seven rings; whether an accidental variety, or as Burmeister thinks, one occasioned by the slipping of one ring under the others, it is difficult to say. Quenstedt, however, relied on these, and Dalman's 7-ringed specimen of *O. dilatata*, and asserted the same number for *O. Guettardi*. But the error in both cases led him to see the generic affinity between these two allied species, and he distinctly says that their union with the typical *Asaphi* is unjustifiable. Burmeister, in his first edition, set the number of rings right, but confounded *O. dilatata*, which Sars had well distinguished in Oken's "Isis," (1835), with our species, and adhered to this view in the Ray edition (1846). Emmerich had, in the mean time, spoken of them as different species, and figured *O. dilatata* in Leonhard and Bronn's "Neues Jahrbuch," for 1845. Corda still maintains the error of the seven rings.

British Localities and Geological Range.—LLANDEILO FLAGS only. Not yet known in North Wales; the localities given for it in the "Geol. Journal," vol. i., p. 20, &c., are erroneous, and were stated to be so in vol. ii., p. 128. It abounds in the distorted slates at Shelve and Hope Mill, Shropshire (Sir R. I. Murchison); Rorrington, Middleton, and Meadowtown, Shropshire; Builth, Radnorshire; Llangadoc and Llandeilo, Caermarthenshire (Geol. Survey Coll.) Haverfordwest; Musclewick Bay, Pembrokeshire (Phillips). Not yet found in Ireland.

Foreign Distribution.—La Couyère, Bain, &c., near Rennes, in the Cotè d'or (M. Rouault). In the north of Europe *O. dilatata* takes its place.

EXPLANATION OF PLATE VI.

Fig. 1. Perfect specimen from Builth (the glabella hardly pointed enough in front.)

Fig. 2. Same specimen dissected; at *a* the slight ascending furrows which cross the neck segment are seen; *b b*, cheeks or wings; *c c*, fulcral points of the pleuræ; *d*, tail.

Fig. 3. Under side of head in front, with the hypostome *b* attached to the continuous under portion *a* of the cheeks; Builth.

Fig. 4. Young specimen from Builth.

Fig. 5. Border of the tail, the inflected striate portion rendered wavy by projecting further inwards on each rib.

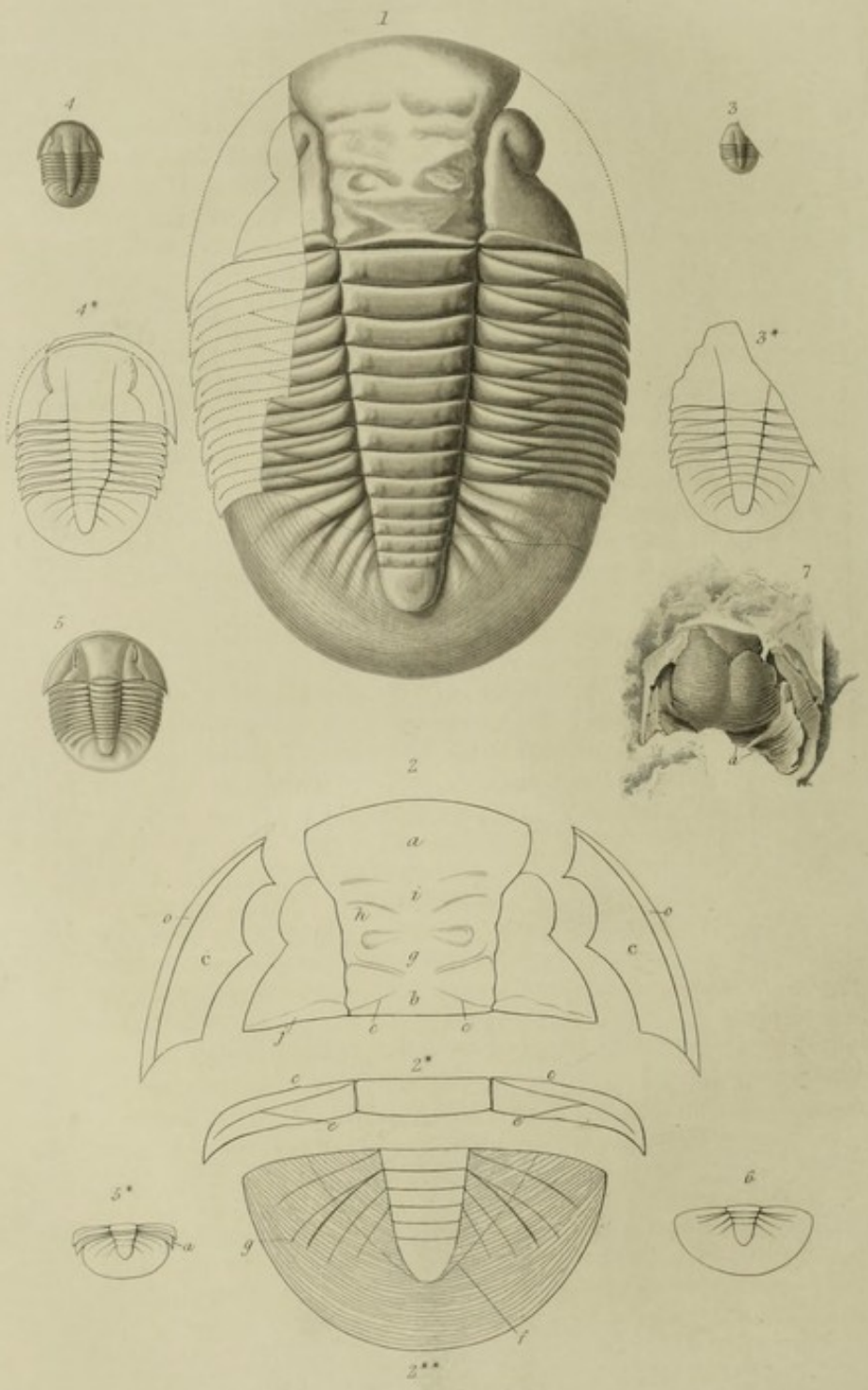
Fig. 6. Variety, with the tubercles on the axis strong; Llandeilo.

All the specimens in the Geological Survey Collections.

June, 1849. J. W. SALTER.

Geological Survey of the United Kingdom.

OCYCIA
(Silurian)



OCYCIA PORTLOCKII ___ *Salter.*

C.R.Bone del.

E.Forbes direx.

J.W.Lowry fc.

BRITISH FOSSILS.

Decade II. Plate VII.

OGYGIA PORTLOCKII.

[Genus OGYGIA. Brongniart. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ). Eyes large, smooth; facial suture cutting the posterior margin; no rostral shield or vertical suture; hypostome entire; body rings 8; tail large.]

Diagnosis. *O. ovali-oblonga; capitis margine angusto; glabellâ genis latiore, obscuré lobatâ; oculis ad anteriorem partem capitis positis; sutura faciali ad frontem marginali; caudæ axi lato brevissimo.*

Synonyms. *Asaphus dilatatus*, Portlock (1832), Geol. Rep., Tyrone, &c., pl. 24, f. 2 (not of Dalman). *Ogygia dilatata*, Phillips, Memoirs Geol. Survey (June, 1848), vol. ii., pt. 1, 239.

Description.—Length 3¼ inches; width 2¼ inches; often larger. General form nearly flat, ovate, widest in front. Head forming rather more than a semicircle, considerably longer and wider than the tail, but about as long as the thorax; the glabella is as wide as the cheeks below, and separated by slight furrows from them; it widens and overhangs the eyes above, and is abruptly bent down in front, where the margin is hardly visible. For nearly two-thirds of its length the glabella is marked by lateral furrows, irregular in direction, dividing it (apparently) into four lobes, exclusive of the forehead and neck lobes. The neck lobe *b* is broad, and rises higher on each side than in the middle; it has two oblique sunk lines, *c c*, rising from the lower angles, which appear to divide it into a pair of lobes (*O. Buchii* has the same marking). Above this lobe lies the more contracted basal one *g*, which does not reach to the margin of the glabella. The second lobe, *h*, is wider and more oblique than the third, *i*, which is very faintly divided from the wide transverse forehead lobe *a*. The fourth lateral lobe, so distinctly marked in *O. Buchii*, is absent in this species. Eyes moderate, placed very high up, towards the termination of the facial suture on the margin; eye-lid semi-lunate, but not constricted above or below; eye line turning a little out above the eye, beneath it obliquely downwards and outwards, cutting the posterior margin at about half the cheek's width; wings moderately large, with a narrow border and a

small spine. Hypostome with the centre gently swelled, and with distinct concentric furrows on the sides; apex . . . . .?

The first and last thorax rings are somewhat narrower than those of the middle; the axis is widest at top, and there only a little narrower than the pleuræ. It is not arched, but flattish, and marked by indistinct tubercles on the sides and middle. The pleuræ are straight; the fulcrum indistinctly marked about half-way along them; the divisions between the segments not nearly so conspicuous as the oblique straight furrow which reaches nearly to the end of each. The ends of the pleuræ are recurved and pointed, the foremost ones perhaps not quite so strongly as in our larger figure, the hinder ones as much as in fig. 2*.

Tail a semicircle, with the upper angles rounded off; the axis hardly more than two-thirds the length, flattened, conical, the end a little pointed. There are about five distinct ribs on the axis, each obscurely trituberculate. Lateral furrows four or five, very oblique, the two uppermost sharp and deep, reaching more than half across the side, with a secondary one between them, the two or three last very short and faint. Margin flat. Whole surface of tail crossed obliquely by lines which all run down from the upper angles inwards, except near the edge, where they are concentric; the incurved portion of the tail concentrically striate, broad, and indented by the axis. On the pleuræ the lines are longitudinal, and form a broad band crossing the segments. We do not know their direction on the head; the hypostome, however, is strongly marked by raised concentric threads.

Variations.—In the young state the middle lobe of the thorax and tail is narrower (of the latter considerably so), and therefore longer proportionally than in the adult; thus, in our smallest specimens, fig. 3, the pleuræ are once and a half as wide as the axis; in fig. 4, which is older, nearly as wide in proportion. In this stage the tail axis is not visibly annulated, but the number of lateral ribs is the same as in older specimens, about four; the upper one is not, however, duplicate. The glabella in the youngest specimens is very obscurely lobed, and the eyes are thrown even further forward, close to the very narrow border in front of the glabella. The latter is not incurved in front.

The most interesting point about these young *Ogygiæ* is, that they appear to confirm the supposition of the number of segments increasing with age. Fig. 3, the youngest, has but four segments to the thorax, and there is no appearance of displacement, the head is not shifted at all. In fig. 4, a little older, there are seven rings, nor can we think there is displacement in this case. The tail has turned a little, as on a pivot, pushing the front edge on one side a little under the last ring, but it has opened from that ring on the other side. Had a ring been shifted off, and lost in the stone, we might have expected to see an

impression of part of it on this exposed side—but there is none. And the probability that we have in this case the whole number of rings is strengthened by observing what takes place in one a little older, fig. 5*, for in this the last segment is very narrow, and appears to be in course of development.* We have no perfect very young specimens of *O. Buchii*, and therefore the point is still open to observation in this genus, in which occasional specimens have certainly been found with seven rings, as noticed by Quenstedt, Dalman, and Burmeister. The usual number is eight.

Affinities.—Its identification with *O. dilatata* by its discoverer, Portlock,† is easily understood by reference to his very imperfect original specimen, which he saw clearly was distinct from *O. Buchii*. With Dalman's figure, too, there is more similarity than with the better figures published since by Sars (Oken's "Isis," 1835), and Emmerich ("Scientific Memoirs," vol. iv.) Our species differs from the Swedish one essentially in the broad glabella, narrow head margin, and forward eyes. The proportions of the caudal axis and the lateral ribs of the tail are altogether different, but the above-mentioned characters of the head will suffice.

British Localities and Geological Range.—LLANDEILO FLAGS. Large and fine specimens were obtained in abundance at Newtown Head, Waterford; smaller ones are common at Builth, Radnorshire.

Foreign Distribution.—Not known. Dalman's figure of *A. dilatatus* is more like our species than the representations given by Sars and Emmerich, but we take it for granted these authors figure Brunnich's species, as their specimens were from Christiania.

EXPLANATION OF PLATE VII.

Fig. 1. Large, but not full-grown individual. Newtown Head, Waterford.

Fig. 2. Same, or similar specimen, dissected.

[The letters on the head are placed in the order of those in the Mem. Geol. Survey, vol. ii., pt. 1, p. 334.]

a, Forehead, or front lobe; *b*, neck lobe, traversed by a pair of oblique lines *c c*, which mark the extent of the articulating surface of the first thorax joint; *g*, basal, or first lobe; *h*, middle, or second lobe; *i*, upper lobe, third; *j*, posterior margin, or lateral neck lobe; C, free cheek, or wing; *o*, margin.

Fig. 2*. Thorax ring of ditto; *c c*, place of fulcrum; *e*, an oblique line running upwards to the furrow (as in *O. Buchii*).

* We believe this increase in number is not a solitary case. The figured specimen of *Trinucleus Lloydii*, Murchison, has but five rings, and seems perfect. It may be peculiar to certain genera. Burmeister has suggested it in the case of *Paradoxides bohemicus*.

† We have great pleasure in dedicating the new species to Lieut.-Col. Portlock, whose careful and elaborate treatise on the Irish trilobites will be always valued by the British student. It was not only the best, but, at its publication, was the only English work containing extended views of the generic affinities.

Fig. 2**. Tail of ditto; *f*, line marking the edge of the thin incurved portion of tail [the lines that cover the tail in this figure are those of the upper surface]; *g*, intermediate furrow between 1st and 2nd.

Fig. 3. Youngest specimen, with four body rings. Builth.

Fig. 3*. The same magnified, to show the narrow caudal axis.

Fig. 4. One rather more advanced, with seven body rings. Builth.

Fig. 4*. The same, &c., magnified; shows the tail a little turned aside.

Fig. 5. Still older; the eyes very forward; eight rings. Builth.

Fig. 5*. The same, magnified: shows the last thorax segment as yet imperfectly developed *a*.

Fig. 6. Specimen of intermediate size, with short axis. Waterford.

Fig. 7. Imperfect hypostome; *a a*, concentric furrows. Waterford.

Note on the Genus.

The near affinity of *Ogygia* with *Brontes* has been perceived by Emmerich, who, in his excellent paper, "On the Morphology and Classification of Trilobites," * placed it next to that genus. The number of segments differs, 10 for *Brontes*, 8 for *Ogygia*; *Brontes*, too, is sometimes very convex, while *Ogygia* is flat; the shape of the glabella and caudal axis differ materially, and there was no genus known which could fill up the interval between the two genera. Both are expanded forms, characterized by large and strongly radiated tails, and flattened glabellæ, and by an obtuse, entire, furrowed hypostome. We are, therefore, fortunate in being able to publish a species of *Ogygia* whose characters link the genera much closer than before, and which, perhaps, might be regarded rather as a new generic form, but that its habit is quite that of *Ogygia*. If we knew more species of the genus, we would propose sub-genera for it, and might divide it into—

1. Glabella indistinctly lobed; facial suture within the margin. *O. Desmarestii*, Brongn. *O. Edwardsii*, Rouault.

2. Glabella distinctly lobed; facial suture within the margin. *O. dilatata*, Dalm.

3. Glabella narrow; facial suture on the margin. *O. Buchii*, Brongn. *O. Guettardi*, Brongn.

4. Glabella broad; facial suture marginal. *O. Portlockii*.

There are three or four undescribed British species of *Ogygia*, but at present we know them only by fragments.

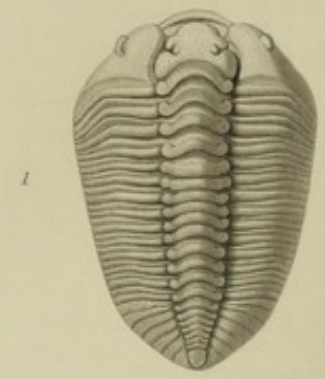
J. W. Salter.

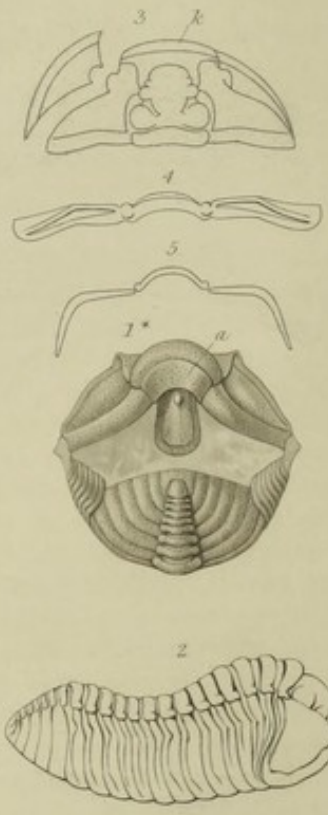
June, 1849.

* Leonhard and Bronn's "N. Jahrbuch," 1845, translated in Taylor's "Scientific Memoirs," vol. iv.

Geological Survey of the United Kingdom.

CALYMENE
(Silurian)





CALYMENE TUBERCULOSA — *Salter*

C.H.Bone del.

E.Forbes direx.

J.W.Lowry fe.

BRITISH FOSSILS.

Decade II. Plate VIII.

CALYMENE TUBERCULOSA.

[Genus CALYMENE. Brongniart. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ). Axis distinct; glabella lobed, narrower anteriorly; facial suture dividing the posterior head angles, submarginal in front; a rostral shield; eyes supine (with a thin cornea?); thorax of 13 rings, formed for rolling.]

Diagnosis. *C. lata, depressa, alutacea; margine frontali capitis producto recurvo, genis gibbosis, glabellâ depressâ; thorace axi angusto, pleuris planis usque ad fulcrum, quod ad dimidium anteriùs, ad tertium posteriùs, positum est; caudâ latâ, superne depressâ, lateribus abrupte deflexis; axi conico, subplano,* 7-8 *annulato, costis lateralibus* 5, *planis, sulcis acutis.*

Synonyms. *C. Blumenbachii vera? a. tuberculosa*, Dalman (1828), p. 36? (not tab. 1, f. 2). *C. Blumenb., var. a. tuberculosa.* Hisinger (1837), Lethæa Suecica, 10? (not tab. 1, f. 3). *C. Blumenb.*, Murchison, (1839), Sil. Syst., pl. 7, f. 5 only. *C. tuberculosa*, Salter (June, 1848), "Memoirs of Geol. Survey," vol. ii. part 1, pl. 12.

Almost every author who has written on *Calymene Blumenbachii* has hinted his belief that two or more species were to be recognized among its protean forms; yet, except Colonel Portlock, who separated the *C. brevicapitata* in his report on the fossils of Tyrone, no one has done more than point out varieties. An extended examination of very numerous specimens convinced us that three distinct species were known in England, and their characters were detailed in the 2nd volume of the "Memoirs of the Geological Survey." Still further investigation of intermediate forms has shaken this opinion again, and we are at present wholly in doubt whether the striking differences about to be pointed out mark only a distinct variety, or are of specific value. At all events, in giving a typical species of this genus, we would rather present the reader with a new and well-marked form, than with one so familiar as that of the famous "Dudley fossil."

Description.—Length, about 2¼ inches, width, 1¼ inch. Whole surface equally and minutely scabrous. General form broad for the genus, not much attenuated posteriorly, depressed. Head short, wide; the

glabella not more prominent than the cheeks, and much narrower, contracted in front, and separated by a deep furrow from the front margin: it has three lobes on each side, the basal one large, the middle one nearly spherical, the third minute; the forehead lobe is small, the neck lobe large and prominent. The neck furrow is continued nearly to the posterior angles, which are rounded. Cheeks gibbous, often more elevated than the glabella, bearing the small eyes on their most prominent part. These are placed opposite the middle lobe of the glabella, and at some distance from it. A strong deep furrow separates the cheeks from the glabella, except opposite the eye, where a buttress is thrown across from the cheek, touching the middle glabellar lobe. The wings are strongly bent downwards, and even inwards on the under surface of the head, and the anterior margin is much recurved, and produced into a snout. On looking at the under view of the head, the margin appears greatly bent, and in the angle so formed the curved rostral shield, half as long as broad, is inserted; beneath this is attached the hypostome, which is squarish oblong with the terminal angles rounded, strongly convex forwards, the convexity terminating in a compressed tubercle; one or two concentric lines, as if of growth, mark the surface, which is also scabrous, like the general crust of the body. The axis of the 13 body rings is convex, but narrower than the pleuræ, and constantly tubercular on the sides. The pleuræ are horizontal half way, and then strongly decurved; their ends rounded posteriorly, and bent forward. Fulcrum distant from the axis, about half way from it near the head,—at one-third, or rather less, behind. Pleuræ sharply furrowed, the forward or fulcral half somewhat narrower than the posterior. Tail nearly semicircular, with the front angles truncated, evenly and gently convex, the axis not prominent, the sides decurved strongly towards their edges. Axis not percurrent, narrow, conical, with seven rings, and a terminal boss. Lateral ribs flattened, separated by sharp, narrow furrows, starting at a wide angle from the axis, and curved back on the sides, simple, or but rarely marked by a central line near their ends,—not bifurcate, as in *C. Blumenbachii*.

—— *Junior.*—The proportions of the axis to the sides and the structure of the pleuræ are similar, but the glabella is more cylindrical, not widened below; the tail is proportionally smaller, has the axis wider and more convex, with fewer ribs, and there are but four distinct ribs on each side. Fig. 8* is the tail of a young animal magnified.

Variations.—In some the axis is a little more prominent, in others a greater or less depression of the glabella occurs, and apparently the production forwards of the snout is not always in the same degree. But these variations are within narrow limits, and our species never seems to approach *C. Blumenbachii* in convexity, especially with regard

to the glabella and caudal axis. The front is constantly produced, the surface minutely scabrous, not covered with scattered tubercles, but this last character occurs in some varieties of *C. Blumenbachii*, which is more variable than we formerly believed.

Affinities.—It is distinguished from *C. Blumenbachii*, with which it has always been confounded, and to which it is closely allied, by the broad depressed form, narrow axis,* glabella not higher than the cheeks, distant fulcrum, and wide depressed tail; the produced recurved snout also is a strong character. *C. brevicapitata* has the snout recurved, but it is shorter; the axis is prominent, and the fulcrum close to it; the glabella also is much shorter and smaller in front, and the whole form is elongate and cylindrical. With the American species, as published by Green, Hall, and Emmons, it does not need a close comparison: *C. senaria* is attenuated posteriorly, and has a wide head, close fulcrum, and a small tail, with the axis as broad as the sides: *C. callicephala* is distinguished at once by the very short triangular glabella; it has also a close fulcrum. It is quite possible that hereafter forms may be found which will connect this species with the more common *C. Blumenbachii;* but at present we do not know such forms, and it is necessary to point out the obvious characters which distinguish them. Between *C. Blumenbachii*, however, and the other British species, *C. brevicapitata*, specimens intermediate in character, both as regards form and sculpture, have been discovered; the present species, therefore, being founded on somewhat similar kinds of variation, must be received with caution.

History.—The early figures and descriptions of animals of this genus had, of course, no reference to such minute differences as are now deemed necessary for specific character; however, there is one early figure which certainly resembles more the depressed tail of our species, with widely spreading and curved side ribs, than *C. Blumenbachii;* we mean that of Linnæus, "Stockholm Trans.," 1759, t. 1, f. 3.

Dalman describes, under *C. Blumenbachii*, three forms,† viz.:—

1. *Var. tuberculata*, in which he erroneously counts 12 segments to the thorax, and reckons about seven ribs to the tail. Length, 2 inches to 2½. Gottland and England; the English specimen having the axis of the thorax tuberculate on the sides, as in the next variety.

2. *Var. Blumenbachii vera? a. tuberculosa*, with 13 segments, and tail with about eight ribs, the axis tuberculated on its sides; the head, tail, and lateral knobs of the axis closely scabrous; the dorsum (axis itself) smooth. Length about an inch. Gottland.

* There is a variety of *C. Blumenbachii*, with narrower axis, found at the Hollies, near Horderley, but the glabella and tail are normal, and the front not produced.

† "Et descriptiones auctorum, et specimina ad hac speciem relata, tantas præbent discrepantias, ut fere credam diversas species sub hoc nomine esse commixtas, de qua re tamen, ob speciminum inopiam, dijudicare nequeo." Dalman, Palæad., p. 35.

3. *Var. Blumenbachii vera, β. pulchella*, "undique punctis elevatis sparsis," the axis hardly tuberculate at the sides; small. Gottland.

Of these three forms the first is the most doubtful. Dalman has probably given a figure of it, bad in all points of detail, in his table 1, fig. 2. This figure seems a little to resemble our species in the rather narrow axis, and distant fulcrum, and there is no indication of bifid ribs to the tail; however, the snout is not produced at all, the axis of the tail is also broad and convex, so that it probably is intended for the common species. Of his var. *pulchella* (tab. 1, fig. 3), we have seen specimens in the cabinet of Sir Roderick I. Murchison. They are dwarfs of *C. Blumenbachii*, and, like it, have scattered tubercles, a large glabella, and convex axis. But the description of var. 2 in so many respects agrees with the subject of our plate, that we have adopted the term *tuberculosa* as a specific name for it. The close minute scabrosity is particularly alluded to by Dalman. Even if the identification be incorrect, it will not involve any confusion of nomenclature. No recognizable figure of this species appeared till the publication of the "Silurian System," in which, at pl. 7, f. 5, a Burrington specimen is figured, and in the description the knots on the axis are mentioned as variable.

British Localities and Geological Position.—WENLOCK SHALE to UPPER LUDLOW ROCKS. Upper Silurian beds, Underbarrow, near Kendal, Westmoreland (Prof. Sedgwick). It abounds in nodules of the Wenlock shale at Burrington, Shropshire, from whence thousands of specimens have been distributed through collections. Small specimens are plentiful at Usk, Monmouthshire, in Upper Ludlow Rock; in neither case associated with the more common *C. Blumenbachii*.

Foreign Distribution.—There is much reason to believe, as before stated, that it occurs with the better known species in Gottland.

EXPLANATION OF PLATE VIII.

Fig. 1. Full-grown specimen from Burrington; the head and tail a little bent down.

Fig. 1*. A specimen from the same locality, partially rolled up, but open sufficiently to show the hypostome or mouth-piece attached to the rostral shield *a*.

Fig. 2. Extended specimen from the same locality.

Fig. 3. Dissected head; *k* is the reflected front.

Fig. 4. Body segment separated, shows the nodular axis, and the distant fulcrum.

Fig. 5. Body segment seen in profile. It shows the depressed form of the body.

Fig. 6. Hypostome highly magnified.

Fig. 7. Magnified portion of the general surface.

Fig. 8. Young animal from Usk.

Fig. 8 *a*. Tail of ditto magnified.

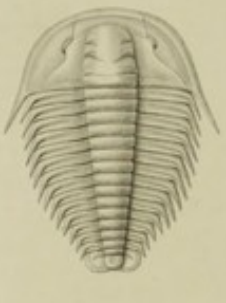
J. W. SALTER.

June, 1849.

Geological Survey of the United Kingdom.

OLENUS
(Silurian)

1



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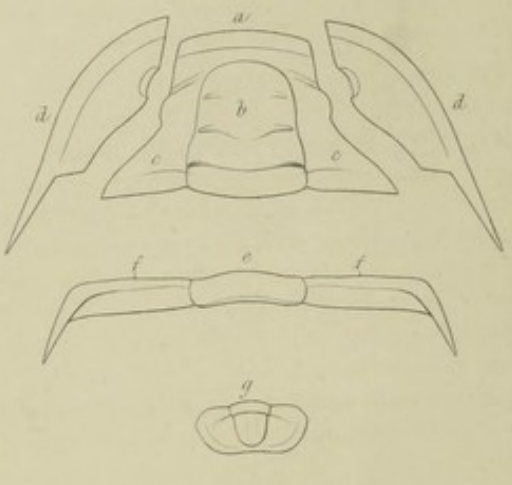

3

OLENUS MICRURUS ___ *Salter*.

C.R. Bone del. T. Forbes direx.t J.W. Lowry fc.

BRITISH FOSSILS.

Decade II. Plate IX.

OLENUS MICRURUS.

[Genus OLENUS. Dalman (in part). Sub-kingdom Articulata. Class Crustacea Order Entomostraca. Family Trilobitæ.) Glabella narrowed anteriorly, lobed; eye smooth, generally with a narrow prominent ridge connecting it with the upper part of the glabella; facial suture marginal in front, and cutting the posterior margin behind; no rostral shield; hypostome . . . .? pleuræ 14, or fewer, pointed and recurved; tail with articulated axis and sides.]

[Sub-genus *Olenus*. Body rings 14; tail entire.]

Diagnosis. *O. ovatus posteriùs attenuatus; glabellâ genisque æqualibus; thorace segmentis* 14, *pleuris postremis axi angustioribus; caudâ transversâ integrâ, apice truncato, axi* 1-*annulato, lateribus unicostatis.*

In the course of surveying the barren country south of Snowdon, Mr. A. Selwyn, of the Geological Survey, discovered fine specimens of this new *Olenus*. They were found only at two or three localities in the lowest fossiliferous beds of the Silurian system, and may be considered, therefore, as the oldest British trilobites; they were associated with a species of *Eurypterus* and a *Lingula*. The discovery is the more interesting, as *Olenus* and *Paradoxides* are among the most ancient genera of trilobites in the Silurian rocks of the Continent. Other British species of the group have been described by Mr. John Phillips, from the black shales of Malvern.

Description.—Length, one inch three-eighths; width, seven-eighths. General form broadly obovate, acuminate posteriorly; the axis rather prominent, and the sides flattened. Head more than twice as wide as long, semicircular, with a narrow equal border, and produced at the posterior angles into moderate diverging spines. Glabella reaching very nearly to the front margin, bell-shaped, not very convex, but a little swelled below, with a narrow neck lobe, and two lateral lobes. Cheeks a little wider than the glabella. Eyes not large, forward, near the glabella, and connected with it by a slight oblique prominence. Eye line cutting the posterior margin far outwards. Pleuræ 14, flattish, increasing a little in width as far as the 6th segment, then shortened gradually, so that the two last are scarcely wider than the tail; each marked by an oblique shallow furrow, deeper near the tips, which are slightly recurved and produced into short spines. Axis narrowed pos-

teriorly, not so wide as the pleuræ in the anterior rings, but in the hinder ones wider than the pleuræ. Tail semicircular, truncate, the axis convex with one rib above, and about equal in width to the sides, which also have a single faint rib. Margin entire, slightly raised. But four specimens have been found, and all more or less distorted.

Affinities.—From *O. spinulosus*, with which the head has considerable resemblance, the entire truncate one-ribbed tail readily distinguishes it. *O. gibbosus*, besides having a triangular, many-ribbed tail, has the glabella not reaching nearly to the front margin, and the eye is placed at a distance from the glabella nearly equal to the diameter of the latter. In *O. micrurus* it is not above half the diameter distant. *O. alatus*, a small species, named by Dr. Boeck, has the glabella extended forwards, but it is very narrow and convex, and the eye is distant. The *Olenus gibbosus* (Corda), which, in shape of tail, is very different from Swedish specimens and Wahlenberg's description, differs from ours in the wide and ribbed tail, as well as in the general shape, which is oval, not attenuated; besides other points. We know of no other species with which it can be confounded.

British Localities and Geological Position.—Lowest Llandeilo flags (Lingula beds), Trawsfynydd, Merionethshire; Cwm-y-Swm mine, Dolgelly, ditto; Marchllyn Mawr, near Llanberis, Caernarvonshire.

Explanation of Plate IX.

Fig. 1. *Olenus micrurus.* Trawsfynydd.

Fig. 2. Same dissected. *a*, central lobe of the head,* including *b*, the glabella, and *c*, fixed cheeks; *d*, the mucronate wings; *e*, thorax segments, the obscure fulcral points are at *ff*; tail, *g*, with two-jointed axis, and single lateral furrow.

Fig. 3. Small specimen, Cwm-y-Swm mine, Dolgelly.

Note on the Genus.

The group of *Olenidæ* (Emmerich) includes genera which differ from each other in the course of the facial suture; in *Paradoxides* and *Olenus* its termination is on the posterior margin, and the wings or free cheeks are produced into spines. In *Peltura* (*P. scarabæoides*) and *Triarthrus*, it terminates in the posterior angle, or even a little above it, on the external margin, and the wings are very small, and by no means produced into spines.

Paradoxides differs from *Olenus* in the large and clavate, not bell-shaped, glabella; in possessing 16 to 20 body rings, and a minute tail, with its axis only articulate.

Olenus is divisible into two sections, if these do not merit the name of genera. 1. The group of true *Olenus*, to which our species belongs, having 14 body rings, and a tail with entire margin. 2. *O. spinulosus*, having fewer, about 12 body rings, and a spinose or laciniate tail; for the latter species, the sub-generic name *Parabolina*, in allusion to the shape of the glabella, might be appropriate.

June, 1849. J. W. Salter.

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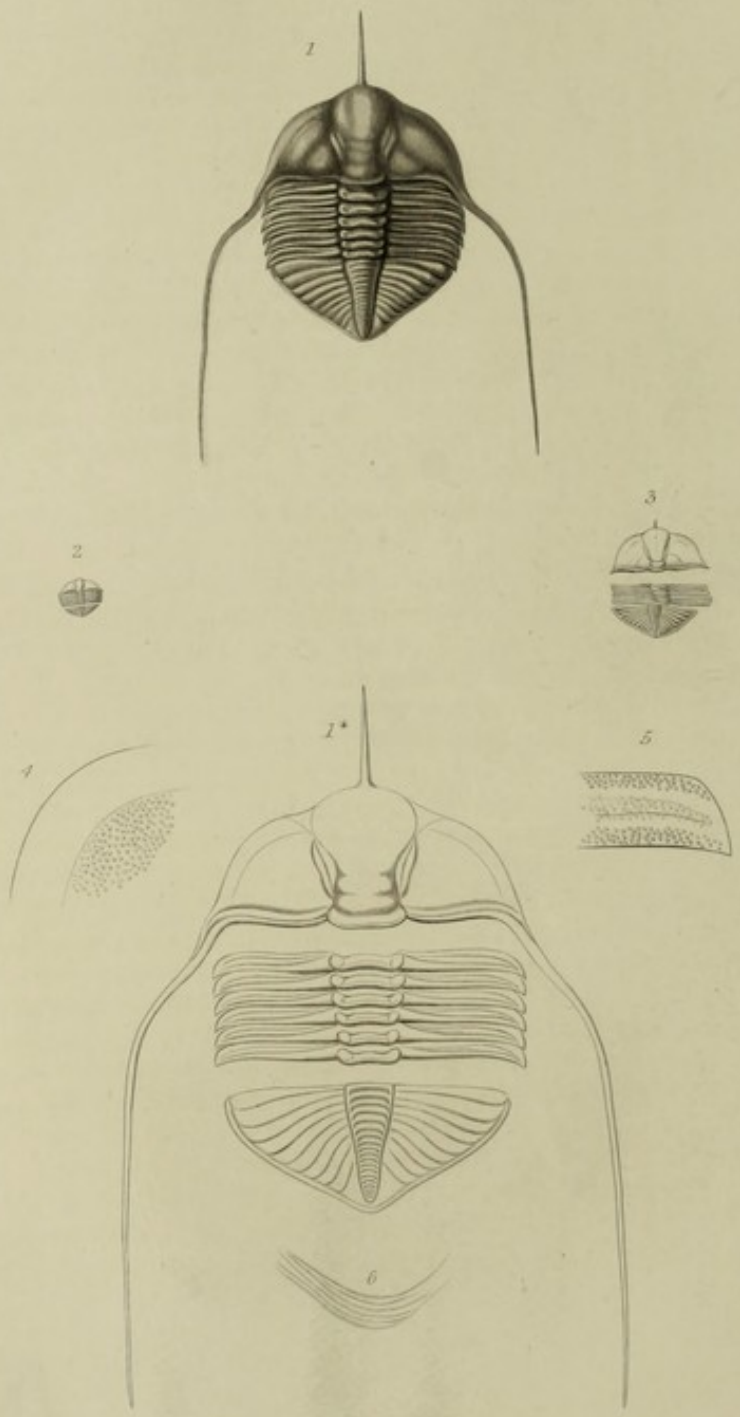
* Corda has proposed to call all this "glabella," and to distinguish it into central and lateral lobes.

Geological Survey of the United Kingdom.

AMPYX
Silurian



AMPYX NUDUS ... *Murchison*

H. Bauby del. E. Forbes direx. J.W. Lowry fc.

BRITISH FOSSILS.

Decade II. Plate X.

AMPYX NUDUS.

[Genus AMPYX. Dalman. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Family Trilobitæ.) Glabella tumid, armed with a frontal spine; head with simple, unexpanded margins; angles spinous; no facial suture; no eyes; body rings 5 or 6; tail entire-margined, margin deflected; hypostome?]

Diagnosis. *A. latus; capite semicirculari, spina frontali brevi; angulis longe-spinosis; glabella vix producta, lateribus bilobatis; thorace articulis* 6; *caudâ lateribus* 8—9 *sulcatis.*

Synonyms. *Trinucleus nudus*, Murchison (1839), "Sil. Syst.," p. 660, pl. 23, f. 5.

Description.—General outline broadly oval; body much depressed; the general axis, consisting of glabella, axis of thorax, and axis of tail, forming a lanceolate, convex, central elevation, narrowing posteriorly. Head, thorax, and tail of equal length. The first is rounded, with the outline, in front, slightly prominent, and the whole less than a semicircle; the last is slightly triangular. Glabella somewhat claviform, rounded and convex in front, narrowing behind the middle, and slightly widening out at its junction with the neck furrow; it is marked at each side by two or three indistinct furrows, and, towards its centre, by two very oblique furrows, which form small elliptical elevated spaces, one on each side, bounded by rounded and curved folds, below the level of the rest of the glabella, and appearing as if distinct from it. From the front of the glabella projects a slender subulate spine, which, in all examples hitherto met with, is rather less than the length of the head: it is not continued as a keel on the central surface of the glabella. The neck furrow is well marked, and the neck fold elevated. The cheeks are broad, depressed obliquely in their centres; the depression proceeds from near the upper extremity of the glabella lobes, and continues obliquely outwards, with an obscure curve towards, but not touching the margin. Between the depression and the hinder portion of the glabella the cheek is gently tumid, and likewise between the depression and the outer margin. The neck furrow runs straight and

close to the hinder margin of each cheek, leaving the edge elevated as a thickened and very narrow rim ; and then, at the angles of the head, making a slight curve, runs into and furrows the base of a long spine. This spine is of a subulate form, and projects backwards in a curved manner from the head angles, and at a distance equal to rather less than the breadth of the cheek, bends backwards and straight to more than the tail's length beyond the posterior extremity. No trace of a facial suture has been observed in any of the specimens as yet discovered.

The axis of the thorax is convex, and nearly equal in breadth throughout, very slightly narrowing at its junction with the tail. Its width is about two-thirds of that of the pleuræ. Each joint of the axis is deeply furrowed centrally, elevated anteriorly and posteriorly, the elevations of the proximate joints uniting to form a strong convex, somewhat curved, rounded rib, running across the axis, and terminated at each side by a conspicuous tubercle. Six such ribs mark as many thoracic articulations. The axis is separated from the pleuræ on each side by a deep but narrow groove. The pleuræ are straight, narrow, and depressed, tumid along their lengths on each side of a conspicuous deep oblique furrow ; extremities obliquely truncated, slightly turned backwards. The surface of the tumid portions of the thorax, and also of the more convex parts of head and tail, are minutely granulated.

Tail triangular, with the sides slightly curved outwardly. Its axis prominent, gently tapering for nearly two-thirds of its length, then becoming parallel-sided, and ending obtusely at the termination of the tail. Nine ribs like those crossing the thoracic axis, but smaller and without marginal tubercles, cross the tapering portion of the axis ; the remainder is ringed by numerous minute ribs. The axis of the tail is divided by a deeply-impressed furrow from the sides, which are gently convex, and grooved by eight strongly-marked lateral furrows, oblique, and curved slightly backward ; the interspaces are tumid. The uppermost furrow commences at the junction of the tail with the body, and proceeds obliquely onwards to the margin, so as to leave a narrow, lanceolate, triangular space in front of it. The distance between its marginal extremity and that of the next furrow is greater than the distance between the extremities of any of the other furrows. The last and shortest furrow originates just above the termination of the tapering part of the tail-axis, and between it and the extremity is a smooth and slightly tumid triangular space. The margin of the tail has an elevated rim, the deflected portion of which is striated.

Young specimens have the same number of thoracic joints with adult examples, and do not appear to differ materially in any respect.

The length, exclusive of the frontal spine, of the largest specimen examined, was one inch and three-twelfths. The frontal spine measured

nearly five-twelfths. The breadth of the thorax was one inch. The length of a cheek-spine one inch and five-twelfths.

Affinities.—Its nearest ally is the *Ampyx mammillatus* of Sars (*A. Austinii* of Portlock), which it resembles in general outline, in form of head, and features of glabella, and also in the number of thoracic rings. The tail of *Ampyx mammillatus* is, however, very differently shaped, and has only one lateral furrow on each side, and its axis is, in great part, smooth. There are also very material differences in the structure of the cheeks and pleuræ. *Ampyx nasutus* (Dalman), is described as having six articulations, but has a very prominent glabella protruding much beyond the cheeks, and a tail represented as smooth at the sides. The figure given by Dalman, however, so closely resembles the *Ampyx rostratus* of Sars (*A. Sarsii*, Portlock), that I am inclined to think that the fold on each side of the tail above the single lateral furrow was mistaken for a joint of the thorax, for in all the other species of *Ampyx* there are only five thoracic segments with the peculiar triangular outline of the head, which is so shaped in consequence of the great projection of the front of the glabella beyond the cheeks. These characters we see combined in *Ampyx rostratus*. *Ampyx Portlockii* (Barrande), *Ampyx bohemicus* of Hawle and Corda, and my *Ampyx parvulus*. The *Ampyx Bruckneri* of Boll has the same form of head, but the body of that species is unknown. If, in the end, all the five-ringed species should prove to have long heads, and those with six thoracic segments to have short and rounded ones, the latter section may be conveniently distinguished from the former as a subgenus, under the name of *Brachampyx*.

History.—This curious trilobite was discovered by Sir Roderick Murchison, and figured by him in the Silurian System as a species of *Trinucleus*, of which genus he considered it a member, supposing the border of the head to be lost, and regarded it as allied to his *Trinucleus fimbriatus*, but as differing in the number of ribs on the tail. In 1845, a number of specimens were found in the original locality at Builth by Sir Henry de la Beche and myself, in more perfect condition than those first figured, and they proved, without question, to belong to the genus *Ampyx*. On examination of the original specimens figured in the Silurian System, I found that they also exhibited traces of the frontal spine. The true generic position of this trilobite was afterwards indicated in a note to the Ray edition of "Burmeister's Essay;" that author had regarded it as a mutilated example of *Trinucleus fimbriatus*.

British Localities and Geological Ranges.—Hitherto this *Ampyx* has occurred only in the Llandeilo Flags of Carneddau Hill, near Builth, Radnorshire, South Wales.

Explanation of Plate X.

Fig. 1. Figure of the entire trilobite, slightly restored, from the Builth specimen. All the parts are shown in specimens in the collection of the Geological Survey.

Fig. 1*. Dissection of the species. Lines as if of a facial suture are seen on the glabella, but they do not seem to indicate any true separation of parts.

Fig. 2. An individual still younger.

Fig. 3. A small specimen, showing the constancy of its characters at an early stage.

Fig. 4. Granulation of the head.

Fig. 5. Granulation as seen towards the extremity of one of the pleuræ.

Fig. 6. Lineation of deflected surface of tail margin.

Note on the British Species of Ampyx.

The genus *Ampyx* was first recognized as British by Lieut.-Colonel Portlock, R.E., who described and figured two species, *Ampyx Austinii*, identical with *A. mammillatus* (Sars), and *Ampyx Sarsii*, identical with *A. rostratus* (Sars), and probably with *A. nasutus* (Dalman). Both these forms were discovered during the researches of the Ordnance Geological Survey in Ireland, the former in the Silurian slates of Tyrone, and the latter in those of Newtown, near Waterford. Recent researches have led to the conclusion that the strata in which these fossils were found are members of the lower (Llandeilo or Bala) division of the Silurian rocks.

In Great Britain neither of these species of *Ampyx* have, as yet, occurred. The only species described as British, besides that now figured, is my *Ampyx parvulus*, from the Lower Ludlow of Vennal Hill (Mem. Geol. Surv., vol. ii. pt. 2, p. 350, pl. x.) There appears, however, to exist a third species in the Rhiwlas limestone, near Bala; one distinct from any as yet described, but of which only heads and tails have been found. The largest head is half an inch in length, exclusive of the spine. It is nearly allied to *A. rostratus*, but differs in having much smaller cheeks in proportion to the glabella, which is even more produced than in the *rostratus*, and exceedingly tumid The cheeks in the species to which I have compared it are beyond the middle of the glabella; in the Rhiwlas form never so far as that part. The neck lobe of the latter is narrow, and the tail, though similar in sculpture, much shorter and wider. The proportions of the cheeks and glabella remind us of *A. Bruckneri* (Boll in Dunker and Von Meyer's Palæontographica, 1st Band, 11 lief., t. xvii., f. 8), but that species has a carinated glabella, and very broad neck lobe. *Ampyx Portlockii* (Barrande), is said to have the glabella much less elongated than *A. nasutus*, and therefore cannot be the Rhiwlas form. *A. bohemicus* (Hawle and Corda, t. 3, f. 19), comes nearer, but is represented as having a much wider glabella and a proportionately much smaller tail, with no traces of rings on its axis. I propose to name the Rhiwlas species, *Ampyx tumidus*.

Ampyx baccatus, of Portlock, does not belong to this genus.

E. Forbes.

July, 1849.

MEMOIRS

OF THE

GEOLOGICAL SURVEY

OF

THE UNITED KINGDOM.

Figures and Descriptions

ILLUSTRATIVE OF

BRITISH ORGANIC REMAINS.

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BRITISH FOSSILS.

DECADE THE SEVENTH.

THIS Decade is devoted to figures and descriptions of Trilobites, a group of extinct Crustacea of the highest geological interest. These remarkable fossils are wholly restricted to Palæozoic formations. The progress of research has shown that the various genera and species of Trilobites are remarkably characteristic of well-defined geological horizons; consequently, the study and exact definition of them is laid much stress upon by the geologist whose labours are directed to the investigation of the more ancient rocks.

The recent publication of a beautiful work by M. Barrande, on the Trilobites of Bohemia, in which the species are fully illustrated and described, affords means of comparison with the specimens of British Trilobites (usually less perfectly preserved), such as we did not before possess. It will be seen from the following descriptions that but few of our species are identical with those of Bohemia, and thus we get at an interesting indication of a geographical distribution of these primæval animals.

Of forty-five species here described, but one, a *Phacops*,—a member of a different section from that previously illustrated, belongs to any genus as yet selected for these Decades.

Cheirurus is exemplified by a species heretofore known only in a fragmentary state.

Sphærexochus mirus is a cosmopolitan fossil, of which excellent specimens have been lent to us for illustration.

Encrinurus and *Acidaspis* are typified by new species from the lowest fossiliferous deposits.

Cyphaspis and *Æglina* are for the first time published in England; and a new genus, *Cyphoniscus*, is proposed for some minute and hitherto undescribed forms.

Remopleurides is republished, with some additional data for the correct account of its structure. It is proposed, for what appear to be cogent reasons, to refer some curious variations in closely allied forms to sexual differences.

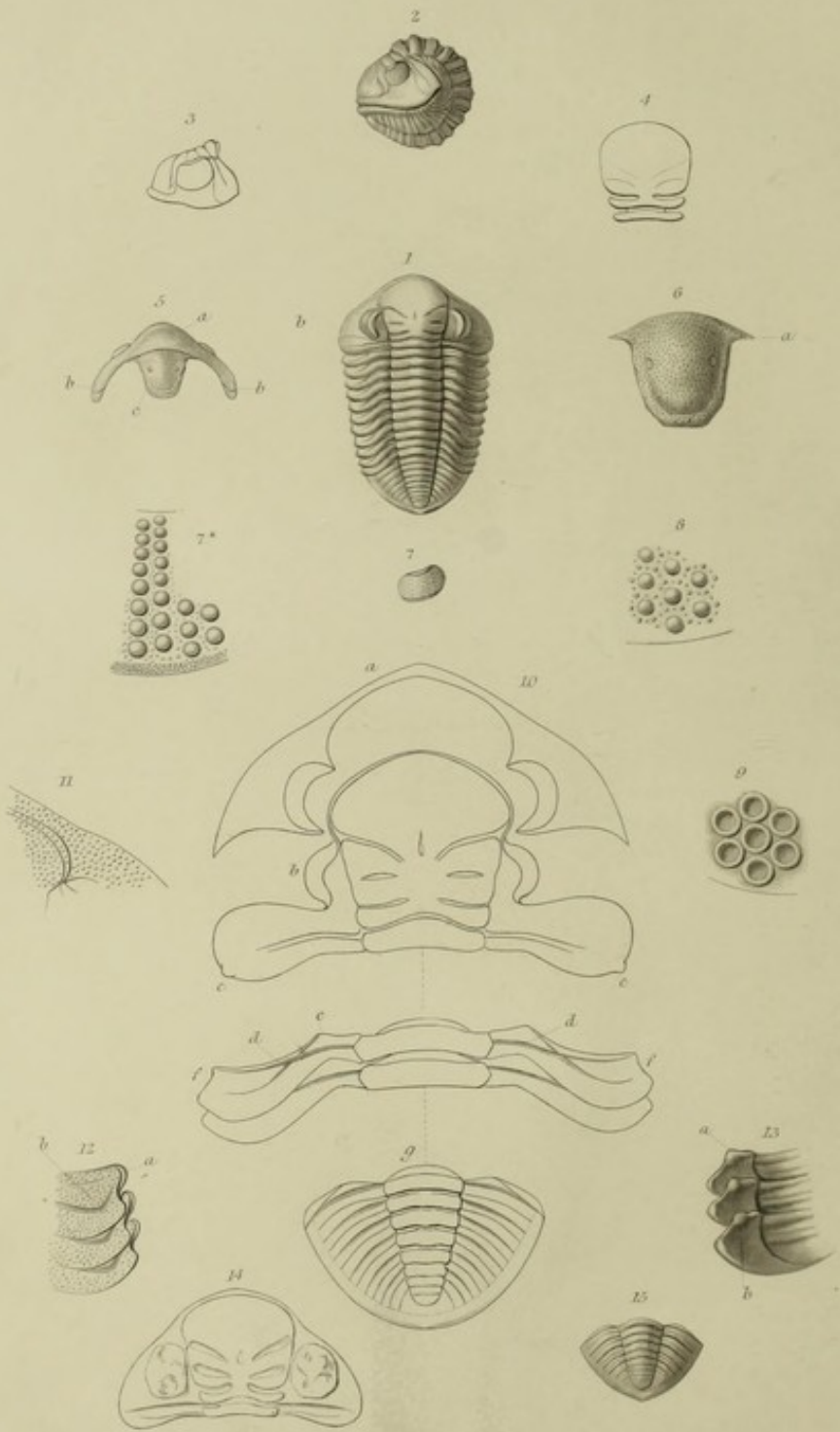
Under the ten genera here illustrated, the descriptions of all known British species are given. They have in every instance been drawn up by Mr. Salter.

EDWARD FORBES.

August 1, 1853.

Geological Survey of the United Kingdom.

PHACOPS
(Silurian.)



PHACOPS DOWNINGIÆ — *Murchison.*

C.B. Snow del.

E.Forbes direx.

J.W. Lowry fc.

BRITISH FOSSILS.

Decade VII. Plate I.

PHACOPS DOWNINGIÆ.

[Genus PHACOPS. Emmrich. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Head strongly trilobed; glabella lobed, and broadest in front; facial suture ending on the external margin; eyes largely facetted; hypostome oblong, rounded at the end; thorax of 11 segments, the pleuræ grooved and facetted for rolling up; tail strongly ribbed, of several segments, the margin entire or toothed.]

[Sub-genus *Acaste*. Goldfuss. Form convex, and contractile into a ball. Glabella not much inflated, all the lobes distinct; facial suture within the edge or marginal in front; head angles rounded or with short spines; hypostome obtuse, entire; body segments rounded at the ends; tail of a moderate number of distinct segments (11 or less), its edge without lateral spines.]

Diagnosis. *P. alutaceus; capite transverso, margini frontali angulato; glabellâ depressâ oblongâ subparallellâ, sulcis utrinque tribus distinctis, lobo basali lineari, secundo ovali, superiori transverso—sed margine superiore ascendente sinuato—lobis omnibus planis et fere ad medium glabellæ extensis, spatio angusto interjecto: lobo cervicali elevato; oculis magnis nec eminentibus: caudâ subtrigonâ, axi convexo costis quinque distinctis tribusque obscuris prædito,—lateribus quinque-costatis, costis duplicatis; margine distincto, apice angulato.*

Synonyms. *Calymene macrophthalma* (Brongn.), Buckland (1836), Bridgw. Treatise, pl. 46. fig. 5 (not 4.) *Calym.? Downingiæ*, Murchison, Silur. Syst. (1839), pl. 14. fig. 3. Milne Edwards (1840), Crust., 3. 324. *Acaste Downingiæ*, Goldfuss, Syst. Uebersicht der Tril., Neues Jahrb. (1843), 563. *Phacops macrophthalmus*, Burmeist. (1843), Org. der Tril., 139, 140, and in ed. 2. (1846), p. 92. *Phacops Downingiæ*, Emmrich, Neues Jahrb. (1845), 40. pl. 1. fig. 2. [icon mala]; Transl. in Taylor's Scient. Memoirs (1845), vol. iv. pl. 4. fig. 2. Phillips and Salter, Memoirs Geol. Surv. (June 1848), vol. ii. pl. 1. p. 239, 336. pl. 5. fig. 2. 3. 4. M'Coy (1851), Synopsis Pal. Foss. Woodw. Mus. 160.

Junior.—Asaphus subcaudatus, and *A. Cawdori*, Murchison, Sil. Syst. pl. 7. fig. 9, 10. *Phacops subcaudatus*, Salter and Phillips, l. c. 239.

One of the most common, and certainly one of the most elegant trilobites in the Silurian System—occurring in abundance wherever Upper Silurian strata are found. It is a very characteristic fossil of

the Dudley limestone. And yet, perhaps, there is no species of trilobite which has been so much misunderstood; the confusion apparently arising from this circumstance—that it is rarely, if ever, found out of Britain; although somewhat similar species have been identified with it, both British and foreign. It was named in compliment to Mrs. Downing, of Dudley, from whose cabinet the figures in the "Silurian System" were drawn.

Description.—Length from an inch and a half to two inches. The general form long-ovate, the anterior end being considerably broader, and with the axis following the same lines, and regularly tapering from head to tail. The surface is moderately convex, the axis raised above the sides, not separated by deep furrows except in the head, and more convex in the thorax than in the head or tail. The head is somewhat less than a semi-circle, though just twice as long as broad, the general outline being rather triangular, from an indentation in the curved outer margin on each side of the wide glabella; the front is not produced, but angular. The glabella occupies more than one third the width of the head in front, and tapers but little backwards, having nearly straight and parallel sides; it rises considerably above the cheeks, but is rather depressed than convex, especially the forehead lobe, which is not at all inflated, but slopes gradually to the narrow front margin, from which it is separated by a shallow furrow. Neck lobe strong, broader than the first basal lobes, which are transverse and linear; the middle pair are broader than these, and oval, the direction of the first and second rrows determining their shape—the lower furrow curves downwards, and reaches the side of the glabella; the upper one, which is abbreviated, curves the reverse way; the upper lateral lobe is transverse, scarcely triangular, and bounded above by a sigmoid furrow, which runs very obliquely out above the eye. All the furrows stretch equally towards the middle of the glabella, leaving but a narrow space between their ends; between the upper pair a short longitudinal depression occurs. The lobes are not swelled between the furrows, but the surface is even and the furrows shallow (they are, however, sharply defined on the internal cast); the neck furrow and basal furrows are strong—the two upper ones very faint.* The cheeks are steeply bent down, their outer margin not distinguished by any furrow, and they slope gradually from the eye, without any ridge or groove beneath the latter; the neck furrow is continued almost to the posterior angle, which is rounded off and only shows a slight projection (fig. 10, *c*) in the place of a spine. The facial

* Memoirs Geol. Survey, vol. ii. p. 1. pl. 5. fig. 2.

suture cuts the outer margin in a curved line in front of the posterior angles, and opposite the base of the eye; on the under surface of the head (fig. 5) the suture cuts the margin further backward (*b b*). Above the eye it continues along the axal furrow and round the front of the glabella just outside the marginal furrow. Eyes rather large, conical, rising in some specimens nearly to the level of the glabella, placed about half-way up the cheek, near to the two upper glabella lobes, and occupying their length: eye lobe with a raised outer margin; lentiferous surface broad, with about 155 lenses in each eye, each vertical row containing eight. The cornea is convex over the lenses, and the intermediate flattened spaces are finely granular, the granules forming a rough hexagonal network toward the base of the eye; the lenses are nearly their own diameter apart, but this varies much in different individuals, the space being often much less (figs. 7, 8).

On the under side of the head, the incurved front portion (which, as in all the genus, is continuous across,) is broad (fig. 5, *a*), and granular, like the upper surface; it supports the broad base of the hypostome, which is also granulated. This organ is subquadrate but broadest at its base, and very regularly convex, almost tumid; a faint concentric furrow running round the sides and tip just indicates a narrow margin, more flattened than the other parts; there are no lateral furrows, but high up on each side is a small tubercle. The tip is straight and somewhat truncate, and the exterior angles are cut off so as to render the end somewhat polygonal; but there are no traces of projecting teeth, and the appearance of the apex is obtuse. The entire organ is much narrower than the glabella, and not above half its length, but from the position of its base it reaches as far backward as the middle pair of glabellar furrows. And these glabellar furrows, as Burmeister has shown, doubtless indicating the position of the jaws and accessory parts of the mouth, the hypostome must have served the office of labrum or upper lip.

Thorax considerably longer than the head, of 11 not very highly arched rings—the axis moderately convex, of nearly equal breadth with the pleuræ. These, which are traversed by a straight deep groove, (fig. 10, *d*), are curved rather abruptly downwards at the fulcrum (fig. 10, *e*), which anteriorly occurs at the inner third of their length, and in the posterior ring does not reach further than one fourth. The anterior edge of each pleura is sharpened or facetted * to pass under the preceding one, and the posterior edge is thickened. Each pleura is much bent forward at its end, which is deeply notched

* M'Coy, Annals Nat. Hist. (Dec. 1849.)

(figs. 12, 13), and on the under side of each, in front of this notch, is placed a tubercle (fig. 13, *a*). When the animal was in the act of rolling up, the tubercle prevented the next ring from being pushed too far forward; the tail, too, has them on its anterior edge. Some such contrivance as this, for giving compactness to the rolled up form, is probably general in trilobites, and Mr. John Gray, of Dudley, who first drew my attention to it, has succeeded in developing nearly the whole of the under surface of this species.

The tubercles just mentioned occur on the incurved crustaceous portion (fig. 13, *b*) of the pleuræ, which, in this species is but narrow, while in *P. caudatus*, Decade II. Pl. 1., it extends some distance inwards.

The tail is sub-triangular and rather pointed, nearly twice as wide as long, and moderately convex; the axis is more convex, but does not rise abruptly from the general surface, nor is it separated from the sides by any distinct axal furrows. It is conical, not so wide as the sides, extending to about four fifths of the length of the tail, with an obtuse scarcely prominent end; it is crossed by five distinct and two or three obscure rings. The sides have five or six rather deep and curved furrows, which end abruptly at the thickened margin; smaller and shallower furrows occur between each of the principal ones for the whole length. The incurved under margin is narrow but thick.

The whole of the upper surface, and the incurved margins of the head and tail, are covered with fine, close, equal granulations; the hypostome is also equally rough—none of the grains become tubercles, but all remain of equal size.

Variations.—Among the specimens in the cabinets of Messrs. Fletcher and Gray, occur one or two with the eyes (fig. 3) very considerably larger than usual, so as almost to equal those of *P. Stokesii;* the specimens, however, clearly belong to the species we are describing. The following measurements in lines will give an idea of this difference, which is represented in our figure 3:

Ordinary specimen:—		*Large-eyed variety:—*	
Length of head - -	5 lines.	Length of head - -	$5\frac{1}{4}$ lines.
Length of the eye - -	2 „	Length of the eye - -	$2\frac{3}{4}$ „
Height of eye - -	1 „	Height of eye - -	$1\frac{1}{2}$ „

The surface, therefore, in one case is nearly double that of the other, and the number of lenses is increased to about 180, the lenses themselves being each a little larger and not distant from one another more than half their diameter. Another specimen, in

Mr. Gray's cabinet (fig. 8.) has the lenses decidedly small, distant their full diameter from each other, and the intermediate granulations more elevated and connected into zigzag lines. Fig. 7* shows the ordinary surface of the eye. Some specimens have the axis of the body more prominent than others, and the tail is more pointed in some than in others. The glabella varies in width, and divergence of the axal furrows; many specimens having the sides nearly parallel, as in fig. 4, others, as fig. 10, somewhat more clavate. And in a dwarf variety from the Caradoc sandstone, found by Professor Sedgwick at Llanrwst, in North Wales, the clavate form is very marked. Occasionally (fig. 4) the two front furrows become quite obscure; but this is a rare variation. These two upper furrows are always shallower than the lower one and neck furrow, and they show but little in the internal cast; but they are never quite lost. Fig. 14 is from a fine large head from Ledbury, in Mr. C. Stokes's cabinet; the glabella furrows are remarkably deep, considering it is an internal cast, and the lobes somewhat more tumid than usual.

Affinities.—The variation just noticed gives the specimen a great resemblance to a nearly allied species, which, however, belongs to the section *Phacops*, viz.—*P. Stokesii*, M. Edwards, (*P. macrophthalma*, Brongn., t. 1. f. 5., figured in Mem. Geol. Surv., vol. ii. pt. 1. pl. 5. fig. 1). This, which is abundant at Walsall and Dudley, and frequently met with in the Wenlock limestones of the Malverns, is easily distinguished from all the varieties of *P. Downingiæ* by the shape of the lowest glabella lobe, which in this is narrow, very strongly marked off from the rest of the glabella by a nearly continuous transverse furrow, and its extremities are terminated by two rather small but strongly marked tubercles, while in *P. Downingiæ* this lobe is always linear and destitute of tubercles. The uppermost glabellar furrow is bent as if broken, while in *P. Downingiæ* it is a simple sigmoid curve. The tail of *P. Stokesii* has only two or three of the upper furrows of the axis and sides distinct; *P. Downingiæ* has them all marked, and the side furrows interlined by finer ones. But there is a Lower Silurian species, hereafter noticed, still more nearly resembling ours in all its parts—the *P. apiculatus*, Salter. In this the general shape of the head, and of the glabella and its obes, have just the same appearance as those of our species, but a careful comparison will show marks of decided difference in all these parts. In the *P. apiculatus*, which is as common in the Lower as the *P. Downingiæ* in the Upper Silurian, the head is longer, and the glabella more elongate and narrower, and more con-

vex anteriorly ; from its greater length, too, the lobes do not appear so crowded ; they differ also in shape. The lower or basal pair are not linear and transverse, but subtriangular, and are cut off by a shallow depression from the body of the glabella (as in the sub-genus *Phacops*), and the neck lobe rises in the middle between them. The second or middle furrow extends to the glabella edge, and is bent down there ; and the upper one is more deeply impressed, and ends in a decided notch at the glabella margin, (even of this there is some trace in our species, but not nearly so distinct). There is an important difference, too, in the presence of a small spine at each of the head angles. The tail in *P. apiculatus* is decidedly triangular, and at the apex pinched up and drawn out into a recurved spine.

With *P. macrophthalma*, Brongn., t. 1. fig. 4., it really has little in common. The head of that species* is far too long in proportion to the breadth for *P. Downingiæ;* the forehead lobe is too clavate, and the head long, not transverse, and with a strongly pointed front, as represented in the original figure. The eyes, cheek angles, glabellar furrows, and tail all differ widely from those of the species before us. From *P. Brongniarti*, considered the same with it by Col. Portlock, it differs considerably. In that species, independently of the great length of the head, the glabella is widely clavate, with its basal pair of lobes obsolete, and the eyes enormous ; the furrows also of the tail are almost twice as numerous. It appears to be the pointed form of the head, not, however, very conspicuous in *P. Downingiæ*, which has suggested the reference of this and of other trilobites to our species. *P. microps* (Green), as far as can be ascertained from his cast, No. 6, much resembles *P. Downingiæ*, but it cannot be identified. *P. Phillipsi*, Barrande, is very like our species, but the glabella furrows do not converge, and the upper ones are nearly obsolete.

History.—Had Brongniart not figured two trilobites with large facetted eyes under one common name, thereby implying that they were at least closely related, it is not probable that any succeeding author would have identified the species we are describing with either of his figures. But as one of these was from an original drawing, made for Mr. Stokes from a Dudley specimen, it was

* M. Ad. Brongniart's kindness permitted us to examine the original figured specimen at the Jardin des Plantes in 1849. Of four specimens arranged as *P. macrophthalma* in this collection, the figured specimen is the only one without the name attached. One, particularly labelled by Alex. Brongniart as *P. macrophthalma*, has a more clavate glabella than the true species, and is a decided *Cryphæus*, from the United States.

likely that both British and foreign naturalists should conceive the common Dudley species, with a pointed front, to represent the more pointed variety of Brongniart. Green, in his description of the *C. macrophthalma*, 1832, noticed the great difference between the two figures: and, referring to a fine slab of Dudley trilobites, noted that these agreed exactly with the description given by M. Brongniart of the head of his species; and one of Green's published casts is from a British specimen.

Professor Buckland, who in 1836 published a drawing of this species in the Bridgwater Treatise, conceived it to be represented by the more pointed form of *P. macrophthalma*, (Brongniart, fig. 4), and named it accordingly; and Sir R. I. Murchison followed this view, at the same time rightly distinguishing it from the obtuse headed species (fig. 5 of Brongniart), which occurs, though rarely, in company with it at Dudley. He considered the latter fossil, which has enormous eyes, to be more properly the type of Brongniart's species; and gave the new name to that one which was conceived to represent his figure 4. Milne Edwards in 1840 recorded it as distinct from either of Brongniart's species; and as the French fossil with a pointed front evidently furnished Brongniart with his description, retained his name, *Calym. macrophthalma*, for that species, and gave that of *C. Downingiæ* to the present one. He also applied a new name, *C. Stokesii*, to the rarer British fossil represented by Brongniart's fig. 5. In this view all naturalists are now agreed. In the meantime, and immediately after the publication of the Silurian System, Professor Emmrich had established the very natural genus *Phacops* for all those trilobites with largely facetted eyes and 11 segments to the thorax; and he of course quoted the present species under the genus, but supposed it might probably be a variety of his Bohemian species, *P. proœvus*. He afterwards, 1845, admitted it under the present name. Professor Goldfuss, too, in the general systematic Review of Trilobites, published in the Neues Jahrbuch for 1843, had admitted the species; and perceiving the great distinction that existed between those forms with all the glabella furrows distinct and strong, and those in which the anterior ones were obsolete, he separated the group which includes the present species under the term *Acaste*, reserving *Phacops* for those species with inflated heads and obscure glabella furrows, which Dr. Emmrich had already pointed out in his Dissertation as the type of his genus. The latter, in his systematic table of the genera, published in the Neues Jahrbuch for 1845, objected to this arrangement, and grouped together the two sections just adverted to as constituting

a sub-genus *Phacops*, while he formed the section *Dalmannia* for the more expanded forms, such as *P. caudatus*, *P. Hausmanni*, &c.*

Professor Burmeister had already, 1843, regarded our species as a synonym of *P. macrophthalma*, Brongn., and has repeated this reference in his second edition, 1846. And Lieut.-Col. Portlock, in his admirable work on the Geology of Tyrone, endeavoured to escape from the difficulty by proposing a fresh name, *P. Brongniarti*, to include Brongniart's and Murchison's species, as well as a new and perfectly distinct form, discovered by himself; thus adding innocently to the confusion. In the Mem. Geol. Survey, 1848, I returned to Milne Edwards' correct classification of these species, and described both the English forms. Professor M'Coy has since confirmed their distinctness, and we may now consider *P. Downingiæ* as having established its claim to rank as a distinct British species, highly characteristic of the Upper Silurian rocks, and unknown, so far as we are able to learn, in other countries.

British Localities and Geological Position.—CARADOC SANDSTONE to LUDLOW ROCK.—Caradoc Sandstone; Moel Seisiog, and other places near Conway and Llanrwst, North Wales (dwarf specimens). Wenlock Shale; Bryn Craig, &c., Usk; and Slate Mill, Hasguard, in South Wales. Wenlock Limestone; west of Hereford Beacon; Ledbury; Malvern Hills; Dudley and Walsall, abundant. Lower Ludlow and Upper Ludlow Rocks of the Abberley Hills. Upper Ludlow; Underbarrow and Benson Knot, Kendal; Pont-ar-y-Llechau, near Llangadoc, South Wales; Ludlow Rocks, Golden Grove, and other places south of Llandeilo.

EXPLANATION OF PLATE I.

Fig. 1. *Phacops Downingiæ*, of ordinary size; Dudley limestone. (Collection of John Gray, Esq.) At *b*, the outer termination of the facial suture is seen.

Fig. 2. Do.; a rolled-up specimen, same locality. (Collection of T. W. Fletcher, Esq.)

Fig. 3. Do.; variety with very large eyes, each with about 180 lenses. Same locality and collection.

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* As we think, however, that there are three distinct groups, we have adopted the term *Acaste* for the present sub-genus, and left the species with inflated and lobeless glabella in the section *Phacops*. In this latter view we have the sanction of the greatest authority on trilobites, M. de Barrande, whose great work, just received from the publisher, will long be the standard for reference. Otherwise we should have been unwilling to disturb the nomenclature adopted by Professor M'Coy, who has given to the latter group the new name *Portlockia*, reserving *Phacops* for those species which have the glabella lobes distinct, but have not the expanded form or numerous tail segments of *Dalmannia*.

Fig. 4. Glabella of a specimen from the Wenlock limestones of the Malverns, with the two upper furrows nearly obselete; the lower ones are stonger than usual; a rare variation. (Coll. Mus. Pract. Geol.)

Fig. 5. Under side of the head, showing the entire rostral portion *a*, the termination of the facial suture on each outer side at *bb*, much further backward than on the upper surface (see fig. 1, *b*); *c*, the obtuse hypostome or labrum. (Coll. Mr. John Gray, Dudley.)

Fig. 6. Hypostome of last specimen, magnified. The basal processes (*a*) extend even further outwards in some specimens, and are probably attached beneath to the ends of the upper glabella furrows.

Fig. 7. Eye of an ordinary specimen, natural size. Dudley.

Fig. 7*. Portion of do., highly magnified, showing the separate convex portions of the cornea over each lens, with granules on the interspaces.

Fig. 8. Portion of the eye of another variety, with the lenses proportionally smaller and more distant, and the granules collected into an hexagonal network between them. Dudley.

Fig. 9. Highly magnified cast, in fine silty mud, of the interior of the eye, showing the cups from which the lenses have fallen out. These cups therefore occupy the place of the depressed tip of the crystalline or vitreous body. (Burmeister.)

Fig. 10. Enlarged specimen, the head divided at the facial suture, showing the first segment, *a*, as an entire ring or segment which bears the eyes. On the second ring, *b* is the upper eye lobe; *c*, the tubercle or rudimentary spine; at *d*, the pleural furrow is shown, and at *e*, the fulcral point of a middle thorax joint; *ff*, the notched tips of the pleuræ; *g*, the tail.

Fig. 11. Part of the front of the head and glabella, to show the equal granulation of the surface.

Fig. 12. Magnified notched ends of the pleuræ (upper side), showing their surface to be granulated even over the facetted portion, *b*; at *a* the tubercle is shown, which is better seen in the next figure.

Fig. 13. Magnified under side of three pleuræ, showing the narrow incurved under portion *b*, and the tubercles which serve as buttresses in rolling up, *a*.

Fig. 14. Internal cast of a large head, from Ledbury, Wenlock limestone (Mr. C. Stokes's cabinet); the furrows are much broader and deeper than usual.

Fig. 15. Tail, natural size, from Dudley, to show the sub-triangular pointed form usual in the species.

Other British Species of Phacops, of the Section Acaste.

1. *P. apiculatus, Salter* (1852), in Prof. Sedgwick's Synops. Classific. Palæozoic Rocks, fasc. 2, Appendix, iii. pl. 1 G. f. 17–19. *Portlockia? apic.* M'Coy (1851), ib. fasc. 1. p. 162.

P. omnino P. Downingiæ simillimus; sed capite longiore, glabellâ elongatâ, antice conveziore, lobis basalibus circumscriptis subtriangulatis nec transversis; sulco medio glabellari longiore, supremo distinctiore; oculis elongatis subdepressis; angulis posticis capitis brevissime mucronatis; caudâ ad apicem paullo compressâ et in apiculum recurvum brevem productâ; axi angustato.

Localities.—Common in the Llandeilo flags of North Wales, and in the Caradoc sandstone of Hope Bowdler and Acton Scott, Shropshire. [Geol. Surv. and Woodw. Mus.]

Heads of this species have also occurred in the hard quartzites of the coast of Cornwall, at the Great Peraver, in company with *Calymene, Orthis* and other Silurian forms.

2. *Phacops Brongniarti*, Portlock (1843), Geol. Rep. Tyrone, pl. 2. fig. 8. (excl. ref.) *P. Murchisonii*, ib. fig. 9.

P. biuncialis, elongatus granulatus, modice convexus; capite longo trigono, fronte angulato subrecurvo; glabellâ ad basin contractâ anterius valde dilatatâ nec convexâ, lobis utrinque tribus radiantibus; lobo antico maximo triangulato, a frontali sulco valido—a medio sulco leviore—sejuncto; lobis infimis minutis hemisphæricis circumscriptis sese remotis; lobo verticali eminentiore; oculis maximis, a lobo frontali usque ad sulcum verticalem tractis; angulis genarum obtusis; thorace axi convexo angustato, lateribus parallelis abruptè deflexis; pleurarum apicibus rotundatis, fulcro intra medium posito; caudâ trigonâ, axi longe conico angustissimo fere ad finem caudæ extenso, decies annulato; apice prominulo; lateribus 5-costatis, costis per totum divisis, nec marginem lævem attingentibus.

Col. Portlock had united with this species both the *P. macrophthalma* of Brongniart, and *P. Downingiæ*, Murch. They are however, as above stated, quite distinct species. The present is well characterized by the pointed front and contracted base of the glabella, as well as by the large eyes, which have each 170 lenses.

Localities.—Bala and Llandeilo Rocks: Tyrone; Carrickadaggan, Wexford; Llanfyllin, and other places, N. Wales.

3. *P. Dalmanni*, Portl. l. c. f. 7.

Omnino precedenti simillimus—caudâ multi-annulatâ, oculis maximis, glabellâ ad basin contractâ, granulosâ; sed capitis fronte rotundato, nec producto; [an forsitan fœmina inermis?]

This neat species occurring with the last, and of the same or of rather less dimensions, so much resembles it in form, proportion, and sculpture, that we are compelled to regard it as of the same species, and as indicating either a variety with a rounded front, or, what is more likely, the female form. Portlock's original specimens are all of one character, and the front appears to have been really rounded, not broken off.

Locality.—Desertcreat, Tyrone.

4. *P. Jamesii*, Portlock, G. Report, pl. 3. fig. 10. (mala).

P. unciam latus; capite semicirculari, bis quam longo latiori, fronte angulato, marginato, crasso; glabellâ fere planâ tuberculatâ antice latissimâ postice ad dimidium contractâ, lateribus rectis; lobo frontali latè triangulato, oculis impendente; cæteris radiantibus,—supremo maximo triangulato, medio lineari obliquo haud abbreviato, basali transverso; lobis omnibus fere ad medium glabellæ, spatio angusto interjecto, conniventibus; genis lente declivibus marginatis, angulis obtusis; oculis abbreviatis valde curvatis; (thorace — ?) caudâ [unâ cum capite congregata] rotundatâ, quam longâ tertiam partem latiori, depressâ; axi satis magno conico, marginem nullo modo attingente,—annulis 8–9; lateribus sulcis 6–7 æqualibus, lævitèr interlineatis.

Portlock's figure but imperfectly expresses the great width and flatness of the glabella, which is not the result of pressure; the tuberculation covers the glabella only, while the cheeks are merely granulated. The shape of the glabella and its radiating lobes, and the short curved eye, approximate this species nearly to the next, from which the glabella and pointed front of the head readily distinguish it. The head too is not so broad in proportion.

Locality.—Tyrone; in calcareous sandy schist, Waterford; also in sandstone at Newtown on the Suire, in the same county. [Geol. Surv. Coll.]

5. *P. alifrons*, Salter, in Appendix to Sedgwick's Brit. Pal. Foss. l. c. ii. t. 1 G. f. 12–14, M'Coy, ib. 159.

P. capite sesqui-unciam lato, gibboso, tuberculoso, antice truncato, bis quam longo latiori; glabellâ elevatâ sed paullum convexâ, ad basin angustatâ, superne dilatatâ obtusâ, lateribus subrectis; lobo frontali brevi transverso limbum crassum impendente, et utrâque angulis

tumidis cum margine genarum confluentibus; lobis lateralibus tumidis, supremo subtriangulato anticè obliquo, reliquis fere rotundis brevissimis; genis declivibus tuberculatis marginatis, angulis rotundatis; oculis elevatis brevibus curvatis; pygidio semicirculari tumido; axi lato convexo 8–9-annulato, apice obtuso nec marginem attingente; lateribus convexis, costis 7–8, radiantibus simplicibus, margine angusto.

The peculiar character of this species, which a good deal resembles *P. sclerops* Dalman, consists in the absence of any separating furrow between the upper lobe of the glabella and the outer margin of the cheek, the glabella thus seems to be drawn out into it on either side.

Localities.—Capel Garmon, Llanrwst; near Penmachno; Pont-y-Glyn Diffwys; and Bala; all in the Bala or Llandeilo rocks of North Wales.

6. *Phacops Jukesii.—n. sp.* [*P. sclerops*, var., Dalman, Pal., t. 2. fig. 1 *g.* (mala)?]

P. capite unciam et plus lato, fere quam longo ter latiore, convexo (granuloso?); glabellâ haud elevatâ antice valde dilatatâ, postice contractâ, utrinque tri-lobâ; lobo basali transverso lineari, secundo paullo majore rotundato, supremo magno triangulato, frontali maximo transverso toto oculo elevato brevi curvato imminente, lobo cervicali elevato nec lato; genis latis marginatis, [angulis rotundatis?]; sulco verticali fortè exarato; lineâ faciali impressâ; sulcis axalibus profundis.

This curious species, which we have only just now detected in the collections from Bala, differs materially from the next, in the comparatively equal size of the lateral glabella lobes. The upper one is large and triangular, but not nearly so large as in *P. conophthalmus*, and the second is distinctly rounded and larger than the basal lobe, instead of being contracted and almost lost, as in that species.

Locality.—Bala limestone, west of Gelli grin, Bala. [Survey Coll.]

7. *P. conophthalmus*, Bœck. sp. [*Calym. sclerops*, var. Dalman, Pal., t. 2. fig. 1 *d*?] *Tril. conicoph.* Bœck Gœa Norveg. (1838), l. 4. *Phacops con.*, Emmrich Dissert. 21. *Asaphus Powisii* (head only), Murch. Sil. Syst., t. 23. f. 9. *Calym. Odini* (Eichw.), De Vern. Geol. Russ., t. 27. f. 8. *P. sclerops*, Burm., ed. 2. (1846), t. 4. f. 5. excl. syn. (icon bona, ab editione prima multo emendata.) *P. conophthalmus*, ib. p. 91. *Chasmops Odini*, M'Coy, l.c. t. 1 G. f. 22, 23. *P. conophthalmus*, Angelin, Pal. Suec. (1852) t. 7. f. 5, 6.

P. ovatus, magnus; capite valde transverso, fere quam longo ter latiore, granuloso, convexo; glabellâ convexâ, anticè valde dilatatâ, postice angustatâ, utrinque bilobâ, lobo mediano omnino contracto obsoleto, basali transverso lineari, supremo maximo triangulato, supra paullum sinuato; frontali rhombo-trigonali maximo nec oculo imminente; lobo cervicali lato; genis convexis latè marginatis; angulis in cornua lata extensis [interius rotundatis] oculo brevi valde curvato; lineâ faciali impressâ; cauda (associata) lata punctata, vix marginata, axi conico, lateribus angustiore, 9–10 annulato; costis lateralibus 8 arcuatis, omnibus duplicatis.

This remarkable species is abundant in the Silurian strata on the Baltic coasts; it is equally common in Britain, but although fragments are abundant, we have only seen perfect specimens of the head in the Woodwardian Museum. I collected these in company with Professor Sedgwick, and with them was associated the tail above described, which could hardly belong to any other species. It is found with fragments of the head in some other localities, and agrees well also with that figured by Professor Burmeister. But the figure given by Angelin represents the tail as considerably more pointed, and we have specimens from Wales more of this character; there are other species of *Phacops* in which similar variations occur. The heads figured in the "Silurian System," from the Caradoc sandstone, belong to this species. Angelin has figured two other Phacops with very similar lobes to the glabella, but it is possible his *P. bucculenta* and *P. macroura* may prove but varieties of this.

We have seen the eyes of this species, and they are reticulated as in other species of Phacops. But from their greatly curved shape they are generally broken off, and this has led Professor M'Coy to the establishment of his genus *Chasmops*, which had better be expunged, as this group is so closely connected with the ordinary *Phacops* by means of such species as *P. Brongniarti* and *P. Jukesii*.

Localities.—In Bala Limestone; Llansaintffraid Glyn Ceiriog, south of Llangollen; Alt-yr-Anker, Meifod, North Wales [M'Coy], Welshpool [Sil. Syst.]; Llanfyllin, Montgomeryshire; Llanbedrog, Carnarvonshire [Survey Coll.]; Applethwaite Common and Coniston, Westmoreland [M'Coy]. Caradoc Sandstone; Cheney Longville, Shropshire [Sil. Syst., figured specimen]; Acton Scott, &c., abundant.

Section Odontochile (Dalmannia), Decade II. Pl. 1.

Additional British Species.

P. mucronatus, Brongn. sp. *Entomostrac. caudatus*, Wahl. Nov. Act. Soc. Ups., v. 8. t. 2. f. 2. *Asaphus mucr.* Brongn., Cr. Foss. t. 3. f. 9. Dalman, Pal., t. 2. f. 3 *a b*. *Phacops*, Emmrich (1839), Diss. 24. N. Jahrb. 1845. Burmeister, ed. 1. p. 113., and ed. 2. (1846), p. 95. (excl. syn. Murch. "Sil. Syst.") Angelin, Pal. Suecica (1852), t. 8. f. 1.

P. triuncialis et supra; glabellâ convexâ, anticè parum dilatatâ, utrinque lobis tribus subæqualibus transversis, sulcis longis satisque profundis sese separatis; caudâ latè triangulari acuto, axi subconvexo limbum planum haud æquante, in 9–12 annulos et appendicem trigonalem diviso, appendice in apicem caudæ brevi-mucronatum percurrente; lateribus costis 7 planis, sulcis angustis acutis valde curvatis et cum tot lineis intermediis profundioribus ad apices confusis; margine angusto nec distincto.

Portions of the head and perfect caudal shields of this rare species have been found in a stratum over the bed of volcanic ash at Pen-y-Rhiw, west of Bala, where it is to be hoped other collectors may obtain fresh specimens. The head is not complete enough to give the diagnosis. Our Bala specimens, as well as those from Sweden in Sir R. I. Murchison's cabinet, have but 9 rings and a triangular terminal portion to the axis of the tail, but in a specimen from Haverfordwest part of this terminal portion is annulated, and there are 12 rings. The lateral ribs are much arched at their ends, and strongly duplicate, of double furrows, each pair uniting at their tips in a broad depression. The apex is recurved; the mucro varies in length.

Localities.—Pen-y-Rhiw, west of Bala [Survey Coll.]; Haverfordwest, Pembrokeshire [Mrs. Day's cabinet]; in Llandeilo flags.

P. amphora, n. sp.

P. caudâ magnâ biunciali elongatâ, convexissimâ, fere semicylindricâ; sulcis axalibus fere obsoletis; axi lato nec eminenti, marginem caudæ haud attingente, in annulos sexdecim subplanos diviso, apice obtuso; lateribus valde curvatis deflexis, costis 14–15 planis, sulcis acutis separantibus,—costâ quâque lineâ mediana lævi elevatâ (sub cortice impressâ!); margine angusto inflexo, apice obtuso (emarginato?).

Very like in general form to *P. truncato-caudatus*, Portl., from which it is at once distinguished by its convex form (almost like that of a half cask or barrel), and the axis not at all distinct from the sides—the axal furrow being almost obsolete; this latter character is very unusual in Phacops. Along the middle of each of the flattened side ribs a narrow and but slightly elevated ridge runs the whole length; on the internal cast this is represented by a depressed line of connected dots. Something similar, but less distinct, occurs in the allied species above quoted.

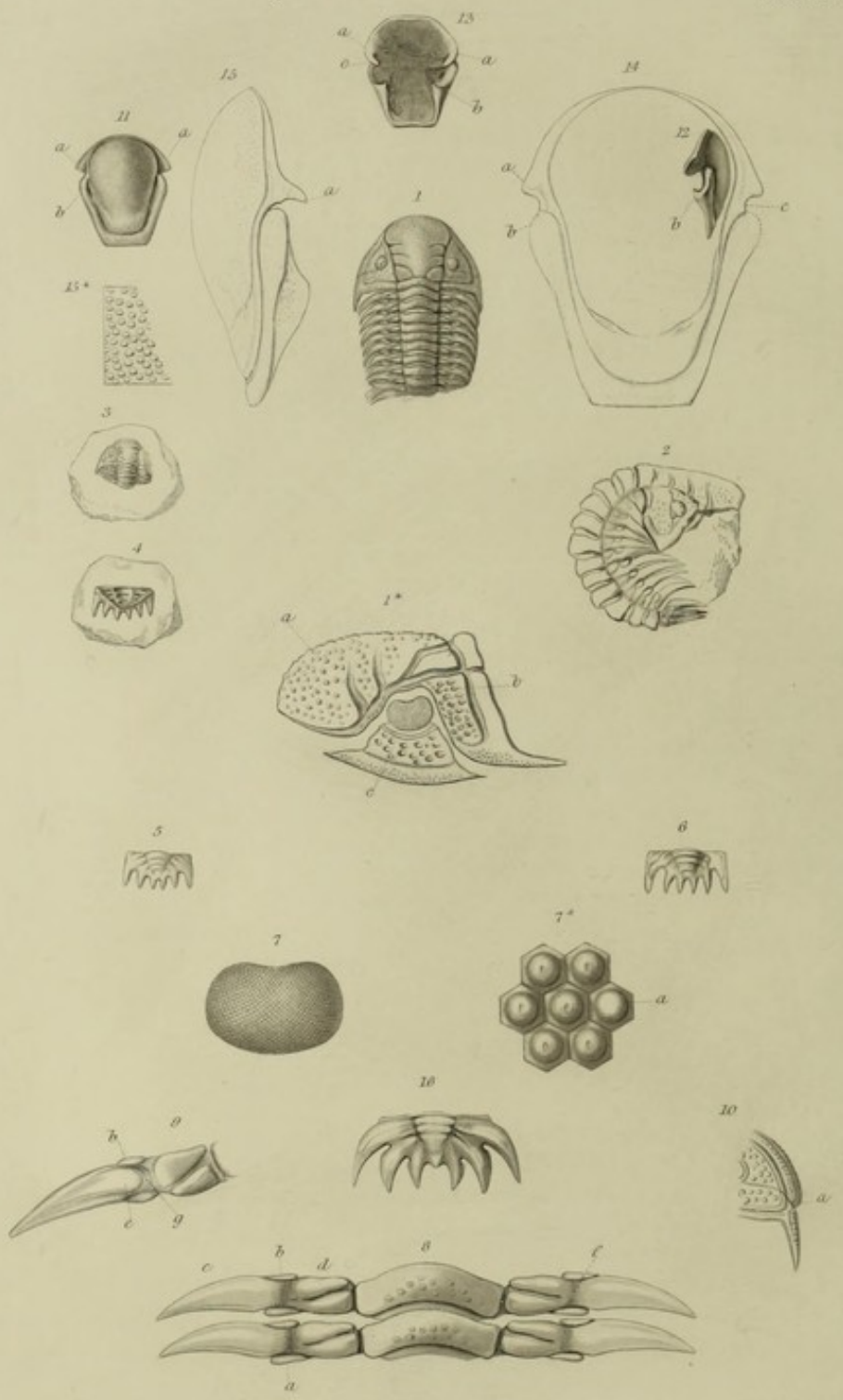
Locality.—Grug Quarry, near Llandeilo [Survey Coll.]; one fine specimen was presented by Mr. Williams, of that place. In Llandeilo flags.

J. W. Salter

August, 1853.

Geological Survey of the United Kingdom.

CHEIRURUS
(Silurian)



CHEIRURUS BIMUCRONATUS — *Murchison*

W. H. Baily del.t E. Forbes direx.t J. W. Lowry fc

BRITISH FOSSILS.

DECADE VII. PLATE II.

CHEIRURUS BIMUCRONATUS.

[Genus CHEIRURUS. BEYRICH. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Head strongly trilobed; glabella with three lateral lobes, the basal ones circumscribed; eyes facetted; facial suture ending on the external margin; a rostral shield: Barrande. [Cheeks scrobiculate]; hypostome inflated, oblong, truncate, with a marginal furrow and lateral auricles; thorax of 11 joints, the pleuræ strongly nodular as far as the fulcrum, the ends free and pointed; tail of few, 3 or 4, segments, free at their ends.]

DIAGNOSIS. *C. grandis; glabellâ superne latiori, sulco frontali et oculari obliquis propè medium glabellæ terminatis; lobis inferis trigonis (ætate rotundioribus) sejunctis; genis glabellâ angustioribus, oculis medianis, spinis posticis parallelis; thorace pleuris trituberculatis; caudâ parvulâ, utrinque pleuris tribus subæqualibus ad basin brevisulcatis, apicibus robustis, arcuatis.*

SYNONYMS. Var. *α*. *Bimucronatus—caudâ mucrone centrali nullo.* *Calymene speciosa* [DALMAN (1826), Pal., pp. 58, 76 ?] HISINGER (1840), Lethæa Suecica, Suppl. 2d. t. xxxix. fig. 2. *Paradoxides bimucronatus*, MURCHISON (1839), Sil. Syst., pl. 14. fig. 8, 9. MILNE EDWARDS (1840), Crustac., vol. iii. p. 343. *Arges bimucr.* GOLDFUSS (1843), Neues Jahrb. 544. *Cheirurus bimucronatus*, BEYRICH (1845), über einige Böhmische Tril., p. 18, 19. *Cheir. ornatus* (Dalm.), *β*, *bimucronatus*, BRONN. Ind. Palæont. (1848), 1. 286. *C. speciosus*, SALTER (June 1848), Memoirs Geol. Survey, vol. ii. pt. 1. pl. 7. fig. 4, 5, 6. *Ceraurus Williamsii*, M'COY (Dec. 1849), Ann. and Mag. Nat. Hist., p. 408, Pal. Foss. Woodw. Mus. (1851), pl. 1 F. fig. 13.

VAR. *β*. *Centralis*, fig. 16.—*caudâ mucrone centrali brevi*, Mem. Geol. Surv., l. c. fig. 7.

The subject of our present notice received some degree of illustration in the second volume of the Memoirs of the Geological Survey, and we need not repeat here the figures which indicate the large size to which the species grew, but take advantage of a beautiful and nearly perfect specimen, found near Aymestry, and lent to us by the Rev. T. T. Lewis, whose valuable labours are so frequently

acknowledged in the "Silurian System." Messrs. Gray and Fletcher, of Dudley, have kindly enabled us to complete the details, and the figures in this plate are nearly all drawn from Upper Silurian specimens, while those previously given, with one exception repeated in this plate, were from the Llandeilo flags of South Wales.

The genus to which this rather common fossil belongs is highly interesting for the remarkable sculpture of the body rings, which are broken up into a number of prominent swellings divided by deep furrows, and have their ends freely extended into sharp points, which are so widely distant from each other, that it would require the animal to roll up to bring them into contact. The tail is made up of a few similar rings, cohering only at their base, and having the ends also free and pointed. The nature of the eyes also is worthy notice, inasmuch as they are covered by a facetted cornea, like that of *Phacops caudatus*, and not, as in most trilobites, with a smooth one. The facial suture, in this and one or two closely related genera, runs as it does in *Phacops*, to the outer margin of the head. The shell or crust is strong and calcareous, the furrows of the head well marked; the hypostome or labrum has a considerable resemblance to that of the genus above mentioned, and the number of rings in the thorax is the same—so that it is almost certain, much as the general appearance resembles *Paradoxides*, that there is a really close affinity between it and those species of Phacops which have the tail fringed with long spines.

Description.—One of the largest of trilobites; it measures occasionally 15 inches, and probably more, judging from the proportions of the large fragments previously figured* to that of perfect specimens of a smaller size. Those found at Dudley are not above one and a half or two inches long,—specimens from the Malverns are much larger. Length to breadth as three to two; the head occupies fully one third the length, and is a little broader than the body. General form moderately convex, and oblong, but narrowed suddenly towards the posterior end; the sides of the thorax and tail deeply serrated by the projecting ends of the segments. The animal is sometimes found half coiled up; the pointed ends of the pleuræ closing together and overlapping each other (fig. 2.)

Head rather more than a semicircle,—the obtuse front projecting; glabella gently convex, equal in breadth at the base to the cheeks, above considerably broader, marked with three strong furrows on each side besides the neck furrow, the lowest being

* Mem. Geol. Survey, vol. ii. pt. 1. pl. 7.

directed obliquely downwards and joining the neck furrow before reaching the middle ; it thus encloses a spherical triangle as a basal lobe. In older specimens this lobe is somewhat squarer, and the furrow more curved. The other furrows curve but little downward, and are variable in length, but usually extend more than one third across the glabella on each side. The furrows on the glabella, as well as the axal furrows, are sharp, but not broad or deep exteriorly, although they are so on casts of the inner surface. Forehead lobe of moderate size, half as long as the entire glabella, and on the sides overhanging the other lobes,—in front it is somewhat produced and occupies all the margin. The glabella is neither gibbous nor depressed, a line taken from the front edge to the neck furrow presenting a regular and gentle convexity. Cheeks subtriangular, not so wide as long, with a broadish margin distinctly separated by a furrow, which meets the strong straight neck furrow at the posterior angles ; these angles are spinous, the spine short and directed backwards. The eye is placed more than half-way up the cheek, and not close to the glabella, it is opposite the middle furrow,* and is rather small, supported by a raised rim below ; the eyelid is narrow and indented,—the lentiferous surface (fig. 7) very convex, supine, and covered with minute, closely set, convex facets with no spaces between them. Our figure, 7*, represents each facet as with a minute pit upon it, but this is due to wear, (at *a*, a lens is seen in the natural condition). Above the eye the facial suture takes a sigmoid curve, and cuts the margin exactly where the axal furrow ends on it ; below the eye it turns directly downwards to the smooth border, which it cuts considerably in advance of the posterior angle, and in an oblique direction, so that it reaches further back on the lower side than on the upper. We do not know the course of the suture in front,—it is probably direct across, beneath the front margin, leaving the cheeks united there, as in *Sphærexochus*, next described. The surface of the glabella is sparsely covered with small granules (fig. 1*, *a*) ; the cheeks are largely scrobiculate, (*b*, *c*), and the wings or free cheeks have their border smooth and only scabrous on its outer edge ; they sometimes, as fig. 10, dilate a little in advance of the facial suture. Hypostome (figs. 11 to 15) large, ovate, oblong, very convex, its length one fourth more than the width, but in appearance more ; broadest near the base of insertion, from which the central convexity rises immediately and reaches

* Lovén calls the upper furrow "*frontalis*," and the middle one "*ocularis*," and, though not always strictly correct, it would be a very useful designation. We have employed it above in the diagnosis.

nearly to the tip. A rather narrow ring or rim surrounds the apex and sides, terminating abruptly near the base on each side in what may be called an auricle, followed by a deep notch *c*, above which the ascending processes *a*, *a*, take their origin. The apex of the hypostome is truncate, the corners angular or even mucronate. A distinct sulcus separates the border all round, and within this there is a short oblique furrow on each side. Its whole surface is closely scabrous (fig. 15*) ; the convex portion has besides scattered larger granules. The organ is hollow when viewed from the inner and under side, and the structure there observable is such as has been often described.* These are two ascending processes, *a*, *a*, rising from the ends of the basal or front margin, and directed obliquely backwards ; and on the sides, *b*, *b*, the inflated broadly triangular portions characteristic of the genus. These triangular curved plates give the appearance of thickness on viewing the organ from the side (fig. 12), but the general surface on the inner side is concave, answering to the great convexity of the outer side. Thorax much longer than the head, but narrower, and for most part of it parallel sided, of 11 gently convex rings which are very minutely scabrous ; the axis is narrower than the glabella, of nearly equal width all the way down, but scarcely so wide as the pleuræ. These are linear and directed straight outwards for two thirds their length, then curved a little backwards and tapering to a sharp point. The fulcrum, placed at about one third, is of singular structure,—a small semi-oval piece (fig. 8, *a*) is attached to the posterior edge of each pleura, and against this piece abuts a similar tubercle (*b*), placed on the front edge of each, and the two pieces, forming together a narrow oval tubercle, are insulated by a deep sulcus from the body of the pleura, which is also constricted and furrowed across at this point, so as to have the outer and pointed portion (*c*) quite distinctly separated from the small inner one. The latter (*d*) is very strongly divided into two tumid lobes by a short oblique sulcus, and just beyond the constriction the outer portion rises into a stout boss, (fig. 9, *e*) giving the tri-tuberculate form characteristic of the genus.

* M. de Barrande, Neues Jahrbuch (1847), 389, has given a full description of the hypostome of *Cheirurus*. He describes the ascending processes *a*, *a*, (Flügel), as bent upwards at right angles to the surface of the organ, and uniting with the upper crust along the line of the dorsal or axal furrow, with a broad base of attachment, reaching from the upper to the middle glabella furrow. In *Phacops* it has nearly the same position. He also describes a second organ, of the same size and shape, but less convex in all its parts, lying immediately behind the hypostome, between it and the upper crust of the head. This organ he calls *epistoma* ; and he has seen it both in *Cheirurus insignis*, and a species of *Phacops*. It has never yet occurred to our observation.

The line of the fulcral points is parallel to the axis for all its length, and the constriction beneath them, though not very marked on the upper crust (fig. 8), produces a longitudinal ridge on the under surface, and a strong furrow in casts (fig. 9). Tail, at least in Dudley specimens, very much narrower than the body, with three strong spinous lateral lobes on each side directed backwards, the outer ones a little divergent and longest; all extend equally backwards,—the tail is therefore truncate—but exclusive of the spines, it is broad triangular, following somewhat the shape of the axis; it is marked on each side by four short deep puncta or furrows, which do not run to the margin in young individuals. The axis is convex and short conical, of three distinct ribs and a small terminal piece —the last very obscurely indicated; there is no mucro between the lowest spines in the ordinary Wenlock forms.

Variations.—The following have been observed. In a Dudley specimen the front or forehead lobe occupies much more than half the length of the glabella, the side lobes being therefore more crowded. In a Dudley specimen, a large tubercle occurs in the middle of the forehead lobe. In some individuals the glabella widens more above, in others it is nearly parallel-sided, and the lateral furrows vary in length. The head spines occasionally reach the third thorax segment. The margin of the cheek in one specimen is notched at the facial suture (fig. 10, *a*). The axis of the thorax is, sometimes, though rarely, as wide as the pleuræ. The most important variations occur in the tail,—in fig. 5, we have represented the spines as all directed backwards, and the two central ones closely approximate; they are so in the large Ledbury specimen figured in the "Silurian System," where too they are shorter than the outer spines. In fig. 6, they are a little space apart; in a Lower Silurian specimen we have seen a small tubercle appear between, and in our var. β a decided, though short, mucro protrudes. Lastly, as a monstrous variety from the Silurian rocks of Kildare,—we have reason to think it of the same species,—we have one with a wider interval, and a bifid mucro. In old specimens, as well as in var. β, the spines diverge much more than in those we have here figured. Perhaps some of these variations are due to sex.

Affinities.—The considerable variations above mentioned lead us to believe that the *Ch. insignis*, Beyrich, may be but a variety of this species. We have not materials enough to justify our recording it as a variety, as Beyrich describes and figures it as with a much wider glabella, the furrows reaching but a short way across. The hypostome is very similar, and the tail differs very little, except in

the much greater central mucro and more divergent spines, towards which characters we have shown considerable approaches in some of our varieties. It was these close resemblances which induced us to say, in the volume already alluded to, that our British species occurred in Bohemia with the *C. insignis*. But I find the Bohemian specimens do not show any tendency to vary towards ours.

Barrande, in his great work which has just been published, figures a fine new species, *C. Quenstedti*, closely allied to both the above, but the head spines are very much longer and slenderer, and so are those of the tail; the glabella too is parallel-sided, its furrows run quite across, and the lower pair of lobes nearly meet. *Calym. ornata* of Dalman, since fully described by Lovén, must be very nearly like our species; but the greatly elongated first pair of spines to the tail, and the parallel-sided glabella must separate it for the present; we subjoin a note giving a few of its prominent characters.* *Ch. obtusicaudatus*, Corda, is another nearly allied fossil.

History.—The history of the species dates clearly, we think, from Hisinger's Lethæa Suecica, where the head of a large specimen is figured, and the species considered identical with the *Calymene speciosa* of Dalman, found by Nillson in the isle of Œland. There is, however, some doubt of the correctness of this reference. Dalman described in a supplementary note to his "Palæadæ" two species, *C. speciosa* and *C. clavifrons*, comparing the former with the *Trilobites Sternbergii*.† This comparison sufficiently indicates that a large species, with the glabella broad in front, must have been intended; and we lay the more stress on this, because it proves that the species with a small oval glabella, narrowed in front, which was figured by M. Sars in Oken's Isis, 1835, as *C. speciosa* of Dalman, is not that species, and could never have suggested the comparison above mentioned. We believe it was this erroneous reference by Sars, joined to Dalman's rather loose description, "smooth, large, oval, and convex glabella," which has thrown doubt on the identity of his species with Hisinger's figure. But since there are several species of the genus found in Norway and Sweden, as indicated by the figures of M. Sars, above quoted, and those lately given by

* Glabella æquilata; abdomen articulis 3, basi connatis; primo secundum longè superante, in appendicem crassam teretem longissimam utrinque producto; secundo tertium excedente, hoc verisimiliter brevissimo. Loc. Husbyfjol, Ostrogothia. Lovén in Ofversigt Vetenskaps Akad. (1844), p. 64.

† Sternberg, Verhandl. Vaterlands, Mus. Prag. 11th pt., p. 45. tab. 13 *a*. Dalman says, that in his species "the glabella lobes are all connected down the middle, while in Sternberg's they are separated by transverse furrows."

Angelin in the "Palæontologia Suecica," we prefer with Dr. Beyrich,* to leave the question undecided, and wait for the descriptions and references now in course of publication by M. Angelin.

Sir R. I. Murchison first published it in this country, referring it to Paradoxides, as the only genus then published which it appeared to resemble, especially as he regarded the two lower prongs only as constituting the tail; he also figured the body rings, and commented on their remarkable rough sculpture; this figure of the body is accidentally reversed upon the plate, the portion nearest the head being turned downwards.

It is next mentioned by Lovén in 1844, describing two of Dalman's species, the *C. clavifrons*, and *C. ornata*, and to the latter he referred the figures given by Murchison of the present species. But the comparison could be made only with the body segments, and these are far too much alike in different species. The description too of the head given by Lovén, though agreeing in the main with the perfect examples we now possess, is not sufficiently precise, and we are not therefore justified in reuniting ours with *C. ornata*, more especially so, as the excellent figure of that species lately given by Angelin, Pal. Suecica, p. 21, fig. 1, represents the uppermost or forehead lobe of the glabella as not wider than the rest, ("equilata glabella," Dalm.), or occupying nearly so much space in length as in our species.

It is to be regretted that to these descriptions, the author has not added that of *C. speciosa;* he does not even mention this disputed species. In 1845, Dr. Beyrich first described the entire animals of this genus, and introduced the British fossil as an undoubted species of *Cheirurus*, leaving for future observation its identity or otherwise with his *C. insignis*, to which, as above stated, it bears great resemblance.

It was again published in the second volume of the Memoirs Geological Survey, 1848, where the head of the species was described and identified with *Calymene speciosa* of Hisinger. And we still regard Hisinger's excellent figure as a proof that our species is found in Gottland, in a stratum marvellously like our own Wenlock limestone. In that notice the very large size the species attained was represented, and we accidentally repeated the error of reversing the position of the body ring by turning the front edge downwards. Lastly, Professor M'Coy, in one of his useful contributions to the "Annals of Natural History," described the entire animal, which he has since figured in the Synopsis of the Woodw. Mus. fossils,

* Untersuch. über einige Böhm. Trilob. (1845), 1st part, t. p. 17, 18.

retaining the generic name *Ceraurus*. We had previously selected this beautiful example from the collection of Mr. Williams, who found it near Llandovery, and we have since again examined it. It is much elongated and narrowed upon the cleavage of the rock, but is identical with the present species, and is very interesting as showing that the Lower Silurian form is somewhat intermediate, as regards the tail, between the ordinary Dudley form and our var. β, for the lower prongs are but slightly distant, and have but a tubercle, instead of a prominent mucro between them.

Barrande's exquisite figures of the genus, fortunately now before us, show the structure of all parts of the body completely. He has figured the hypostome in several species; we are fortunate in here being able to add the under side of that organ, and the structure of the eye.

British Localities and Geological Range.—LLANDEILO FLAGS to AYMESTRY LIMESTONE.—In Llandeilo flags; Sholes Hook, and Pelcombe Cross, Robeston Wathen, and Llandowror, near Haverfordwest; Goleugoed, Llandovery, (Cambridge Museum). In Bala limestone; Rhiwlas and other localities, near Bala, North Wales; Chair of Kildare, Ireland. In Lower Silurian rocks, at Mullock, Girvan, Ayrshire, (Coll. Sir R. I. M.) In Woolhope limestone; Nash Scar, Presteign, (Coll. Mr. Davis.) In Wenlock limestone; Haven, near Aymestry, (Coll. Rev. T. T. Lewis); Brand Lodge, Malverns; Dudley; Dormington Wood, Woolhope. In Aymestry limestone; Downton Castle, Ludlow.

Var. β.—In Wenlock strata; Nelson's Tower Wood, east of Carmarthen.

Foreign Distribution.—Gothland, in Upper Silurian (HISINGER); (Œland, Lower Silurian, DALMAN?).

EXPLANATION OF PLATE II.

Fig. 1. Specimen, perfect except the tail, from Haven, near Aymestry; in the collection of the Rev. T. T. Lewis, of Bridstow, Ross.

Fig. 1*. Head of same, dissected, showing the granulate glabella, *a*, and deeply pitted cheeks, *b*, *c*. (the eye is raised too much.)

Fig. 2. From Dudley, collection of J. Gray, Esq. A fine half coiled specimen, showing the whole 11 rings, and the small tail.

Fig. 3. Same locality and collection. Very young coiled specimen.

Fig. 4. Same locality and collection; showing the under side and incurved edge of the tail, with the spines a little more apart.

Fig. 5. Tail of young specimen, from Dudley; collection of T. W. Fletcher, Esq. It has the posterior spines approximate.

Fig. 6. Same locality; collection of J. Gray.

Fig. 7. Eye, magnified.

Fig. 7*. Do., still more highly magnified; the facets are convex; and at *a*, one is in its original condition; the pits on the others are due to wear.

Fig. 8. Two thorax joints of Aymestry specimen (fig. 1); at *a* and *b*, the curious tubercles at the fulcral point are seen; *c*, is the outer spinose portion; *d*, the inner bilobed part; they are separated by a furrow, *f*.

Fig. 9. Specimen from Nash Scar, Presteign, collection of J. E. Davis, Esq. This is an internal cast, and shows the outer tubercle *e*, and the furrow *g*, more strongly than in fig. 8, which has the crust on.

Fig. 10. Under view of cheek from the same specimen (as fig. 9); it has an unusual swelling above the facial suture *a*.

Fig. 11. Perfect hypostome (collection Geol. Surv.), from Dormington Wood, Woolhope; *a*, the lateral ascending processes; *b*, the marginal wings.

Fig. 12. Side view of do.; the incurved triangular plates are shown at *b*, the lateral notch at *c*.

Fig. 13. Under view; *a*, *a*, the "ascending processes," which are attached to the under surface of the glabella at its sides; *b*, *b*, the incurved triangular lateral plates, possibly for the attachment of muscles; *c*, the hollow space under the ascending processes, answering to the lateral notch in fig. 12.

Fig. 14. Outline of the largest hypostome we have seen, from the Lower Silurian limestone of Kildare, Ireland; the letters are the same as in fig. 11.

Fig. 15. Lateral view of the same.

Fig. 16. Var. *β*, *centralis*, from the Wenlock strata of Nelson's Tower Wood, Llandeilo.

Remarks on the Genus.

It seems necessary to contend for the generic name adopted here, because a rigid adherence to priority would compel us to relinquish a name now familiar to naturalists, and bestowed by Beyrich on a group which he had carefully investigated and fully described. Now that Hall has given such excellent figures of *Ceraurus*, we know perfectly well what was meant by the obscure and imperfect plaster cast published by Green under that name. But the original description was scarcely more than sufficient to indicate that it was a trilobite, and consequently it has been referred with doubt to various genera by Bœck, Beyrich, Lovén, Portlock, and Burmeister. A genus so ill constructed and imperfectly described, can have no authority; and it would be unjust to substitute such names for those given by the first real describers. The same rule we think fully justifies us in rejecting *Zethus* of Pander, a name lately revived by Dr. Volborth*; for the genus as constituted by Pander consists of two species, to either of which the meagre and incorrect description will apply; the first of these being, by Dr. Volborth's own admission, a species of *Cheirurus*, the second a *Cybele*. He would restrict the name to the latter; but custom and the opinion of naturalists in general would point in doubtful cases like this to the first as the typical species, and we should then have to apply *Zethus* to all we now call *Cheirurus*; more especially as it was the *Cheirurus* only of which Pander knew the entire body. He describes it as having 16 ribs in thorax and tail together, the segments of the tail being free like those of the thorax; this is untrue for either genus; and he denies any trace of eyes. Of the *Cybele*, a fragment only is figured, and Pander even doubts whether it belongs to the genus, so that he evidently intended the first for his type; and had either his figure or description been intelligible, or had he referred to Sternberg's or Dalman's species as cognate, his name ought to have been retained. But we believe the right of priority of name, rather than that of description, cannot with advantage be so rigidly enforced, and we accept *Cheirurus* as the first intelligible description, as well as the clear definition of a remarkable group. With regard to the affinities of the genus, we have

* Transactions of the Royal Mineralogical Society of Petersburgh (1847.)

come, as above stated, to the conclusion that it must be considered nearly related to *Phacops*. Barrande, in his ingenious and simple arrangement of the groups lately published,* places *Cheirurus* among the series which he defines as having the "plèvre à bourrelet;" and certainly it is most closely allied to some genera, *Spherexochus*, *Cybele*, &c., which possess this character. But an inspection of our plate will show that the characteristic furrow ("sillon") of the pleuræ is only shortened, not absent in this genus. In several Bohemian species it is quite evident, and in the *Cheirurus claviger*, which Corda elevates to the rank of a genus, the furrow continues along the whole length, as it does in most trilobites; and we may state generally, that we believe this character to be merely a special modification, since all pleuræ have the furrow, either bisecting them as in the ordinary form, or so near the anterior edge as only to separate a mere line for the front or fulcral portion.† In *Sphærexochus*, the nearest ally of the genus we are considering, it is not, perhaps, indicated at all. We think, therefore, that the other characters which we regard as of more importance, viz. the structure of the eyes, and the course of the facial suture, will connect *Cheirurus* with *Phacops*. But with respect to the limits of the genus, we are strongly inclined to think *Sphærexochus* ought not to be separated from it, since such species as *Ch. clavifrons* of Dalman, and *Ch. globosus* of Barrande seem exactly intermediate, having the head of *Sphærexochus* and the tail of *Cheirurus*. However, if we allow the striking character of the thorax rings to guide us, we shall find it agree with the habit in marking out three distinct genera already recognized, viz.—

Eccoptochile. Corda. Cheeks scrobiculate; pleuræ 12, furrowed; hypostome with lateral furrows:

Cheirurus. Beyrich. Cheeks scrobiculate; pleuræ 11, nodulated; hypostome with lateral furrows:

Sphærexochus. Beyrich. Cheeks not scrobiculate; pleuræ 11, simple, rounded; hypostome without lateral furrows:

And the species which have globose glabella, but still have the 11 nodular pleuræ, will remain in *Cheirurus*, not in *Sphærexochus*, just as we find this variation in the glabella of *Phacops*, while the characters of the thorax remain the same.

The genus is Silurian and Devonian; it does not rise into the Mountain Limestone.

Other British species of Cheirurus.

Section Crotalocephalus.

Glabella furrows continuous across, all strong and distinct.

1. *C. articulatus?* [*Calym. articulata*, Münst. Beitr. Heft, 3. pl. 5. fig. 7?] *Ch. Sternbergii* (Münst), Phillips, Pal. Foss., fig. 247.

I do not venture to characterize this species from the imperfect fragments we possess. The glabella is long, narrow, and scarcely clavate forwards, and not very convex. The upper and middle glabella furrows are very strong, and go right across, and the basal lobes are narrow, triangular, transverse, and they nearly meet in the middle of the glabella, leaving but a small space between.

The latter character I suspect to have been much exaggerated by Münster, in the figure above quoted, who has represented the basal lobes as forming one transverse piece. Our rare British fossil is certainly more like this figure than the *C. Sternbergii* of the same author, in which the furrows are partially obliterated in the middle, and the glabella is broader.

Locality.—Barton, S. Devon (Phillips); Newton Bushell, in Devonian limestone. Presented by R. A. C. Austen, Esq.

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* Système Silurien de la Bohême, 1853. Also Ann. and Mag. Nat. History, Sept. 1850.

† This narrow line may certainly be seen in *Acidaspis* and *Cybele*; in *Bronteus* it seems to have completely vanished.

SECTION CHEIRURUS proper.

Glabella with the furrows all distinct, but not meeting across.

2. *Ch. speciosus.* Dalm. sp.—above described.

3. *Ch. gelasinosus,* Portlock. *Amphion gelas.* id. Geol. Rep., t. 3. fig. 4. (head); and *Arges planospinosus,* pl. 5. fig. 9. (tail). *Cheirurus,* BEYRICH (1845), Böhm. Tril., 1. p. 19. Salter (1851), Quart. Geol. Journ., vol. vii. pl. 8. fig. 1. *Cheirurus planispinosus,* Bronn. Ind. Pal. (1848).

Ch. depressus, capite transverso, glabellâ rectangulari sulcis brevibus transversis, lobo frontali brevi, basalibus oblongis transversis vix circumscriptis, uno ab altero spatio æquali sejuncto; genis latis, marginibus depressis, spinis brevibus; caudâ (hic haud dubie refertâ) latâ, segmentis utrinque tribus latis, ad basin longe adnatis, acuminatis; primo in appendicem longam producto secundum longe excedente, hoc tertium brevem superante; axi 4*-annulato, articulo ultimo minimo angusto, nec apicem caudæ profundè emarginatum attingente.*

The upper lobe of the glabella is not at all broader—sometimes it is narrower—than the rest; and in the furrow beside it there is a very deep indentation. On the under side of the crust this would be a strong ridge, to which, as Barrande has shown, the processes of the hypostome are attached. The transverse form of the head, especially the wide cheeks, easily distinguish this from any other species. The surface of the glabella is smooth, or nearly so.

There can be little doubt that, as Beyrich has suggested, the head and tail belong to one animal. They are alike broad and depressed, and agree in size, while no other species of the genus occurs with them.

Locality.—Co. Tyrone, head and tail; limestone of Ayrshire, head only. [Presented by Mr. C. Moore.]

4. *Ch. cancrurus.* sp. n.—*Ch. satis magnus, caudâ lineas* 20 *latâ transversâ, apice abruptè truncato præmorso; axi lato, annulis quatuor subæqualibus, tertio â quarto punctis binis remotis solum separato; lateribus spinis quatuor longis sub-parallelis, ad basin adnatis, transversis, apicibus lente decurvatis; basalibus utriusque lateris longo intervallo remotis.*

A most remarkable species, in which the four lateral lobes of the tail start horizontally from the broad axis, instead of gradually converging beneath it, and leave its apex bare; the breadth of this space being increased by the outward direction of the spines themselves, which begin to curve downwards only when when they have attained half their length. The appearance of the perfect tail is just like that of a crab; *præmorsus* might have been an appropriate specific name. *C. obtusatus,* a Bohemian species, somewhat resembles this, but the spines are radiating, not parallel.

There is a rare cephalic shield in the Chair of Kildare limestone, which may very probably belong to this species; it is as unusual in its character as the tail we have described. It is the *Ch. gelasinosus* of M'Coy's Synopsis Sil. Foss. Ireland, 44. The cheeks are scrobiculate, and the eyes forward, the glabella smooth, clavate, long, and narrow; the neck furrow trends upwards towards the middle on each side; the basal furrows curve downward, but do not meet the neck furrow, or quite circumscribe the subtriangular basal lobes; the middle furrows are strong and transverse, the upper pair apparently obsolete (probably some faint traces of them may be found.) But there is enough to distinguish the species as a very curious one, and provisionally I refer it to the *C. cancrurus,* with which it agrees well in size.

Locality.—Limestone of the Chair of Kildare in Ireland. [tail in Survey coll.; supposed head in the cabinet of Mr. R. Griffith.]

5. *C. octolobatus.* M'Coy's Synopsis Pal. Foss. Woodw. Mus., t. 1 G. f. 10. [Mem. Geol. Surv., vol. ii. pt. 1. pl. 7. fig. 36, without name.]

C. pygidio transverso elliptico semiunciali, bis quam longo latiori, margine octolobato; axi depresso, annulis tribus, duobus superioribus subæqualibus, tertio lato a limbo terminali punctis

binis solum distincto, lateribus planis, lobis anticis curvatis et distinctis, reliquis ad basin connatis, apicibus ovatis.

Locality.—Bala limestone; Bala, frequent; Hendre wen, Cerrig-y-druidion, Denbighshire.

SECTION ACTINOPELTIS. Corda.

Glabella inflated, the upper lobes indistinct.

6. *Ch. clavifrons*, Dalm. sp.? [*Calymene*, Dalman, Palæad. 59. not of Hisinger. Lovén Ofv. Kongl. Vetensk. Akad. (1844), 63, 64?] *Sphærexochus juvenis*, Salter (June 1848), Mem. G. Surv. vol. ii. pt. 1. pl. 7. fig. 1–3 (exclude 3 *b*). *S. clavifrons*, ib. Errata, p. viii. *Cheirurus clavifrons*, in Appendix, Pal. Foss. Woodw. Mus., t. 1 F. fig. 11, and 1 G. fig. 9. *Ceraurus*, M'Coy, ib. 154 (1851.)

C. capite sesquiunciali semi-elliptico, in juveni rotundiore, convexissimo; glabellâ maximâ ovali gibbâ, genis latiore, granulosâ; sulcis duobus anticis brevibus obscuris, basali profundo fere ad cervicalem decurvato lobumque subovatum ambiente; genis declivibus scrobiculatis brevi-spinosis; caudâ axi longo, 4-annulato, articulo ultimo rotundo, lateribus utrinque trispinosis, spinis valde inæqualibus vix basi connatis, primo ad basin lato, brevisulcato, secundum longe superante, hôc integro angusto tertium brevem sæpe obsoletum multo excedente; spinis omnibus retrorsis subparallelis.

The glabella, when perfect, shows small regular granules or tubercles widely scattered all over it. The punctations too on the cheeks are rather small, and scattered. The terminal spines of the tail in some specimens are very short and obtuse, and the whole tail is in some shorter and broader than in others, even from the same locality, and the spines consequently more divergent at their bases.

There are some points of difference between our fossil and that which Lovén has carefully described from Dalman's original specimen and we may have again to recur to the name *juvenis* as above quoted. The Swedish species is described as having long straight head spines, the glabella nearly as wide as the cheeks. Ours, now that we have more perfect specimens of the head and caudal shield from Ireland, shows short head spines, and the inflated glabella is certainly wider than the cheeks. In all other respects Lovén's description applies well. By the description also of the tail of the *C. ornatus*, Dalm., given by the same author with the above, it would appear that this species had a caudal shield precisely similar to that of ours.

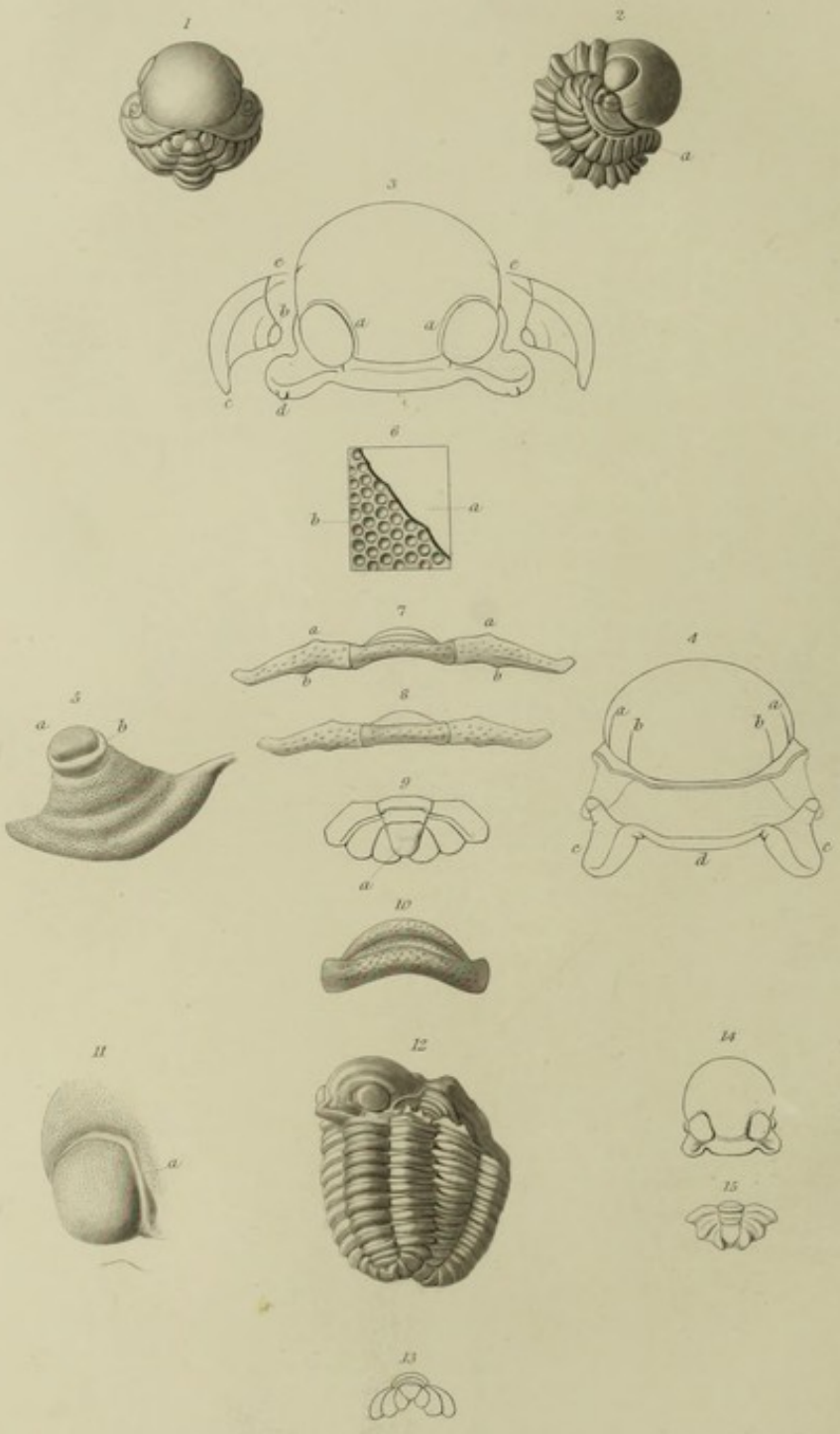
Localities.—Llandeilo and Bala rocks; in South Wales, Sholes Hook, Haverfordwest. In North Wales, Bala, abundant; Cader Dinmael, Denbighshire; near Llanfyllin, Montgomeryshire—in Upper Bala beds; in Westmoreland, Applethwaite Common; in Ireland, Chair of Kildare,—frequent, and of large size.

J. W. SALTER.

August, 1853.

Geological Survey of the United Kingdom.

SPHÆREXOCHUS
(Silurian.)



SPHÆREXOCHUS MIRUS. *Beyrich.*

C.R. Bone del.

E. Forbes dirext.

J.W. Lowry lt.

BRITISH FOSSILS.

DECADE VII. PLATE III.

SPHÆREXOCHUS MIRUS.

[Genus SPHÆREXOCHUS. BEYRICH. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palædæ.) Eyes facetted? "Head very convex, the cheeks not scrobiculate; facial suture ending on the external margin near the angles, in front continuous and submarginal; glabella large and nearly spherical, with three furrows on each side, the two upper very obscure, the lower strong and curved down to the neck furrow; thorax of 11 joints, without any furrows; tail of 3 segments, free at their ends;" hypostome subtrigonal, with a marginal furrow, but without lateral furrows. No rostral shield.]

DIAGNOSIS. *S. granulosus; "glabellâ lobis infimis profunde circumcinctis, paullum tumidis,—spatio interjecto diametrum eorum superante; caudâ pleuris tumidis."*

SYNONYMS. *Calymene clavifrons*, HISINGER (1840), Leth. Suec., Supp. 2d. t. 37. fig. 1 (not of Dalman.) *Sphærexochus mirus*, BEYRICH (1845), über einige Böhm. Tril., p. 21. *S. mirus*, ibid., Zweite Stück (1846), t. 1. fig. 8. *S. calvus*, M'COY (1846), Syn. Sil. Foss. Ireland, pl. 4. fig. 10. *S. mirus*, CORDA (1847), Prodrom. einer Monog. Böhm. Tril., fig. 72. BARRANDE (1853), Syst. Sil. de Bohême, vol. i. pl. 42. fig. 11–18.

We are indebted to Mr. John Gray for the fine Dudley specimens which figure in this plate, and to Mr. Fletcher for those from which the details are drawn. Fragments and detached heads are not uncommon; but these are the only perfect British specimens we are acquainted with. The species is cosmopolitan, at least it ranges from Bohemia to the Western States of America, and in our own country is found both in Upper and Lower Silurian rocks.

Description.—The animal is capable of rolling itself into a complete ball, of which the large head forms a very conspicuous part. The general form is oblong; the length of English specimens usually about an inch and a half, and the breadth ten lines; they never appear to reach the length of two inches.

The head is more than one third the whole length, and the glabella is very large, occupying, as seen from above, four fifths of the width,

and quite overhanging the narrow front margin. It is, excluding the neck segment, nearly a true hemisphere, and has a pair of large orbicular lobes at the base, deeply circumscribed, and further apart from each other than their own diameter. The furrow that bounds each of these lobes is broad, sharp, and equal in depth all round, leaving no communication with the body of the glabella (fig. 3, *a*, 11 *a*). Above these lobes on each side are two faint impressed lines which represent the upper furrows (in fig. 4); of these (*a*) the one next to the round basal lobe is placed at a less distance from it than the diameter of that lobe, at about the point of the head's greatest width, and the upper one (*b*) at an equal distance in advance of it towards the front. The cheeks are small in comparison with the glabella, and hang vertically from its sides (fig. 4, *cc*), like a pair of lappets from a cap or helmet; they are oblong and have a thickened margin. The small convex eye is placed very near the glabella, and below the middle of the head; the facial suture runs from it outwards, and reaches the exterior margin which it cuts obliquely a little in front of the posterior angle, as at fig. 3, *c*; in front of the eye it continues parallel to the glabella, and runs along the edge of the narrow front margin, leaving the free cheeks connected beneath by a narrow band (fig. 4, *d*). Each free cheek is hatchet-shaped, and the small eye (fig. 5, *a*) occupies the inner corner, supported on a fold of the crust, *b*, which truncates, or even indents it below. The eye is thus pushed up into a supine position; it is short, oblong, and very convex. The lenses are numerous, larger in size than the granulations of the general surface, and placed near together, less than half their diameter apart. In this specimen we have not the outer surface sufficiently perfect to enable us to say whether the cornea is raised into facets (as Barrande thinks) or not; the surface is therefore left blank (fig. 6, *a*); from the inferior surface, *b*, the lenses have fallen out, leaving pits which indicate their size. The posterior corners of the head are rounded off and contracted to a less width than the free cheeks, and they bear instead of a spine, only a small tubercle (fig. 3, *d*), which is placed far inwards.

The hypostome has not yet been found in England, but it is figured in M. de Barrande's* plates. It is subtrigonal, straight at the base, where it is much broader than it is long, and the apex is

* If this figure be as complete as M. de Barrande's figures usually are, there is no lateral notch nor any visible ascending processes. M. Corda's figure, however, exhibits a narrow rim at the base, with a small lateral process on each side. The notch would then exist between the lateral border or wing (flügel), and these small processes and the resemblance to *Cheirurus*, in other respects so closely allied, would be more complete.

rounded and slightly emarginate. A broad shallow furrow runs round the end and sides, leaving only a small central convexity of the same shape as the hypostome; this convexity is not indented by any lateral furrows.

The surface of the head is covered by a fine close granulation (fig. 11), which occupies also the free cheeks or wings (fig. 5); it is therefore one of the generic distinctions from *Cheirurus*, in which the cheeks are always pitted or scrobiculate.

Thorax parallel sided, scarcely tapering backwards, of 11 thick rounded rings; the axis as wide as the sides, and of equal breadth throughout, very convex; each joint much raised and rounded (see fig. 10). Pleuræ horizontal as far as the fulcrum (fig. 7, *a*), and then abruptly deflexed, and from this point the pleura tapers outwards to a conical blunt point, which at the extreme tip is a little bent forwards. The fulcrum is placed at rather less than half-way from the axis, but in the last segment (fig. 8) it approaches much nearer,—to about one third. Its place is indicated by a protuberance both on the forward and hinder edge of each segment (fig. 7, *a* and *b*), but these swellings are not isolated tubercles as in *Cheirurus*, nor are there any oblique or longitudinal furrows on the pleuræ, as in that genus, to break up the uniform convex surface of the segment.

Tail about semicircular, truncate; the axis conical, its base of two depressed close-set rings, its apex of one long triangular joint, which is separated from the second joint by a deep depression; from thence it is flattened, or even depressed for some distance, but suddenly rises to an obtuse and elevated tip (fig. 9, *a*); which, seen sideways, presents the appearance represented in fig. 2, where *a* is the obtuse tip of the axis. The sides are composed of three obtuse convex lobes which scarcely project on the margin; the upper one follows the bend of the hindermost pleura, the second is less curved, the third parallel to the axis; all are deflected so that an end view of the tail (fig. 13) presents an angular figure.

The entire surface of the thorax (fig. 10) and tail, like that of the head, is covered with a fine granulation, the grains of equal size throughout.

Variations. — Our Dudley specimens have the tail somewhat shorter and wider, and the terminal joint of the axis therefore shorter, than those from Bohemia. Irish specimens (figs. 14, 15) are more like the foreign ones in this respect. The space between the lower glabella lobes is least in these Irish specimens, though some of them have it considerably wider than the diameter of the lobes; in a Wexford specimen, the space is proportionally as wide

as in those from Dudley, which often have the lobes as far apart as in Bohemian examples.

Affinities.—But one species, and of that only a caudal shield, has been described, which at all closely resembles this,—we allude to a species published without name by Dr. Beyrich, from Gottland, in his second paper (1846, pl. 1. fig. 9); it has the side lobes of the tail lengthened out into spines of some length. The terminal joint of the axis too is shorter. There is a second species in Britain, found at Haverfordwest, to which if it were perfect enough, a new name might be applied. It differs from *S. mirus* in this respect, that the large basal lobes of the glabella are more really tumid, especially outwards, less than their diameter apart, and connected with the body of the glabella by a narrow depressed neck on the inner side, the boundary furrow not completely circumscribing the lobe as in our species. But only a fragment of the head has yet been found, and I may say, that it is singularly like a fragment apparently of this genus lately discovered by Captain Strachey in the Silurian rocks of Tibet. There is a species figured by Sars in Oken's Isis, 1835, tab. 9. fig. 8, as the *Cal. clavifrons* of Dalman, which has a nearly globose glabella with the basal lobes very small; but it is probably a *Cheirurus*, and would, we think, be found to possess punctured cheeks.

History.—That Hisinger's figure of *Calym. clavifrons* does not represent the species so described by Dalman, though very probably, as Beyrich suggests, it may have been associated under the same name in his collection, has been shown by every author who has since written on the subject; and the great similarity between it and the species we are describing must be evident to all. Dr. Beyrich supposes it may be the head of the other species we have mentioned above from Gottland; but, as Hisinger's specimen came from Furudal in Dalecarlia, this is not certain, and we think we cannot be wrong in referring it to the present cosmopolitan species, of which it is a very good representation. Dr. Beyrich, when he formed the genus in 1845, had only the head and caudal shield, but these were sufficient to show him the generic distinctions, which we think are now confirmed by characters drawn from the hypostome and thorax rings, since figured by M. Corda and Barrande.

Professor M'Coy next described the head from Irish specimens, considering it a distinct species from the Bohemian one, but identical with that of Hisinger. His description is very clear, but having found among the Irish specimens considerable variation in the point he marks out as distinctive, viz., the breadth between the lower

lobes of the glabella, we have here ventured to unite them ;—the species agrees in all other essential characters. M. Corda in his Prodromus, 1847, next figured an outline of the entire animal and its hypostome, and Barrande's accurate figures complete the illustrations of this trilobite.

British Localities and Geological Range.—LLANDEILO FLAGS to WENLOCK LIMESTONE. In Lower Silurian, Chair of Kildare, county of Kildare, Ireland; and in beds of the same age, Carrickadaggan, county of Wexford. In Wenlock strata, Dudley Castle Hill; Trindle near Dudley; Walsall (Survey Coll.)

Foreign Distribution.—In Bohemia; Komorau, Hills of Listice, Kolednik, &c., in Etage E, Upper Silurian, and also in one of the "*colonies*" in the Lower Silurian, Etage D, (BARRANDE). In Sweden, Furudal, Dalecarlia; in Lower Silurian (HISINGER). In North America, Springfield, Ohio, Upper Silurian. (De Verneuil and Sir C. Lyell.)

EXPLANATION OF PLATE III.

Fig. 1. Coiled specimen from Dudley; Mr. John Gray's collection.

Fig. 2. The same specimen viewed sideways; *a*, the terminal boss of the axis of the tail.

Fig. 3. The head, dissected; *a*, *a*, the strong basal glabella furrows; *b*, the small eye; *c*, termination of the facial suture in front of the posterior rounded angles; *d*, the rudimentary cheek spine; *e*, *e*, connecting portions of the free cheeks.

Fig. 4. Front view of ditto; *a*, is the middle glabella furrow; *b*, the anterior one; *c*, *c*, the free cheeks; *d*, the connecting portion, here separated from the glabella along the line of the facial suture; the dotted lines at *b* indicate the natural position in this view of the fixed cheeks, which are much bent down.

Fig. 5. Free cheek, with the supine eye (*a*) actached; *b*, the fold of the crust which supports the eye, the "*palpebra inferior*" of some authors; the surface of the cheek granulated equally all over.

Fig. 6. Magnified portion of the eye; *a*, upper surface, obscure in these specimens, but probably facetted; *b*, lower suface, the lenses fallen out.

(Figs. 3 to 6 also from Mr. Gray's collection.)

Fig. 7. Third or fourth thorax ring; at *a*, the fulcrum, and *b*, the prominence against which the fulcrum of the succeeding segment abuts.

Fig. 8. Last thorax segment, the fulcrum near the axis. In this and the preceding figure the pleuræ are represented as flattened out to show their characters; they would appear much shorter on viewing them from above.

Fig. 9. Tail; at *a* the prominent tip of the axis is shown.

Fig. 10. Part of thorax joint; *a*, the axis magnified.

Fig. 11. Basal lobes of the glabella, magnified to show the fine granulation that covers the whole head; *a*, the deep circumscribing furrow.

(Figs. 7 to 11 are taken from Mr. Fletcher's specimens, Dudley.)

Fig. 12. A group from Dudley, Mr. J. Gray's collection.

Fig. 13. End view of the tail.

Fig. 14. Head, from the limestone of Kildare; it is a little elongated by pressure. Other specimens show a rounder form. [Survey collections.]

Fig. 15. Tail, more elongated than in the Dudley specimens, also from Kildare.

Remarks on the Genus.

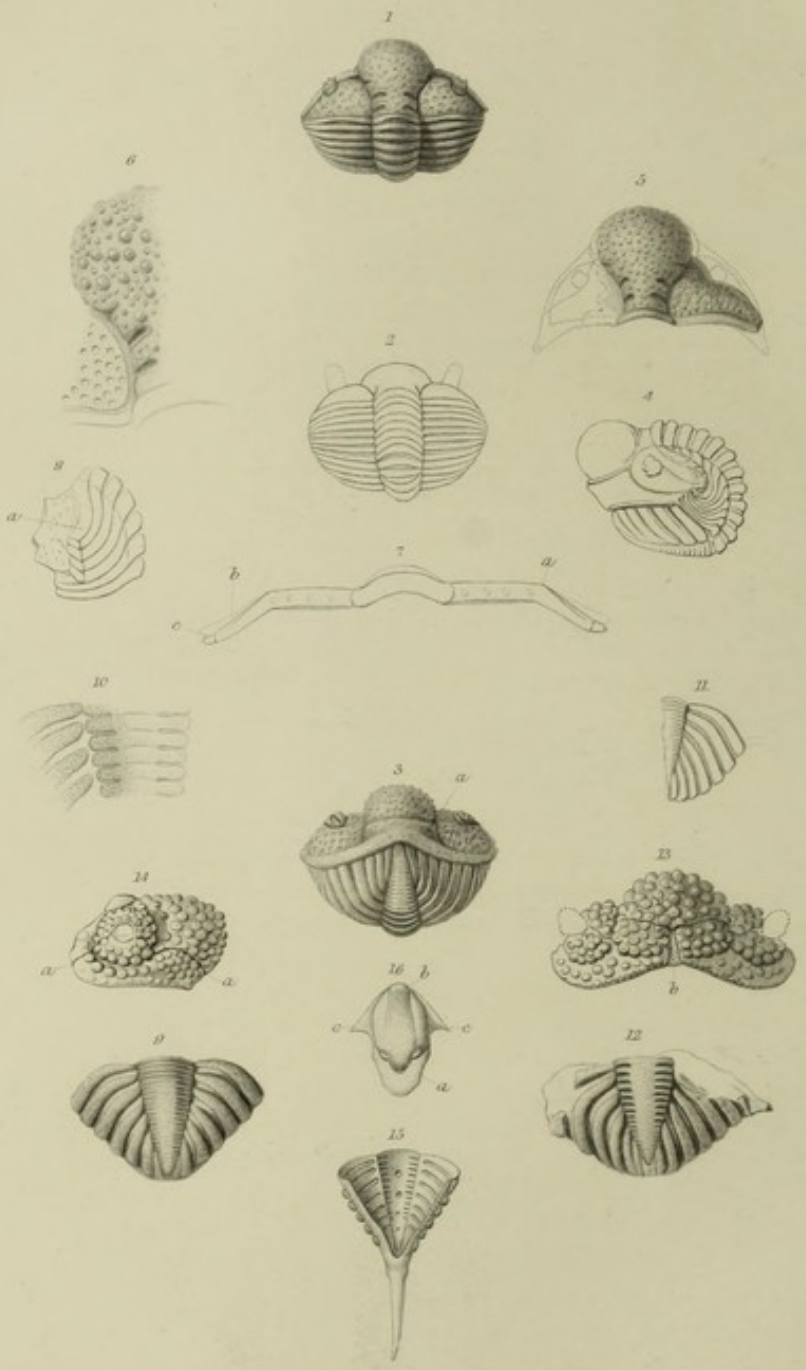
When originally described by Beyrich, in 1845, he naturally included in this genus the species of *Cheirurus* with an inflated glabella, in which the anterior furrows are nearly obsolete, such as *C. sphæricus* of Esmark (which Sars described and figured as the *C. clavifrons*, Dalm.), and the true *C. clavifrons*, of which Lovén has since given so excellent a description. But the latter species has the nodular and furrowed thorax rings, spinose cheeks, and the long spined tail, characteristic of *Cheirurus*, so much so, that Dr. Beyrich asserts that portions of separate trilobites must have been combined in the description. We have, however, in England, as above described under Plate 2, the same or a very closely allied species, showing these characters, which we formerly described as *Sphærexochus*, but now consider a true *Cheirurus*. The *Cheirurus globosus* of Barrande, and the *C.* (*Actinopeltis*) *Caroli Alexandri* of Corda, are examples of this section, to which for convenience sake, the sub-generic term *Actinopeltis* might be applied. [See *Cheirurus*, ante.]

J. W. Salter.

August, 1853.

Geological Survey of the United Kingdom.

ENCRINURUS
(Silurian)



Figs. 1. 11. ENCRINURUS *(Emmerich)* SEX-COSTATUS — *Salter.*

Figs. 12. 13. E. VARIOLARIS — *Bronguiart.*

Figs. 14. 16. E. PUNCTATUS — *Brunnich.*

BRITISH FOSSILS.

DECADE VII. PLATE IV.

ENCRINURUS SEXCOSTATUS. Figs. 1 to 11.

[Genus ENCRINURUS. EMMRICH. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Glabella inflated, clavate, with 3 indistinct lateral lobes, and a large forehead lobe; eyes pedunculate, smooth (finely facetted, Kutörga); the facial suture posteriorly ends in advance of the head angles, and in front runs above the margin; the cheeks are separated in front by a vertical suture, enclosing a narrow vertical rostral shield; thorax segments 11, equal, without pleural grooves, notched at the ends, but not produced into spines; tail with the ends of the pleuræ free, the axis many ringed. Ενκρινος a lily-shaped animal; ουρα a tail, in allusion to the resemblance between the many-jointed axis of the tail and the stems of the Crinoidea.]

DIAGNOSIS. *E. latus; glabellâ anticè subsphericâ et ad marginem frontalem fasciâ latâ crassâ circumcinctâ; genis scrobiculatis, angulis spinosis; caudâ trigonâ, obtusâ, axi annulis crebris, per medium (nonnullis anticis exceptis) obliteratis; pleuris* 6, *rarius* 7, *subplanis.*

SYNONYMS. *Cybele sexcostata*, SALTER (June 1848), Memoirs Geol. Surv., vol. ii. pt. 1. pl. 8. fig. 10 (not fig. 9). *Zethus sexcostatus*, M'COY (1851), Synops. Pal. Foss. Woodw. Mus., fasc. 1. 156. *Encrinurus sexcostatus*, SALTER (1852), ib. Appendix A. vol. iv. pl. 1 *g*, fig. 6, 7.

We are induced to figure this trilobite, although it is not quite perfect in all its parts, because it completes the illustration of the same species formerly given in the second volume of the Memoirs, where the tail only was figured; and it is the more desirable to present it in illustration of the genus, as the two species which are best known, the *E. punctatus*, and *variolaris*, are chiefly Upper Silurian, and have been fully illustrated lately in the "Geological Journal."

In the general appearance, in the structure of the remarkable elevated eyes and of the hypostome, the coarse tuberculation of the head,—the many-jointed axis of the tail, and its few lateral ribs, there is the greatest similarity to *Cybele*,* with which genus

* *Zethus* of Pander and Volborth, a name which we cannot adopt, because Pander's ill-defined genus was chiefly founded on a *Cheirurus*.

we have hitherto considered it identical, although there are 12 body rings to the latter, and only 11 in *Encrinurus*. But the delineations of the facial suture given by Drs. Volborth and Kutörga in the Transactions of the Royal Mineralogical Society of St. Petersburgh, 1848, show that in this important particular, as well as in the number of body rings, the two genera differ; and when to this is added that the hinder segments of the thorax are not in *Encrinurus* produced into long spines but are all equal, we have a combination of characters sufficient to justify the separation. But there are species of *Cybele* whose habit is so like that of *Encrinurus*, that should a species hereafter be found with the facial suture of one of these groups, and the number of body rings distinctive of the other, we should recommend their reunion as sections of one natural genus.

Description.—Length about an inch and a half, breadth an inch. Some specimens must have been larger. General form broad-ovate; the head and tail convex, the body rather flat. Head about equal in length to the tail, but shorter than the thorax; its shape triangular, the lateral angles produced, the front rounded, gibbous, and overhanging. The glabella occupies full one third of the width of the head in front, where it is much inflated and more than hemispherical; it overhangs the margin, which, as is usual in the genus, is not distinctly separated from it in front, but within the margin and above it on the glabella, there is a strong furrow which runs quite across the glabella, separating from it a thick prominent ridge (fig. 3, *a*) so completely that it appears not to form a part of the glabella, but to belong to the thickened front margin.* The entire glabella is pyriform, constricted behind to half its width, and separated by a strong sulcus from the neck segment, which is broad and prominent. It is indented half-way up by three short furrows on each side. The cheeks, though convex, are much less so than the glabella, and they bear the eye in the middle of the cheek. In our specimen the eyes are broken off, but in all probability they were elongated, and directed forwards and outwards, as we have indicated by the dotted lines in our fig. 2. The outer margin of the cheek is thick, and separated by a furrow, and the posterior angles are produced into spines; the posterier edge also has the strong neck furrow continued along it. The glabella is covered with tubercles of unequal size, mixed with granules, but the specimen

* This singular furrow is probably the place of the facial suture, which in this genus crosses the front of the glabella. This suture is not visible in our specimens; but its course in front is well seen in *E. variolaris*, figs. 13 and 14, *a a*.

does not show whether these tubercles have each a pit on their summit; it is probable they are so constructed, like those of the other species in the genus. The raised fascia, too, in front, has so worn a surface that tubercles are not visible, if they ever existed. The cheeks, instead of being tuberculate, are pitted like those of *Cheirurus* or *Amphion*, and the raised interstices are covered with fine granules. The margins appear smooth, or only finely granular. We have no specimens of the hypostome, or indeed any part of the under surface of the animal.

The thorax consists of 11 segments; the axis moderately convex, of nearly equal breadth throughout, and considerably narrower than the pleuræ. These are quite horizontal as far as the fulcrum, which is placed more than half-way from the axis; and from this point they curve backward and downward to the tip, which is again a little bent forward, so that the line from the fulcrum outwards is a sigmoid curve; the hinder pleuræ curve less backward. Each pleura is nearly semicylindrical, with three or four tubercles along it, and there is little or no space anteriorly for the narrow flat rim which exists in the species of *Cybele*, and which we have called sometimes the fulcral portion.* We have not the extreme ends preserved; but from what has been observed in *E. punctatus* and *E. variolaris*, there is little doubt it was terminated by a bilobed tip, such as we have indicated by dots in fig. 7; the notch *c* being in front of the blunt outer tip, and indenting the end of the facet *b*. This facetted or flattened portion, which passes beneath the preceding ring in rolling, is shown in fig. 8, *a*.

Tail of a triangular form, wider by one third than the length, with an obtuse rounded apex, and flattened above, the sides and the tip deflected, so that the tail is moderately convex; the axis at the upper part is about one fourth the width of the tail, and tapers to a point at some little distance within the blunt apex; it is convex at its broadest end, and there the rings are continuous across, but from about the upper third it becomes flatter, and the rings are effaced along the middle; its apex is quite flat. There are about 20 rings in all, and no tubercles down the smooth central portion. The sides of the tail have six strong ribs, which are broad and somewhat flattened, divided from each other by narrow deep furrows, and have the tips squarish and obtuse. The ends of the

* In this genus, as in *Amphion*, *Acidaspis*, and some others, the pleura is not divided by a groove along its middle as it is in *Calymene*; the division into two parts, an anterior or fulcral portion and a posterior portion, exists, but the latter occupies nearly all the outer surface of the pleura.

four upper ones are free (or rather much overhanging the margin); the remaining two are distinct nearly as far as to the margin, but they there become fused with those from the opposite side, and extend in a very blunt point beyond the tip of the axis. The uppermost ribs arch strongly outwards, the next less so, and the last pair lie parallel to the axis.

On the internal cast, the furrows, especially those which bound the axal lobe, are all stronger and deeper, but there is no other difference. Externally the whole surface of the tail is covered with a close scabrosity (see fig. 10).

Variations.—In the cast from Sholes Hook (fig. 12) the rings on the axis of the tail are effaced down the middle for a broader space, and there are but few of the upper rings continuous across. Our figure in this case does not show the uppermost rings. There are sometimes (fig. 11) seven rings on each side of the tail.

Affinities.—When perfect specimens are obtained, there is no published species with which ours can be confounded. The subglobular shape of the glabella, with its small tubercles, and the pitted, not tubercular cheeks, will easily distinguish imperfect portions of the head from all other British species. The separated tail, especially internal casts of it, may possibly be confounded with the same portion of *E. punctatus*, but the want of a central row of tubercles down the axis, and the arched lateral ribs, will enable observers to distinguish it. The other Lower Silurian British species, *E. multisegmentatus*, Portlock, is diametrically opposed in all its characters; it has a large coarsely tubercular head, and many-ribbed tail. Nor can the detached tail of our species be confounded with that of *Cybele verrucosa*, Dalman, so abundant in company with it, if the four tuberculate lateral ribs of that species be attended to. Ours has six or seven smooth ones.

History.—We first described this in 1848, in the work above referred to, under the name *Cybele sexcostata*. In those figures there was associated with the tail, but only provisionally, a coarsely tubercular head, which occurred so frequently in company with it, that the two might reasonably be supposed to belong to each other. The figure we now give justifies the caution there expressed, for it is the "more clavate form of head rarely occurring," which properly belongs to the species; the head figured in company being, we are now all but certain, that of the *C.* (*Calym.*) *verrucosa*, Dalman, a species which we hope hereafter to illustrate as the British type of the genus *Cybele*, Lovén.

It had been previously described in manuscript for Professor Sedg-

wick's intended memoir on the fossils of Westmoreland and Wales; and a short description of it will be found in the Appendix to the second fasciculus of his large work on the "British Palæozoic rocks;" it is also described by Professor M'Coy, in the first fasciculus, as *Zethus sexcostatus*.

British Localities and Geological Range.—LLANDEILO FLAGS. Rhiwlas and Llwyn-y-ci, north-west of Bala Lake; and Llechwedd Ddu, east of the lake, North Wales; in the former locality very abundant; Sholes Hook and Pelcombe Cross, Haverfordwest. Not yet found in Ireland.

EXPLANATION OF PLATE IV.

Fig. 1. Coiled specimen; from Rhiwlas.
Fig. 2. Do.; back view, to show the 11 thorax segments.
Fig. 3. Do.; showing the raised fascia *a*.
Fig. 4. Do.; side view.
Fig. 5. Imperfect head; the dotted lines are added from other specimens; the cheeks show the pitted surface.
Fig. 6. Magnified portion of head.
Fig. 7. A thorax segment enlarged; at *a*, the fulcral point; *b*, the facetted surface, and *c*, the blunt indented tip, as usual in the genus; they are added in dotted lines as the specimens are not perfect enough to show them.
Fig. 8. Side view of the pleuræ in the coiled state; at *a*, one of the facetted surfaces is seen by the breaking away of the other segments.
Fig. 9. Tail of a Rhiwlas specimen.
Fig. 10. Part of the same, magnified, to show the scabrous surface.
Fig. 11. Variety of tail with 7 side ribs. Rhiwlas.
Fig. 12. Internal cast of variety with the central part of the axis more free from ribs. Sholes Hook.
Fig. 13. Front view of the head, slightly enlarged, of *E. variolaris*, to show the course of the facial suture in front of the head, and the vertical suture *b*, which divides the cheeks, filled at its lower end by a narrow triangular rostral shield. Wenlock limestone of Dormington, Woolhope.
Fig. 14. The same, a side view; *a a*, facial suture.
Fig. 15. Under view, somewhat enlarged, of the tail of *E. punctatus*,* to show the incurved scabrous margin which unites the lateral ribs of the tail; their free points are seen projecting beyond it. Walsall, near Dudley.
Fig. 16. Hypostome of do., enlarged; *a*, sinuated margin; *b*, cucullate base; *c*, the points of the extended base of attachment. Walsall.

The above figures are all from specimens in the collections of the Geol. Survey. The last four figures are enlarged to once and a half their natural size.

Notes on the other British species of the Genus.

If the strict rule of priority were observed, irrespective of clear definition, we should be compelled to adopt the name *Cryptonymus* for this genus, as that of *Zethus* for *Cybele*. Dr. Kutörga, indeed, in the journal above quoted (1848), advocates this course, and has

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* See description at the end.

restored the name *Cryptonymus*, under which Eichwald at first described several varieties of the common *Asaphi* of the Russian Silurian Rocks. Subsequently, aware of his error, he restricted *Cryptonymus* to such trilobites as the *Calym. variolaris*, Brong., including the *C. punctatus*, and some forms of Cybele. But, though thus marking out the group he intended, he gave no description of the amended genus; besides which he was now applying the name to a totally different set of fossils to those for which it was originally intended. Under such circumstances it is impossible to retain his name in opposition to the genus clearly indicated, though not sufficiently described, in Emmerich's scientific arrangement, 1845. The latter name has been adopted, and the typical species fully characterized by Professor M'Coy (Synopsis Sil. Foss. Irel., 1846). The genus *Encrinurus* has a nearly universal range, being found in Silurian rocks from Russia to North America, and from the Arctic regions to Australia; and it has rather an extensive geological distribution, being found in Lower and Upper Silurian, and in the Devonian strata of Germany. *Cromus*, Barrande, a Bohemian fossil, is probably of the same genus; it has, however, four lateral lobes to the glabella, instead of three.

2. E. PUNCTATUS. Brünn. sp. Pl. 4. f. 14–16.

Syn. *Entomolithus paradoxus*, Linnæus, 1759, Act. Reg. Acad. Sc., Holm., p. 22. t. 1. f. 2. *Tril. punct.*, Brünn., Kjobenh, Sellsk. Skrivt. nye Samml. 1. 394. *Entomostrac. punct.*, Wahl. (1821), Act. Soc. Sc. Ups. v. viii. 32. t. 2. f. 1.—tail only. *Calym. variolaris*, Brongn., Crust. Foss., t. 1. f. 3 A. (not B.) *Cal. punctata*, Dalm. Pal. 47. t. 2. f. *a*, *b*. Murch. Sil. Syst. (1839), pl. 23. f. 8. *Phacops variolaris*, Emmrich. Diss. (1839), 20. *Asaph. tuberculatus*, Buckl. Bridgw. Tr., pl. 46. f. 6. *Encrinurus punct.*, Emmr. (1845), Neues Jahrb. 42. *Encrinurus Stokesii*, M'Coy (1846), Syn. Sil. Foss. Irel., t. 4. f. 15. Pal. Foss. Woodw. Mus. (1851), p. 158. *E. punctatus*, Corda (1847), Prodr. Tril. Böhm. 91. fig. 55. bona. *Cybele punct.*, Fletcher, Quart. Geol. Jour. (1850), vol. vi. pl. 32. f. 1–5.

E. ovatus, biuncialis; glabellâ clavatâ convexâ sed parum inflatâ tuberculosâ; tuberculis anticis paullo majoribus, in arcu dispositis, sulcis glabellaribus brevibus vix inter tuberculos magnos visis; genis convexis profunde marginatis, tuberculis sub oculo valde elevato angusto collocatis, angulis spinosis; hypostomate basi subcompresso, rostro apiculato; thorace axi pleuris curvatis paullo angustiore, segmento septimo decimoque brevi-spinosis; caudâ longe triangulatâ, lateribus ante apicem nunc planum recurvum, nunc deflexum obtusiorem contractis; costis lateralibus 8 *obliquis, ad apices prominulis; axi nec convexo, annulis crebris per medium omnino obliteratis, tuberculis quinque vel sex in serie longitudinali dispositis.*

Var. α. *Calcareus.—Caudâ in mucronem planum seu recurvum producto.*

Var. β. *Arenaceus.—Caudâ apice deflexo obtusiori.*

The original Swedish species appears certainly to differ in no respect, so far as the tail is concerned, from that common in the Dudley limestone; the tubercles on the lateral ribs, on which so much stress has been laid, being always present, either at the origin of the rib or on its surface. And the species is pretty well represented by M. Corda from Swedish specimens. The thorax rings we have not seen from Sweden, but they are tuberculate as ours are, according to the figure above quoted.

The variety we have called *arenaceus* appears to differ only in the abrupt ending of the tail, which, instead of being horizontal and drawn out into a mucro of variable length, as in the limestone specimens from Dudley and elsewhere, is deflexed and blunt. But the specimens from the Caradoc and Llandeilo sandstones agree so well in all other particulars, the tubercles collected round the eye, the number of ribs and tubercles on the tail, &c. &c., that it cannot be separated as more than a variety. Its name indicates its usual habitats, and the deficient development of the tail may be connected with the deficient supply of calcareous matter. Upper Caradoc specimens are almost always smaller; occasionally, as at Bogmine, in Shropshire, they are of full size. Some Ludlow specimens have the glabella narrower, and but four tubercles down the axis of the tail.

Localities.—In Bala Rocks, Pwllheli, Carnarvonshire; Mathyrafal Wood, Montgomeryshire; also Westmoreland and South Wales. In Upper Caradoc Sandstone, var. *β*, May Hill and Tortworth, Gloucestershire, in great abundance, first observed at the latter place by T. Weaver, Esq.; Bogmine, Shelve; in the "Pentamerus Limestone" of the Hollies, and of Buildwas, Shropshire, abundant. In Wenlock Shale; Var. *α*. Woolhope. In Wenlock Limestone; Dudley, Walsall. In Upper Ludlow Rocks; Pilliards Barn, Woolhope. Ludlow Rocks of Marloes Bay, Pembrokeshire, var. *β*.

Foreign Localities.—Sweden, Norway, Russia, in Lower Silurian; Gottland, in Upper Silurian.

3. *E. variolaris*, Brongn. sp. *Calymene*, Brongn. (1822), Crust. Foss. t. 1. f. 3 B. (not A.) Parkinson, Org. Rem., iii. pl. 17. f. 16. Murchison, Sil. Syst. (1839), pl. 14. f. 1. mala. (not of Emmr.) Salter, Mem. Geol. Surv. (June 1848), vol. ii. p. 1. 344. Fletcher, 1850, Quart. Geol. Journ., vol. vi. pl. 32. f. 6-10. *Zethus*, M'Coy (1851), Pal. Foss. Woodw. Mus. p. 157.

E. ovatus, obtusus, sesquiuncialis, capite et thorace E. punctato simillimis, sed glabellâ inflatâ, nec anticè tuberculis in serie transverso dispositis, genis per totum tuberculatis, angulis rotundatis; hypostomate basi convexo; thorace axi inermi, pleuris rugoso-tuberculatis; caudâ convexâ brevi trigono, axi convexo pauci-annulato, annulis subæqualibus 9–12 *interruptis et in tuberculos varie disposi'os insectis, lateribus costis* 7, *deflexis, sæpe tuberculatis; apice abrupto deflexo.*

Professor Burmeister in the supplement to his valuable work (ed. 2. p. 115), pointed out the obvious discrepancy between the two figures referred by Brongniart to his *Cal. variolaris*, and in a great measure set the synonyms right. But he was wrong in quoting the figures in the Bridgwater Treatise and Emmrich's description as for this species, which has obtuse and rounded, not spinose angles to the head. The characters of the tail are amply sufficient to separate the two common species; and I may add that those of the head, even if the angles are broken, are also well marked, the glabella of *E. variolaris* being inflated and equally clothed with large tubercles, whence the name "Strawberryheaded Trilobite;" while in *E. punctatus* it is convex, but not inflated, and in front has the tubercles distinctly gathered into a tranverse series or crest, a character more marked in our next species. There should be no more confusion as to the names, since the publication of Mr. Fletcher's figures and description quoted above.

Localities.—Wenlock Limestone and Shale. Dormington Wood, Woolhope; Dudley and Walsall (abundant.)

4. *E. multisegmentatus*, Portl. sp. *Amphion*, Portlock, G. Rep., pl. 3. fig. 6 (too many side ribs.) *Ampyx baccatus*, id. (head), fig. 11. *E. multisegm.*, Emmr. (1845), Neues Jahrb., p. 43.

E. sesquiuncialis, depressus? glabellâ valde clavatâ, ad basin angustâ, tuberculosâ, a genis convexis profundè separatâ; tuberculis magnis anteriùs in cristam transversam arcuatam collocatis; genarum tuberculis (nisi duobus maximis), minoribus, caudâ longè triangulatâ, apice acuto nec producto deflexo, axi angusto annulis numerosis circiter 30, *solùm prope apicem obliteratis; lateribus* 12-*costatis, costis arcuatis deflexis.*

The crest of large tubercles, parted in the middle, along the front of the glabella, as well as the numerous ribs of the tail, are good marks of this elegant species. There can be no doubt the two portions above cited belong to each other.

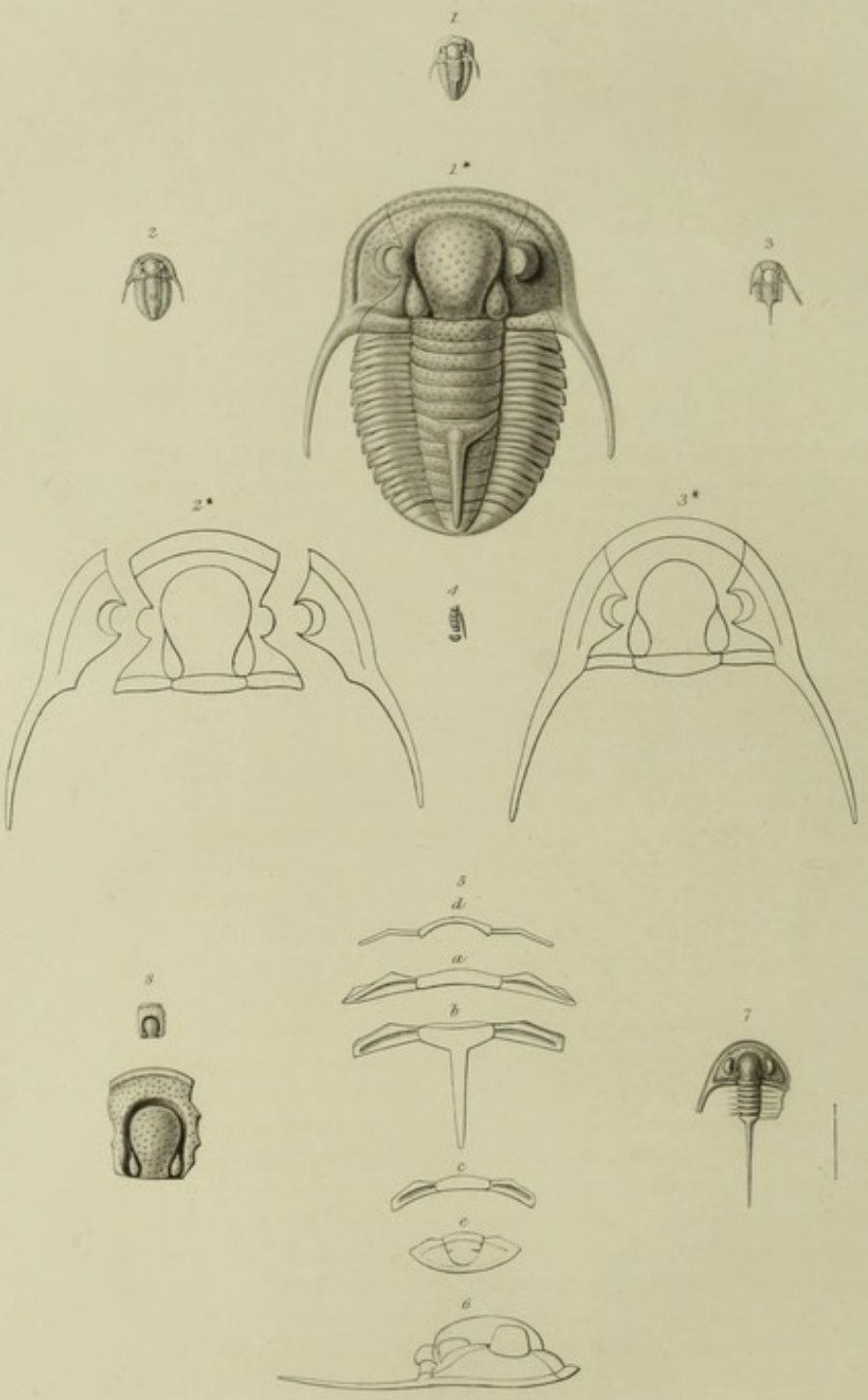
Localities.—Lower Silurian [head and tail], Tyrone; Montgomeryshire [tail only].

J. W. Salter.

August, 1853.

Geological Survey of the United Kingdom.

CYPHASPIS
(Silurian)



CYPHASPIS MEGALOPS — *M.ᶜ Coy.*

C.R. Bone del.ᵗ E. Forbes lithog.ᵗ J.W. Lowry Sc.

BRITISH FOSSILS.

DECADE VII. PLATE V.

CYPHASPIS MEGALOPS.

[Genus CYPHASPIS. BURMEISTER. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Head tubercular, strongly margined; glabella very convex, resembling half an egg, much shorter than the head, without lobes, except a small basal pair which are longitudinal, oval, and deeply divided from the base of the glabella (and an obscure furrow above these on each side); cheeks very gibbous, the smooth eyes rising to a high level, without an ocular ridge; facial suture direct forwards to the margin from the eyes, and behind cutting the posterior margin near the angle, which is long-spinous; a small rostral shield present; thorax of 11 to 17 rings (or more?), the sixth joint of the axis frequently bearing a spine; pleuræ grooved; tail small, of few rings. Κύφος, a convexity; ἀσπὶς, a shield, in allusion to the inflated carapace.]

[Section *Cyphaspis;* glabella moderately large, thorax of 11 rings.]

DIAGNOSIS. *C. parvulus; capite undique granuloso, fronte rotundato; glabellâ subhemisphericâ, nec gibbâ, oculos maximos vix supereminente; lobis posticis obovatis angustis; genis latitudine glabellam æquantibus; angulis longi-cornutis; limbo ante glabellam declivi angusto—vix margini incrassato latiori; thorace segmento sexto armato, spinâ crassâ appressâ caudæ apicem attingente; pleuris inermibus; caudâ lateribus unisulcatis.*

SYNONYMS. *Harpes? megalops,* M'COY (1846), Synopsis Sil. Foss. Irel. pl. 4. fig. 5. *Harpidella megal.,* Ann. and Mag. Nat. Hist. (1849), vol. iv. 412.

We have figured, for the first time in Britain, a complete specimen, of this genus; it has been known for some years on the continent, and is one of those genera which are common to the Lower Silurian, Upper Silurian, and Devonian rocks, while it does not ascend into the carboniferous rocks.

Description.—One of the smallest known species of the genus; its length is never more than half an inch: the head, which is the widest part, is rather more than five sixteenths broad. The usual length is not above three eighths of an inch. General form convex and truly ovate, with the extremities obtuse. Head very convex and strongly granulose, in form about a semicircle, but contracted at the

posterior angles just in front of the strong curved spine, so that the sides are somewhat square. The spine is about equal in length to the head; it is directed first obliquely outwards and then curved a little towards the thorax again, reaching as far as to the 7th segment. The glabella is very convex, parallel sided or slightly parabolic if its whole contour be taken into account, but half egg-shaped if the small lateral lobes are excluded; it occupies about one third the width of the head, and extends forwards only about two thirds its length, a considerable though not very broad space being left between it and the thickened front margin. This space, together with the margin itself, about equals one third of the length of the glabella. Only one pair of lobes are present, which lie at the base of the glabella; they are convex, longitudinally ovate, narrow, each about one fifth the entire width of the glabella, and circumscribed by a deep sulcus, which divides them as much from the glabella as from the cheeks. These last are high-conical, and at about half-way up the head and near the glabella, bear the large, prominent, smooth eyes, which rise nearly to a level with the highest part of the glabella; a thick margin, continuous with the front margin, surrounds the cheek, and is separated from it by a strong sulcus, which does not quite reach the termination of the neck furrow; there is no abrupt hollow or any depression at the angle. The facial suture, contrary to its usual course in this genus, turns considerably outwards above the eye to cut the front margin—along which it runs; beneath the eye its course is abruptly outwards to the end of the posterior margin—a little within the base of the spine. The neck segment is tolerably broad and prominent, and the neck furrow deep and straight.

The thorax is much less convex than the head, and is always a little longer than it; it consists of 11 joints, with the axis moderately convex, tapering quickly backward, and of rather greater width than the pleuræ, especially at its anterior and posterior extremities; in front about equal to the width of the glabella. The 6th segment of the axis is greatly swelled and produced backwards, giving rise to a straight horizontal spine, which lies upon the surface of the posterior rings, and nearly reaches the end of the tail. Pleuræ short, flattish, divided nearly to the tip by a strong, straight groove, the fulcral portion being of the same width as the posterior half. The ends are thickened, truncate, and very faintly bilobed; the fulcrum is placed at about half-way along the pleuræ in the middle segments,—at a less distance posteriorly, and beyond it the forward edge of the pleura is sharpened or facetted for the purpose of rolling up. Tail small, transverse, and but slightly convex, much

less than half a circle, its entire width being but little more than that of the glabella ; the axis is short conical, occupying one third its width, with one distinct ring, another more obscure, and a terminal joint ; sides with one distinct upper furrow, which does not reach the margin.

All the prominent parts of the surface of the body are rough with small tubercles ; but these are by far most evident on the glabella, cheeks, and neck segment ; they are wider apart than their own diameter, and pretty regular in size.

Variations.—The forehead portion of the glabella in our figs. 3 and 3* is much smaller and less inflated than usual, giving the glabella a parabolic instead of sub-rectangular form ; and the same variation is less conspicuous in fig. 7. In other respects they seem to be identical. Some Lower Silurian specimens have the space in front of the glabella a little wider than in those from Dudley, but even in Dudley specimens the anterior margin is sometimes narrower than this space and sometimes broader.

Sex.—Under the genus *Remopleurides*, described further on, at plate 8, the possible indication of sex by certain ornaments or appendages to the dorsal surface is adverted to. Of the small number of this species hitherto examined, we have met with no individuals destitute of the spine at the 6th segment, and it is therefore quite possible that it may be characteristic of the species, and not of one of its sexes. In the collection of Mr. Fletcher, of Dudley, one specimen (fig. 7) has the spine nearly double the ordinary length, or twice the length of the five anterior thorax rings. And this variation, which we can hardly help regarding as indicative of the male, is accompanied by a less inflated glabella, the basal lobes being set more widely apart, as above mentioned, and by a somewhat more pointed form of the head. In *C. Burmeisteri*, the large Bohemian species, the curved dorsal spine always occurs on the same 6th segment, and is always long.* But it is at least worthy of remark that the possession of such a dorsal spine is characteristic of the male of some of the *Cymothoadæ*, a group of Isopod crustacea very analagous, though probably not closely allied to, the Trilobites. In the genus *Sphæroma*, the male of one species, *S. diadema*, is characterized by the presence of a spine very much like that of *Cyphaspis*, and occurring too on the 6th thoracic segment ; in the

* In *Encrinurus punctatus*, described above, pl. 4, such spines, but much shorter, occur on the 7th and 10th segment ; and there are certain trilobites, *Sao hirsuta* and *Bronteus spinifer*, Barrande, for example, that have a prominent spine on every thorax ring: so that we must estimate this character at no more than its proper value.

female of that species, a rudimentary spine or tubercle is all that occurs. Several others are described, *S. armata*, &c., distinguished by such an appendage; it may perhaps be proved that some of these are males of the unarmed species.

Affinities. As nearly all the known species are double the size of this, a close comparison is not necessary; and *Cyphaspis Burmeisteri*, Barr., besides its very much larger size, has 7 to 15 thorax rings according to its age, and the tail with five rings to the axis; the space, too, between the glabella and front margin is very wide: the posterior head spines short, reaching only to the 4th ring. Like our species, it bears a spine on the 6th thoracic segment. *C. Barrandei*, Corda (the species called formerly, with doubt, *C. clavifrons*, by Barrande) has 11 rings, but the glabella is vastly more inflated and the head margin narrow; the posterior head spines, too, are one and a half times the length of the body. *C. cerberus*, of the same author, has the head fringed with spines; and the Devonian species, *C. ceratophthalma*, Goldf., besides its greater bulk and much more convex head, has a scrobicula or pit at each of the posterior head angles. The pretty Swedish species, *C. elegantulus* (*Proetus eleg.*, Angelin), is more like ours, but has an elongate head and 12 unarmed thorax rings. In fact there is no published fossil which can be confounded with it.

The genus is more rich in species than might be supposed, but they have only been discovered of late years. *C. ceratophthalma*, Goldf., of the Eifel, furnished Professor Burmeister with the type, which he described in 1842, in his original work; since which time Barrande, Lovén, and Sandberger have made us acquainted each with a few species. M. Corda has largely swelled the list, dividing the genus into *Goniopleura*, with 12 rings, *Cyphaspis*, with 11, and *Conoparia*, with 13; but the differences he notices are by no means sufficient for the establishment of distinct genera, though possibly the species with a very wide space in front of the glabella, and with more than 11 body rings, may form a sub-genus. Now that we possess the work of M. Barrande, who has discovered the several species with great variations in the number of thorax rings according to their age, (in *C. Burmeisteri*, from 7 to 15), the limits of these sub-genera may perhaps be arrived at. Our species, at all events, will fall into the same group of 11-ringed species, with that originally described by Burmeister.

History.—Abundant but very imperfect specimens of the head of this little trilobite were detected by Professor M'Coy, and carefully described by him in his account of the Irish Silurian

fossils. His specimens were not perfect enough to enable him to see the true position of the large eyes on the head, nor the strong granulation of the glabella, and he referred it therefore, with a doubt, to the genus *Harpes*, suggesting that it might form a new group allied to that genus; this idea was carried out in his classification of the British Trilobites, in the Annals of Natural History, for December 1849, in which this trilobite stands as the type of a proposed new genus, *Harpidella*, and the granulated surface is mentioned. In a communication from him lately, he is agreed with me in identifying these perfect specimens with those described by himself. It is mentioned by myself, Proceed. Brit. Assoc., 1852, Sect. p. 57.

British Localities and Geological Range.—Llandeilo Flags to Lower Ludlow Rock. In Llandeilo flags; sandstones of Ardaun, Boocaun, Cappacorcogue, and Tonlegee, Cong, county of Galway (Mr. Griffiths' collection); limestone of Portrane, county of Dublin; sandstones of Mullock quarry, near Girvan, Ayrshire (M'Coy); Bala limestone of Cader Dinmael, near Corwen, North Wales; in the Wenlock limestone and shales of Dudley and its neighbourhood (figs. 2–6); in the Wenlock shale, west of the Worcester Beacon, Malvern Hills; Lower Ludlow rock, of Hole Farm, near Philsley Beauchamp, Abberley Hills (fig. 1). [Survey Collection].

Explanation of the Plate.

Fig. 1. A nearly perfect specimen, from the Lower Ludlow Rock, Abberley; natural size.

Fig. 1*. The same, enlarged. The tail in this figure is rather too large, both as to length and breadth.

Fig. 2. A fine specimen from Dudley, in the collection of T. W. Fletcher, Esq.

Fig. 2*. The head, magnified, and dissected at the suture. The glabella and its basal lobes are in this of the usual form.

Fig. 3. A variety from Dudley (Mr. Gray's coll.), in which the glabella is shorter and more parabolic in outline; it is a rare variation.

Fig. 3*. The same, magnified.

Fig. 4. A fragment from Dudley, placed laterally in the rock, and showing the dorsal spine parallel to the body, and reaching to the tail. (Mr. Gray's cabinet.)

Fig. 5. Magnified dissections of the thorax; *a*, the anterior segment, with its pleuræ obliquely truncate at their ends; *b*, the 6th segment, showing the broad deep pleural groove and the long dorsal spine; *c*, the last or 11th segment; *e*, the small transverse tail.

Fig. 6. A lateral view of the head, magnified.

Fig. 7. A specimen, from Dudley, with the dorsal spine greatly elongated. Natural size, and enlarged. (Mr. Fletcher's coll.)

Fig. 8. A head from Cader Dinmael, Denbighshire; Bala limestone. Natural size, and enlarged.

Other British Species.

Only one other certain species of the genus has yet occurred in England, and that so like the *C.* (*Proetus*) *elegantulus* from Gottland, that if it were not for some differences in proportion, long head spines, &c., it would have been thought the young of that species. Its characters may be thus given :—

C. pygmæus, sp. nov. [*Proetus elegantulus*, Angelin (1852), Palæontol. Suec., t. 17. fig. 7. Lovén (1845), Ofvers. Kongl. Vetensk. Akad., t. 1. fig. 4. *junior?*]

C. minutus, ovatus; capite granuloso fronte paullum producto; glabella depressâ genis angustiori, lobis basalibus rotundatis; oculis parvis; limbo antico angusto tumido, angulis posticis longispinosis; thorace segmentis 12, *axi angusto, pleuris acuminatis—posticis recurvatis, fulcro anticè ultra dimidium posito; caudâ minutâ, lateribus costatis.*

Not two lines long, (while *C. elegantulus* grows to an inch and a half,) depressed, the head rather more than one third the entire length; glabella round oval, the small basal lobes full twice their diameter from each other. A narrow and tumid space lies between the glabella and the somewhat produced and narrow front border. The cheeks are considerably wider than the glabella, and bear the small eyes at a short distance from the latter; their angles are produced into long divergent spines, which reach as far as to the 7th or 8th thorax segment. The pleuræ are wider than the axis, and have in front the fulcrum very remote, behind it is not quite one third away from the axis. The tail is very small, the axis and sides are ribbed, but it is too imperfect to be described properly.

The characters above mentioned may be those of a young specimen; but it has the full number of rings, and in this genus they increase in number with age the head is not nearly so produced in front, nor the glabella so convex as in *C. elegantulus*, and the head spines are proportionally much longer; above all, the Gottland species has blunt pleuræ, and in ours they are decidedly acuminate, the hinder ones being even recurved at the tips; the pleuræ are grooved nearly to the ends.

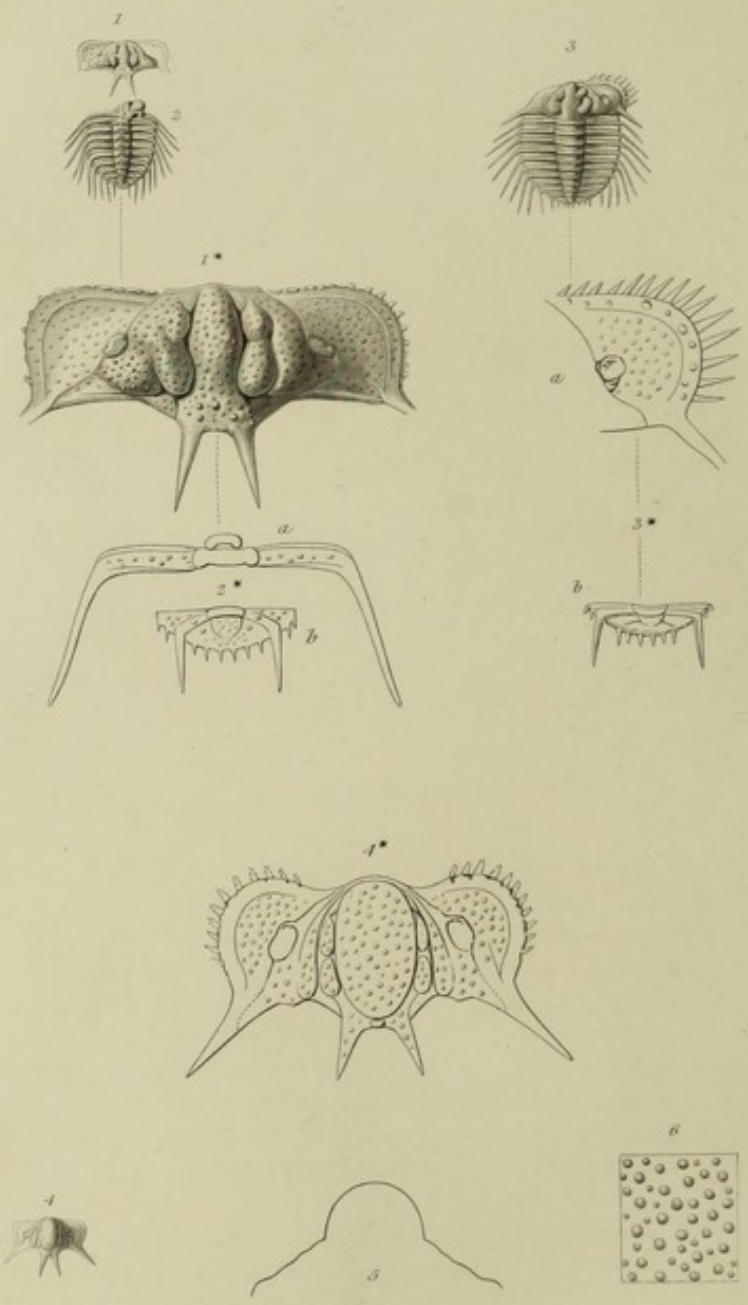
Locality.—Eastnor Castle, Malvern Hills; in Wenlock shale.

J. W. SALTER.

August, 1853.

Geological Survey of the United Kingdom.

ACIDASPIS
(Silurian)



1 3 ACIDASPIS JAMESII — *Salter*.

4 — BISPINOSUS *M'Coy*.

C.E. Bone del.t E. Forbes direx.t J.W. Lowry fc.

BRITISH FOSSILS.

DECADE VII. PLATE VI. Fig. 1, 2, 3.

ACIDASPIS JAMESII.

[Genus ACIDASPIS. MURCHISON. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Capable of rolling up, or even contractile into a ball. Head short, broad, truncate in front; the glabella broadest at the base, with a median portion strongly separated from the three lateral lobes, which are obscurely divided from the cheeks (and often connate with them); cheeks thickened, generally spinose at the margin, and with the angle produced into a spine; eyes smooth, convex, (occasionally elevated on a long peduncle) connected with the front of the glabella by a strong ocular ridge; neck segment much enlarged, and generally produced into spines; body of 9 or 10 segments (fewer during the metamorphosis), with a narrow convex axis, and horizontal pleuræ which are produced at their ends into spines; tail small, axis abbreviated, limb multidentate, with one strong lateral rib on each side produced beyond the margin. ακις, mucro; ασπις, scutum.]

DIAGNOSIS. *A. latus, depressus, granulosus; capite haud convexo, glabellâ triangulari, utrinque lobis duobus ovatis á genâ dilatata fere distinctis—tertio obscuro; oculis medianis; jugo oculari obscuro; angulis brevispinosis; thorace segmentis* 9 *unispinosis, caudâ spinis* 12, *primariis fortibus parallelis, reliquis minutis,—terminalibus sex, externis utrinque duobus.*

SYNONYMS. *Acidaspis bispinosus* (M'COY), SALTER (June 1848), Memoirs Geol. Surv., vol. ii. pt. 1. pl. 9. fig. 5 (not f. 4.) *Acid. Jamesii*, id. (1852), Proceed. Brit. Assoc., p. 57.

We have now sufficient materials to illustrate completely an *Acidaspis* from the Lower Silurian rocks; they are very rare in these formations in Britain, nor are they characteristic of them in other countries, although they are plentiful in the Upper divisions.

The honour of first distinguishing this most remarkable genus is divided between Dr. Emmrich and Sir Roderick I. Murchison; the former having fully characterized the genus* but a very short time after the publication of the "Silurian System," in which the complete head of the more common Wenlock species was figured, and a new genus proposed to mark its peculiarities.

* De Trilob. Dissert. inauguralis (1839), 53, Berlin.

Of all the extravagant forms of this curious family of trilobites, none seems so extravagant in its ornament as the genus *Acidaspis;* the head, thorax, and tail being literally crowded with spines wherever an available angle occurs. The neck segment is produced into 1, 2, 3, or even 8 spines. In the thorax, the segments of the axis have sometimes two long spines on each, and the pleuræ have spines on their surface, and frequently two, or even three at the extremity; the tail is found with from six to 25 of these projections, and the margin of the head is generally furnished with a spiny fringe; to this last character there are but few parallels in the whole family (it occurs in *Staurocephalus, Calymene,* and *Cyphaspis*); and it may be compared with the perforated fringe of *Trinucleus,* or contrasted with the long frontal spine of *Ampyx.* Yet, in some respects, *Acidaspis* resembles *Lichas* (a genus not yet illustrated in these Decades) in the deep separation of the side lobes from the rest of the glabella, and their frequent fusion with the lateral parts of the head; here, too, as in *Lichas,* the facial suture cuts the posterior margin of the head. The tail also is composed of but few segments, as indicated by the joints of the axis, for the number of spines on the lateral parts probably do not indicate half the same number of real segments.

Dr. Emmrich, who wished to show that all trilobites had nearly the same number of body rings—about 20 or 21—noticed that his genus *Odontopleura* possessed a much fewer number than trilobites in general; and he proposed to consider the thorax segment as compounded of two, the free joints of which were exhibited at the ends of the pleuræ. This, however, is not now tenable, for we have seen some species, which on this view would consist of 40 segments, taking the body and tail both into account. It is quite certain that the anterior and posterior divisions of the pleura are both extended, and this character is peculiar to *Acidaspis,* and to some only of the species. Barrande has shown that the segments of the thorax increase in number with age. The genus is found both in Lower and Upper Silurian, and in Devonian strata.

Description.—General form broad and depressed, the surface granulose, the edge fringed with radiating spines. The length, exclusive of the spines, is eight lines, and the breadth six lines. The head is widely transverse, three times as broad as long, and with the front and back edges parallel; the cheeks obtuse, squarish at the upper angles, or even overhanging, and fringed with about 16 spines, which increase in size towards the outer margin; below these there is an abrupt contraction, followed by a widely divergent

spine, which is much shorter than the width of the cheek. The eye is placed midway up the head, a little in advance of the greatest convexity of the cheek, and at one third outwards from the glabella, with which it is connected by a very slightly prominent ocular ridge (perhaps stronger when the crust is perfect). The facial suture appears to run along with this ridge forward, and behind the eye it takes an outward direction and cuts the posterior margin just under the base of the angle spine. The neck furrow is very strong, and is overhung by the gibbous inner base of the cheek.

Glabella broadly triangular, not very convex, with a distinct median lobe and two pairs of round lateral lobes, besides a third upper pair, which are small and not distinctly separated from the cheeks. The basal lateral lobes of the cheeks are equal to the median lobe in width, and are well separated from the most convex portion of the cheeks; above they are fused with them, as is also the upper or second lobe on its outer edge, but both of these lobes are circumscribed above and below, and on their inner edges by deep furrows; the glabella appears on the whole to be quite distinct from the cheek. The neck segment is not cut off by any distinct furrow; it is convex, expanded backwards, and produced into two somewhat divergent spines, about equal in length to the glabella. The front of the head is truncate, and its middle portion as usual free from spines. Surface of the head covered with large and small granules, set thickest on the glabella and gibbous base of the cheeks.

Thorax horizontal, except the very convex axis which occupies rather more than a quarter its width; of 9 segments, which are each semi-cylindrical *(plèvre à bourrelet*, Barrande), and ornamented with granules (fig. 2). They terminate in a strong spine equal in length to the pleura, and bent backwards at right angles to it on the hinder segments; in the forward ones the spines are shorter, and set at an obtuse angle. When the interior cast of the thorax is examined (fig. 3), the pleuræ are not seen as semi-cylindrical, but much flatter, and a broad raised ridge runs obliquely along their upper border, leaving a flat space behind. This is, of course, due to the different thickness of the crust at different points.

Tail minute, semicircular, with a small, narrow, and convex axis of two joints, the limb flat, except the convex ridge which runs obliquely from the axis to the primary spine on each side. These spines are directed backwards, parallel to each other, and extend nearly as far as those which run out from the last of the body segments. Between these are six small equal marginal spines, and a pair of similar spines outside the large ones on each side of the tail.

Scattered granules, like those on the head, are sparingly distributed over the more convex parts of the body rings, and occur both on the axis and sides of the tail (fig. 2*). The spines are all smooth.

Variations.—We have only three specimens, and between our figs. 1 and 2, and fig. 3, the only differences seem to arise from the greater pressure to which the latter has been subjected. In fig. 3, preserved in soft black slate, the axis is widened and depressed, the pleuræ less convex, and their spines more divergent, and the glabella is somewhat widened and deeply furrowed. In addition, the cheek margin appears to overhang more, and to be contracted much more decidedly above the spine. The terminal spines of the tail, too, are rather more crowded.

Affinities.—Except with the species next described, and with which I formerly united it, there is no British fossil which has any near resemblance. Among foreign species, *A. mira*, Barrande, has a pair of neck spines, but has the eyes far backwards, and is a true *Acidaspis*; *A. Prevosti* and *A. Dufrenoyi*, Barrande, which belong, perhaps, to the same section with *A. Jamesii*, have but four terminal and two extremely long primary spines to the tail; and *A. Verneuilii* and *A. vesiculosa*, which belong to the section Trapelocera, and possess each two neck spines, have the eyes remote, as in the Wenlock species quoted in our next description.

Locality and Geological Position.—Llandeilo Flags. Fig. 1, 2, from the sandy schists of Newtown, Waterford. Fig. 3 is in black slate, Duncannon, Wexford. (Mus. Geol. Survey, collected by Capt. James, R.E.)

ACIDASPIS BISPINOSUS.

Decade VII. Plate VI. Fig. 4.

Diagnosis. *A. capite convexissimo, glabellâ lobo mediano ovali gibbo per totum capitis extenso, lobis lateralibus utrinque tribus minutis linearibus; oculis ante medium genarum positis; cervice bispinoso.*

Synonyms. *A. bispinosus*, M'Coy (1846), Synopsis Sil. Foss. Ireland, pl. 4. fig. 7. (not *Odontopleura bispinosa*, Emmrich, 1845), see M'Coy, l. c.

The head only of this species is known, and it is remarkable for the extreme gibbosity of the central lobe. Our specimens are about four lines wide; the one figured by Professor M'Coy is double that size.

Head scarcely thrice as wide as long, and the convexity equal to three fourths the length. The glabella extends nearly the whole

length of the head; it is narrow, oval, and nearly all occupied by the swelled central lobe, the two linear oval lateral lobes on each side, and a minute upper third one, only skirting the base of the large central one, and not indenting its sides, as they do in most other species. In front, this protuberant lobe pushes forward the anterior margin and makes it sinuous, and behind it is immediately succeeded by the two short diverging neck spines (with a small tubercle between them), no space being left for a large neck segment. The cheeks are roundish, rather convex, and steeply bent downwards, as shown in our lowest figure, which is a section of the head; they have a thickish border separated by a strong furrow, and studded on the edge by several small spines, and they are enlarged outwards so as to overhang the base of the stout spine which occupies the posterior angle. Between the projecting anterior margin of the cheeks and the equally projecting front, the border is depressed on each side of the glabella, so as to form a hollow curve in which the facial suture terminates. The posterior margin of the cheeks is uneven, and shows a slightly impressed neck furrow. The eyes are apparently large and prominent, with a tubercular eye lobe, and are placed full half-way up the cheek, and about half-way outward, or rather more, from the convex lobe of the glabella. Between the eye and the small glabella lobes, and parallel to the latter, the space is filled up by a longitudinal swelling or lobe, rising above the surface of the cheek, but fused with it towards its prominent base. An oblique ridge below the eye connects that organ with the stout widely diverging cheek spine, and along this ridge the facial suture runs, and is supposed to terminate just within the base of the spine, but the head could not have been separated at the facial sutures. Coarse tubercles, with a few finer ones, cover the whole of the head except the shallow furrows; they are not, however, distinct on the cheek border, nor on the ocular ridges.

Affinities.—Now that we have a perfect head of this species, there is no other with which it could be confounded. The figure given by Professor M'Coy, cited above, is quite correct, but it was from a very fragmentary specimen, and both he and myself regarded the first found specimens of *A. Jamesii* as identical with it. That species, however, as contrasted with small and more perfect specimens we now possess, differs by its depressed form, and by its lobed glabella, with the median lobe moderate as compared with the side ones. In this species it is monstrously developed at the expense of the others, which are reduced to mere rudiments. The eyes, too, lie more outwards and forwards, and in this as well as the gibbosity

of the head, a nearer approach is made to the typical species of the section *Trapelocera*.

The common two-spined Wenlock species (most inadvertently connected with it in the "Memoirs Geol. Surv.," vol. ii. pt. 1. pl. 9. fig. 4) has much more remote eyes, and the glabella lobes quite fused externally with the cheeks. It probably belongs to the same section with those now described, and if not identical with the *A. (Trapelocera) vesiculosa*, Beyrich, is very closely allied to it. Mr. Fletcher, of Dudley, has named it *A. Barrandii*, and will publish it shortly. It must form the subject of a future plate, as it is the type of the sub-genus *Trapelocera*.

Professor M'Coy, in his work, has shown that this has nothing in common with the *Od. bispinosa*, Emmr., a name proposed by him to be substituted for *O. ovata*, by which he formerly (Dissertatio Inauguralis, 1839,) designated his species; the name in that case refers to the double spinous terminations of the pleuræ, not to the projections from the neck, which appears to be smooth and unarmed.

British Locality and Geological Position.—LLANDEILO FLAGS. In the limestone of the Chair of Kildare, county of Kildare, which, by its numerous fossils, is exactly referable to the age of that of Llandeilo and Bala. [Coll. Geol. Survey.]

EXPLANATION OF PLATE VI.

Fig. 1. Head of *Acidaspis Jamesii*, natural size. Newtown, Waterford.
Fig. 1*. The same magnified.
Fig. 2. Body; shows also portion of the head. Same locality.
Fig. 2*. Portions of the same, magnified; *a*, external surface of one of the thorax rings; and *b*, the 12-spined tail.
Fig. 3. Interior cast of another specimen from the slates of Wexford. This specimen is the same as that figured Mem. Geol. Survey, vol. ii. pt. 1. pl. 9. f. 5.
Fig. 3*. Shows portions of the same, magnified; *a*, the cheek with its spines; *b*, the tail with its marginal spines.
Fig. 4. *Acidaspis bispinosus*, M'Coy, nat. size. Chair of Kildare. [Survey Coll.]
Fig. 4*. The same. magnified.
Fig. 5. Section of the gibbous head.
Fig. 6. Tubercles and granules of the surface, highly magnified.

Notice of one or two other British Species.

3. There is a species found in the Bala Limestone, of which we have only a portion of the head. It differs from *A. Jamesii* in having fewer and larger tubercles on the head, and the central glabella lobe. broader in proportion to the side lobes; it is too imperfect to name.

4. The head of a small species, about equal in size to our figured specimens of *A. bispinosus*, occurs with it very rarely in the Chair of Kildare, Ireland. The central glabella

lobe is very large, and the lateral ones minute and pressed against the sides, as in that species, but the former is parallel-sided instead of oval, not nearly so convex, and instead of being covered equally with small tubercles, is studded with a double row, five on each side and a terminal one, of large boss-like ones, between which the surface is finely granulated. Similar large tubercles occur on the space between the glabella and the forward eyes, and even on the front margin. If it were more complete (we have only the central part of the head without the cheeks), it might be called *A. biserialis*.

5. There is a narrow transverse caudal shield, also from the Chair of Kildare, the hinder margin of which is closely serrated by 19 long spines, the primaries being not much longer than the others. It resembles *A. radiata*, Goldfuss.

Lastly in the Llandeilo or Bala rocks ("Caradoc sandstone") of Shropshire, a small and pretty species, half an inch long, occurs. It has six terminal spines to the tail, as in *A. Jamesii*, but the primaries are more divergent, as are the spines of the thorax. The head has longer spines at the angles, and the glabella is truly triangular and very distinct from the cheeks, the lowest lobes much larger than the second, and the uppermost quite obscure. The eyes are more backward and the cheeks much smaller. We may define it thus :—

6. *A. Caractaci*, sp. nov. *A. semiuncialis, capite semilunari convexo, glabellâ late triangulatâ, tuberculatâ, a genis convexis bene distinctâ, utrinque bilobatâ ; lobo basali centralem æquante rotundo circumscripto, quam secundo duplo latiore, hoc distinctissimo obovato : superiori obsoleto : [cervice—?] thorace axi convexo, pleuris ad apices deflexis bispinosis, caudâ* 12 (*vel* 14 ?) *dentatâ, spinis primariis fortibus paullum divaricatis, terminalibus minutis* 6, *externis* 2 (*vel* 3) ; *axi convexo.*

Locality.—Gretton quarry, near Cardington ; a locality rich in all the characteristic Bala species. *Lichas laxatus, Phacops conophthalmus,* and *P. truncato-caudatus, Calymene Blumenbachii, Illænus,* &c. occur with it.

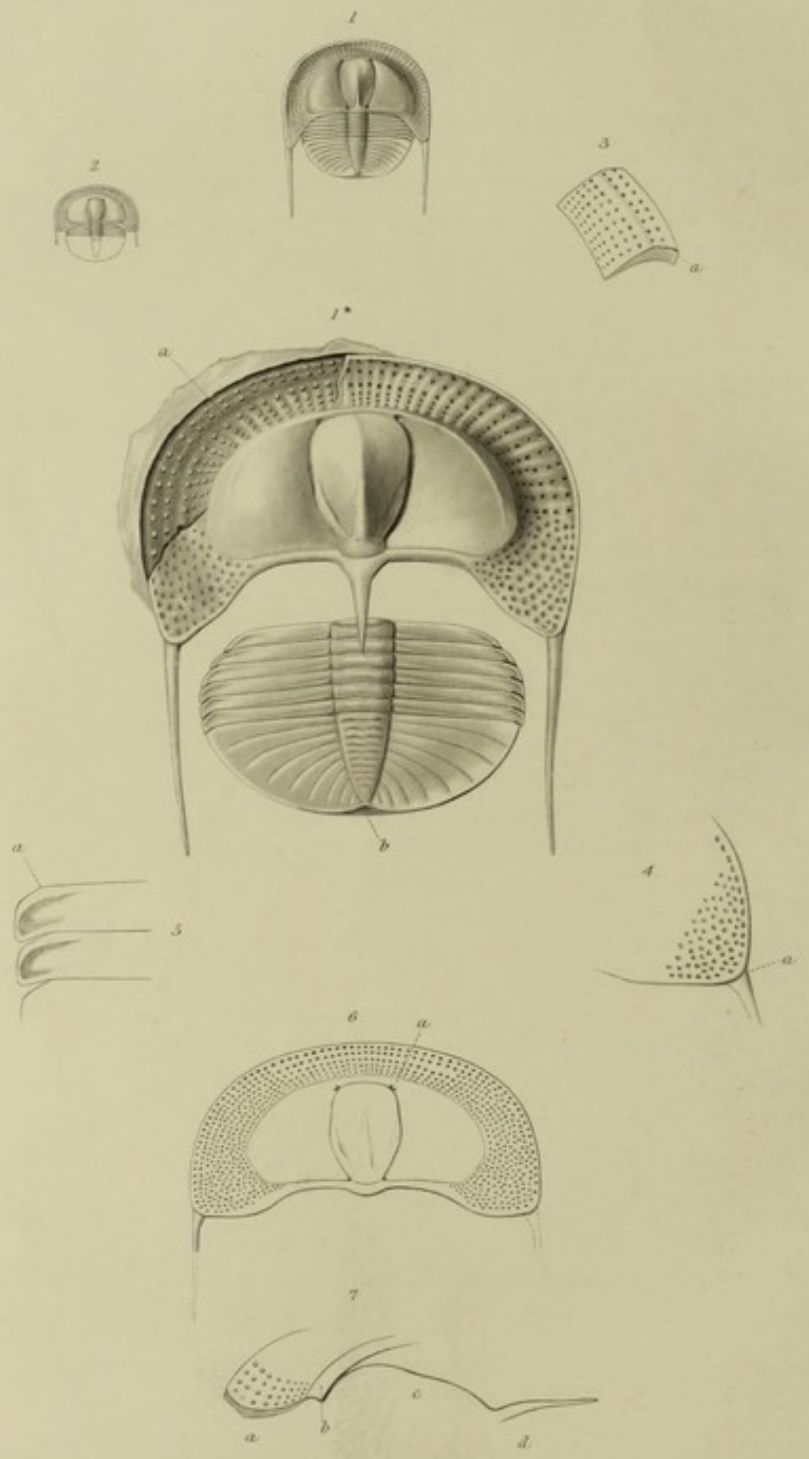
The species which is to be considered the true type in Britain of the section *Acidaspis* proper, is the *A. Brightii*, Murchison, which we hope, with the assistance of our friends at Dudley, to publish hereafter. Several British species will then be enumerated as belonging to that section, and among them a new species, *A. coronatus*, Salter, formerly called *A. Brightii* (Mem. Geol. Surv., l. c. pl. 9. f. 8. 9.)

J. W. Salter.

August, 1853.

Geological Survey of the United Kingdom.

TRINUCLEUS
(Silurian)



TRINUCLEUS LLOYDII — *Murchison.*

E. Forbes del.t

J.W. Lowry fc.

BRITISH FOSSILS.

Decade VII. Plate VII.

TRINUCLEUS LLOYDII.

[Genus TRINUCLEUS* (Llhwyd) Murchison. (Sub-kingdom Articulata. Class Crustacea. Tribe Trilobitæ.) Head of one piece, the facial sutures being soldered; the margin expanded into a hollow fringe, with several rows of perforations; eyes minute, sometimes absent; hypostome convex, elongated, without furrows. [Barr.]; body six-ringed, fewer, 0–6, during the metamorphosis. Cryptolithus, Green.]

[Sub-genus *Trinucleus*. Eye line and ocular tubercle obscure; glabella lobes indistinct.]

Diagnosis. *T. rotundus planus, testâ tenui; glabellâ pyriformi abbreviatâ nec genas excedente, subcarinatâ; cervice spinifero; fimbriâ marginali concavâ, punctis minutis radiatis crebris in ordines* 6 *concentricos collocatis; alis magnis triangulatis, caudam attingentibus, spinis longis parallelis* [*nunc truncatis inermibus?*]; *caudâ concavâ truncatâ, sulcis lateralibus.*

Synonyms. *Trinucleus Lloydii*, Murchison (1839), Silurian System, tab. 23. fig. 4. Emmrich (1839), Dissert., p. 53. Milne Edw. (1840), Crust., vol. iii. 331. *T. granulatus* (Wahl.), Burmeister, Trilob. (1843), 66; 2d ed. (1846), p. 57. Salter (July 1847), Quart. Geol. Journal, p. 254. Phillips and Salter (June 1848), Memoirs Geol. Surv., vol. ii. pt. 1, p. 240.

Var. β. *Corndensis.—angulis posticis capitis brevioribus*, figs. 2 and 6.

This elegant species is abundant in Carmarthenshire and in the mining district of Shropshire, the only localities in which it has yet been observed; for although it has been supposed identical with a species common in Sweden, it is apparently quite distinct, and it is here figured as well to clear up this point, as because it is an excellent illustration of the remarkable genus to which it belongs.

Description.—Length about three quarters of an inch, and width one inch. General form flattish, especially behind,—circular, or, excluding the fringe, a very broad oval, and with long spines directed straight backwards and reaching far beyond the tail.

* From *tres*, three, and *nucleus*, in allusion to the three convex portions of which the head is composed.

Head occupying more than half the entire length, and forming a semicircle, exclusive of the long depending ears which reach to about the middle of the tail. The glabella is pyriform, moderately convex, not equal in width to the cheeks, nor reaching quite to the fringed border in front, but separated from it by a narrow convex space (fig. 7, *b*.) In the strong furrow which surrounds the glabella, and at the anterior part, in a line with its front edge, are placed the two deep indentations characteristic of the genus * (fig. 6, *a*). The glabella is carinate along its lower half; it has on each side a slight longitudinal depression, and at its very narrow base one obscure lateral sulcus above the neck furrow. The neck lobe is produced into a rather strong spine, with a broad base. Neck furrow shallow, continued along the posterior edge of the cheek, which is straight half-way, and then bends suddenly down to form the margin of the large triangular pendant ear; this is slightly concave, pierced by close set puncta, and bordered all round by a raised margin, even at the head angles (fig 4, *a*), where the spines are attached. The fringe which encircles the front is strongly concave on its upper surface, with a thick flattened edge, and very convex below, except just at the margin, where it is plain (see fig. 3); it is closely beset by radiating rows of small holes, six or seven in a row. Of these rows on the upper surface the two outer pores are set close together just within the thickened edge, the next pore much more remote, and placed at rather a greater distance from them than from the three or four close set rows which range along the inner edge (see fig. 1*). The fringe is equal in width all along the front, the glabella not invading it, as it does in some other species. On the under side (fig. 3) the fringe shows a similar arrangement, the space between the second and third row being much more considerable than the others, and frequently rising into a ridge. The spines are not very strong; they project abruptly from the posterior angle, and are not thicker at their origin than elsewhere; their direction is a little inwards rather than directly backward. In some specimens they are as long as the glabella, in others longer than it.† The body, of six flat joints, is equal in length to the tail, and the axis alone

* Professor M'Coy considers this an antennary pore, but this is very unlikely; it answers exactly to the place where, from M. de Barrande's discoveries, the ascending processes of the hypostome are attached.

† The facial suture cannot be traced in this species; in others, and especially in the section *Tretaspis*, it runs from the upper corners of the glabella to the eye, and thence to the posterior margin, just within the punctate border. I have formerly described it in this position, and cannot admit the opinion that it runs round the outer margin of the fringe. [See Barrande, Syst. Sil. 615, &c.]

shows any convexity; it is narrow, not occupying above one sixth the width of the thorax, and consequently is much narrower than the glabella; its rings show the usual division into two parts, an external arch and an articulating front portion. The pleuræ are truly flat, and only marked with a very faint diagonal furrow, but at their extreme end they are a little bent down and strongly indented (fig. 5). The fulcrum (fig. 5, *a*) occurs immediately before the tip. Tail rounded, truncate, less than a semicircle, concave, except the axis; the latter is moderately convex, narrow, and tapering to a point which reaches the margin; it is annulated by seven or eight faint rings, which are indented in the middle. The sides of the tail have seven or eight furrows, nearly reaching the margin; the upper one is straight or nearly so, the ends of the rest are strongly curved backwards. The very narrow margin of the tail is bent down vertically, so as to be invisible in a direct view; a small portion only of it is seen at *b* in fig. 1*, where the tip of the tail is decidedly recurved.

Variations—In many specimens the pendant ears are not so long as in our figured example, and consequently the posterior angles are more obtuse. This is particularly the case with those from the mining district of Shelve and Middleton, in Shropshire; these specimens have also smaller head spines, and the ears are much smaller, and are truncated so as hardly to reach back beyond the first or second thorax ring. This variation may be designated by the name *corndensis*, and if at all common (we have only seen it in specimens from one locality at present) may probably be characteristic of the female. We have figured a young specimen of it at fig. 2, and the head, magnified, fig. 6. The fringe in this specimen is scarcely concave, and the collocation of the pores into rows very indistinct toward the sides.

Affinities.—It is sufficiently distinct as not to be easily confounded with the common species, *T. concentricus*, Eaton, (known better in England as *T. Caractaci*, Murch.) The great size and pendant form of the large head-wings easily distinguish it from that species, and also from the *T. fimbriatus*, Murch. The concave character of the fringe distinguishes it from *T. radiatus*, Murch., which too has a square form of head, from the enlargement of the *upper* corners of the fringe, and divergent not parallel spines. Its nearest ally, to which, indeed, several authors have referred it, is *T. granulatus* of Wahlenberg and Dalman. Good means of comparison, however, are now given us by the accurate figures of Lovén, who of course has access to the very specimens described by the Swedish

authors, and from his figure and description, *T. granulatus* differs in the thicker crust, and in the size, different shape, and greater extension forwards of the glabella, which invades the area of the fringe in front, while in our species it scarcely ever reaches to it. The width of the axis, too, in the tail and thorax, is considerably greater, and the tail, though like in shape, is destitute of lateral furrows, and at its margin is steeply bent down ("præcipiti"). The punctation of the head (if indeed Lovén's specimens were perfect in this part) shows but three or four rows at the most, and the outer row much enlarged (probably having two puncta in a common depression) while in ours they are numerous and of nearly equal size.

History.—First described by Sir Roderick Murchison from specimens gathered at Llangadock by the Rev. Henry Lloyd, after whom the species is named; this figure, however, though characteristic, was from a specimen with but five rings, evidently an accidental growth. The peculiarity, however, was noticed by Lovén,* who doubted its identity with his *T. granulatus* from this circumstance. Burmeister had previously, in 1843, united it with the Swedish species, and in accordance with his suggestion and from the great general similarity of the pendant ears and rounded tail, it was named *T. granulatus* by myself in the "Journal of the Geological Society," and in the lists drawn up by Professor Phillips and myself in the Survey Memoirs. I am glad now, from good specimens, and more close observation, to correct the error.

British Localities and Geological Position.—Llandeilo Flags. In Carmarthenshire; Dynevor Park, and Mærdy bach, Llandeilo; Blaen-dyffryn-garn and Coed Sion quarries, Llangadock, abundant; in Shropshire, Middleton and the country about Chirbury and Shelve, also plentiful.

Explanation of Plate VII.

Fig. 1. Perfect specimen, from the Coed Sion quarries, Llangadock. Presented to the Museum of Practical Geology by the Rev. H. Lloyd.

Fig. 1*. The same, magnified, showing the concave fringe perfect on the right hand of the specimen, and on the left, at *a*, the hollow impression left by its convex lower surface. The thorax and tail are represented as separate from the head; and at *b*, the abruptly vertical margin of the tail is just visible at the recurved tip.

Fig. 2. A small specimen of the var. *β*, with the fringe flattened above (from pressure?); the ears in this variety are much smaller than in the ordinary form.

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* Ofversigt Köngl. Vetenskaps Akad. (1845), 109, pl. 2. f. 2.

Fig. 3. Portion of the under surface of the fringe, magnified, showing the wide space between the second and third rows of pores, and at *a*, the thick flattened edge. The fringe is hollow, and its substance very thin.

Fig. 4. The posterior angle, magnified; a raised edge, *a*, separates the fringe from the spine; the latter is often broken off at this point.

Fig. 5. Extremities of two thorax rings, with strong indentations; *a*, fulcral point.

Fig. 6. Head of fig. 2, magnified. At *a*, the indentations (for the attachment of the hypostome?) on each side is shown.

Fig. 7. A section of the head and fringe, viewed rather from the upper side; *a*, the concavo-convex fringe; *b*, the narrow raised ridge between the fringe and the moderately convex glabella *c*; at *d* the cervical spine is shown.

All the specimens in the Mus. Practical Geology.

The name of this genus can only be retained by general consent, for the typical species was formerly denominated *Cryptolithus*, and sufficiently described by Green; and had, indeed, received the name *Nuttainia* a few months earlier in the "Geological Text Book" of Eaton, the American geologist. But in this case strict priority may be allowed to yield to classical feeling,—the name *Trinucleus*, a strictly appropriate one, having been used in one of the earliest figures given of these or any trilobites, viz., in Dr. Llhwyd's paper in the Philosophical Transactions for August 1698. The '*Trinucleum fimbriatum*,' there figured, along with other trilobites, is the common Llandeilo species, now called *T. concentricus* or *T. Caractaci*.

In a short communication to the Geological Society, read March 1847, I endeavoured to explain the structure of the peculiar fringe of this genus, which had been beautifully figured just before by M. Rouault. However irregularly scattered the pores may seem in some of the species, they can generally be traced as arranged in radiate lines; in *T. radiatus* and *T. fimbriatus* very strikingly so indeed.

If these holes were elongated in the direction of the radii, so as to coalesce with each other, the intervening ridges would become hollow spines standing out from the head margin, and we should then at once recognize them as identical in structure with the marginal spines so characteristic of *Acidaspis*, and a few other genera. On the other hand, in the genus *Harpes*, not yet published in these Decades, the separation of the expanded fringe has not proceeded so far as in *Trinucleus*, the puncta in that genus not even piercing through the fringe, but only impressed upon it.

This genus, like so many others, is now ascertained to undergo metamorphosis, at least so far as increase in the number of thorax rings is concerned, M. Barrande having found the common species with from 0–6 body rings; and a specimen of it with four rings furnished M. Corda with materials for the foundation of his genus *Tetrapsellium*, a name which must of course be cancelled. The late division of the genus by Professor M'Coy into *Trinucleus* and *Tretaspis*, depends partly on this accidental circumstance; but the group *Tretaspis* will form a convenient sub-genus, distinguished by the other characters he has pointed out,—the glabella furrows, the more distinct ocular tubercle, and facial suture, &c.

Trinucleus frequently occurs in a rolled-up form, as figured by Beyrich and Rouault. The genus appears to us strictly Lower Silurian; the specimens said to have been obtained from Wenlock Shale are not yet well authenticated.

Section I. Trinucleus proper.

1. *T. Lloydii.* Above described.

2. *T. concentricus*, Eaton. *Trinucleum fimbriatum vulgare*, Llhwyd (1698), Phil. Trans., v. xx. tab. add. f. 9. Ichnogr. Brit. (1690), tab. 23. at top. *Trilob.* Brongniart, Crust. Foss., t. 4. f. 6, 7. Bigsby, Ann. Lyc. Nat. Hist. New York, 1824, vol. i. pl. 15. f. 1. *Nuttainia concentrica*, Eaton, Geol. Text Book (1832), pl. 1. f. 2. Hall, Pal. New York (1847), pl. 65 and 67. *T. Caractaci*, Murch. Sil. Syst., pl. 23. f. 1. *Ampyx* (*Cryptol.*)

Caract., Emmr. (1839), Diss. 51, bona. *A. tesselatus*, ib. 50. *T. ornatus*, Salter, Quart. Geol. Journ. (1847), v. iii. 253. (including all synonyms); Mem. Geol. Surv., v. ii. pt. 1. pl. 9. f. 1, 2. *T. Caractaci* and *T. gibbifrons*, M'Coy, Pal. Foss. Woodw. Mus., pl. 1 E. f. 14. *T. Goldfussii*, Barr. (1853), Syst. Sil. de Böhême, pl. 30. f. 29–40. *T. ornatus*, ib. f. 41–60.

—*Junior* (four body rings). *Tetrapsellium pulchrum.* Corda, Prodr., f. 18. [mala].

T. ovatus latus, fere rotundus, fronte subangulato, glabellâ obovatâ genis paullo longiore, gibbâ, nec lobatâ, fimbria subtùs angulatâ insuper planâ, interdum lentè concavâ, poris crebris quincuncialiter dispositis aut oblique radiatis, in ordines 4–5 *concentricos (ad frontem sæpissime interruptos) collocatis; alis modicis, spinis longis divergentibus; cervice spinifero; caudâ thorace breviore, axi convexo ad apicem lente decurvo, lateribus paullo concavis radiatim* 5–6 *sulcatis, margini abrupto declivi.*

There are three if not four principal varieties of this variable species, the differences mainly consisting in more or fewer rows of pores being continued round the front, and the glabella being sometimes as broad as the cheeks and sometimes narrower. But the differences are by no means enough to separate them as species. Variety δ, indeed, differs so much that if it were not for intermediate specimens, it would be difficult to believe it the same. A trifling alteration is necessary in the arrangement of the varieties from that given in the Quart. Geol. Journ. vol. ii.

Var. β. *Caractaci.* Murch. l. c.

—*punctis crebris approximatis, ad frontem in ordines* 4 *continuos dispositis, glabellâ latâ.*

Localities.—Welshpool; Dinas Mowddwy and Bala, North Wales, in Bala Rocks.

Var. ε. *Portlockii.* Salter.—*T. Caractaci* and *T. latus*, Portlock, l. c. pl. 1 B.

—*fimbriâ angustiore, punctis ad frontem subradiatis et in ordines* 3 *contractis; glabellâ subclavatâ genis paullo angustiore, caudâ brevi.*

Localities.—Tyrone; Desertcreat; passing insensibly into the next variety.

Var. γ. *elongatus.* Portlock, l. c. f. 7.

—*fimbriâ angustâ, punctis ut in præcedenti; glabellâ angustâ clavata; caudâ longiore, apice nec decurvo.*

The lateral ribs of the tail are very distinct in this variety, the elongation of which is not entirely due to pressure and cleavage; several specimens present the same characters; the whole axis is narrower, the tail longer, and with a raised margin; the lateral ribs, 6 or 7, very distinct; the apex not decurved, but rather elevated. We think it merely the male of it.

Locality.—With the last, Tyrone.

Most of the Bala, Llandeilo, and Pembrokeshire specimens have the fringe with only three puncta in front, and the glabella short, broad, and gibbous; they agree perfectly with *T. concentricus*, and help to establish the passage into the next variety.

Llandeilo and Pembrokeshire varieties, with narrow glabella, and the puncta in somewhat sunk short radii in front, but with the upper angles of the fringe not expanded, connect the above varieties with—

Var. δ. *favus.* Salter, Mem. Geol. Surv. l. c. pl. 9. f. 3.

—*capite transverso, rectangulari, fimbriâ angustâ antice punctis paucis radiantibus; angulis externis quadratis, poris magnis favosis; glabellâ elongatâ.*

Of this curious variety some have the angles more expanded than others. Where the enlargement of the pores takes place the fringe is also convex, and the appearance is just that of honeycomb.

Localities.—Narberth, &c. in Pembrokeshire; also Llandeilo; Middleton, near Chirbury, Shropshire.

Var. α. *Goldfussii*, Barr. (*Sternbergii*, Salter, Geol. Journ. l. c.) is the *Trinucleus* so frequent in the sandstones of Bohemia. It differs little from var. β, except in having closer pores. Specimens of equal size with ours would scarcely differ at all. *T. ornatus*, Sternb., has the pores more remote, and is much more like the common Bala forms

which are intermediate between var. β and ε. It has long and curved spines, a character which our British specimens are never perfect enough to show. Hall's *T. concentricus* shows similar variations in the fringe as ours do, but the tail in his figures is made too blunt. We have it from the Hudson River group, of the usual short subtriangular form.

There is no end to the variety of names under which this fossil has passed. It appears, from Hall's account in the "Palæontology, New York, 235, note," that *Nuttainia concentrica* is the oldest name, having been published in Eaton's Geological Text Book in 1832, and forming the type of his genus. Green's name, *Cryptolithus tesselatus*, though published the same year, was subsequent to it. Sternberg's name, *T. ornatus*, not being put forth till 1833, must give way, and if we have not yet got at the earliest name, we must be ready to change it again. However, as Hall was the companion of Eaton, and collected the very specimens described, his decision must be considered final; and the name *Trin. concentricus* must be applied for the future to this cosmopolite fossil. If we were to go back to Llhwyd's name, certainly the earliest of all, it should be *T. fimbriatus*; but that would be contrary to rule, and only create confusion.

In the Quarterly Geol. Journal, vol. iii., p. 253, I have endeavoured to combine the synonyms of the species; and I see no reason to alter the nomenclature there proposed. I had not then observed that Beyrich had, a year before, suggested the union of *T. ornatus* from Bohemia with the British fossil; but this was from figures only.

Localities.—North and South Wales; everywhere in Llandeilo and Bala Rocks; Horderly and Cheney Longville in Caradoc sandstone; Caradoc shale, banks of the Onny, near Cheney Longville (Sedgwick). Lower Silurian Rocks of Tyrone, Wexford, and Kildare, Ireland; not yet in Scotland.

Foreign Distribution.—North America and Canada. Bohemia. Not yet found in France or Spain, where its place seems to be taken by *T. Pongerardi*, Rouault. Nor is it found in Sweden, where *T. seticornis* is plentiful.

3. *T. Thersites.*—sp. nov.

T. capite lineas 4 lato, semicirculari, fronte paullum angulato, glabellâ genis depressis longiore angustissimâ valde elevatâ et acuticarinatâ; fimbria angustâ, planâ nisi lineâ medianâ paullo incrassatâ, punctis satis crebris nec radiatis in ordines tres concentricos collocatis; cervice brevispinoso; sulco verticali distincto, sub genis latiori; angulis posticis haud expansis, spinis——?

The second or middle row of pores on the fringe is more distinct than the others, on account of the slight swelling of the fringe along that line; and at the angles a few pores are intersposed between this row and the cheeks. The remarkably elevated and carinated glabella easily distinguishes this species, which has remained long in our collection, indicated as an undescribed *Trinucleus* in Professor M'Coy's Mss.

Locality.—Tramore, Waterford; in Lower Silurian slates.

Section II. Tretaspis, M'Coy.

Ocular tubercle distinct; eye-line cutting the posterior margin, but the head not separable at the sutures; glabella lobed.

4. *T. seticornis*, Hisinger (*Asaphus*), Leth. Suec., t. 37. fig. 2. *A. cyllarus*, ib., fig. 3. *T. seticornis*, Lovén, Ofvers. Kongl. Vet. Akad. (1845), t. 2. fig. 1. Portl. Geol. Rep., pl. 1 B. fig. 8. *T. radiatus*, ib., fig. 9. *T. Bucklandi*, Barr. (1846), Not. Prelim. 31. id. Syst. Sil. de Böhême (1853), pl. 30. f. 14–16. *Tretaspis setic.*, M'Coy (1851), Pal. Foss. Woodw. Mus. 147.

T. ellipticus, corpore plano, capite convexo reticulato; glabellâ genis longiore clavatâ antice inflatâ utrinque 2–3-sulcosâ; fimbriâ undiquæ deflexâ, insuper convexâ, margine recurvo incrassato, subtus planiore; poris in ordines 5, 6 collocatis, radiantibus; angulis posticis longispinosis, spinis rectis parallelis; caudâ brevissimâ rotundatâ, lateribus lævigatis, margini lato declivi.

The fringe is always steeply bent down, and follows the declivity of the cheek without any change of direction, except in some specimens a gentle convexity. The pores

are in 6 rows (5 in younger specimens), of which the outer two are placed close together in the deep furrow immediately before the thickened striate margin. The concentric rows are more distinct than the radiating ones in Bala specimens,—in those from Haverfordwest and Ireland the radiation is more manifest. The specimens from the latter locality show the same reticulate character of surface of the head which is seen in our next species. This structure is but rarely to be seen in our other specimens,—nor can we find it at all in two from Sweden in the collection of the Geological Society. Perhaps it is easily abraded; the specimens agree in all other respects.

Localities.—Lower Silurian. In Ireland; Desertcreat, Tyrone; Chair of Kildare; Newtown, Wexford. In Wales; Bala; Llanfyllin; Haverfordwest, &c.; chiefly in limestone strata.

Foreign Localities.—Lower Silurian. Dalecarlia. Kœnigshof, Bohemia (Barrande.)

5. *T. fimbriatus*, Murchison, Sil. Syst., t. 23. fig. 2 (head only.) *Ampyx* (*Cryptolithus*) *fimbriat.*, Emmr. (1839), 52. (not of Portl.) *Tretaspis*, M'Coy, Pal. Foss. 146. pl. 1 E. f. 16.

T. latè ovatus depressus, capite truncato, undique reticulato-punctato; glabellâ convexiusculâ, genas longitudine æquante sed angustiore, utrinque sulcis tribus brevibus; fimbriâ subtus concavâ; insuper primum planâ radiatim sulcatâ, deinde angulatim deflexâ; parte planâ radiatim sulcatâ, poris in utroque sulco 4; parte externâ ad marginem singulo pororum serie ornatâ; angulis capitis haud expansis, spinis brevibus tetragonis divergentibus; thorace abbreviato; caudâ thorace breviore, subtriangulatâ, lateribus læviter 5-costatis, margini declivi.

A specimen of this species in the young state, 2 lines long, has been found with only 5 thoracic segments; it however soon attains the full number. The head is very wide: the fringe is very regular in width round the head, and not invaded at all in front by the glabella as in the last species. It is flat and deeply marked for the first half with sunk radii, full of close-set pores, then rather abruptly deflected and furnished with but a single row on the outer portion.

The tail figured on the same slab with the head of this species in the Sil. Syst. belongs to *Ampyx nudus*; and Burmeister has described it as belonging to the present species; the true tail is short and few-ribbed, as in all the other *Trinuclei*.

Localities.—Only yet found at Builth in Radnorshire; it is exceedingly abundant in the lane leading to the farmhouse called Pen-Cerrig, on the west side of the hill, where it occurs with *Ampyx nudus* and *Agnostus M'Coyii*, (*A. pisiformis*, Murch.)

6. *T. radiatus*, Murchison, Sil. Syst., t. 24. fig. 3. *Ampyx*, Emmr. l. c. 52. (not of Portlock, Geol. Rep., nor of M'Coy, Pal. Foss. 146).

T. paullo adhuc cognotus; præcedenti simillimus, nisi angulis superioribus capitis expansis multipunctatis, glabellâ longiori.

Except in the expanded upper angles of the fringe, which consequently contain at this part many more pores in a row, this does not appear to differ from the last species. The style of the fringe is exactly similar, and the pores placed in furrows in the same way.

The enlarged angles are the chief character, but in some specimens of *T. fimbriatus* there are slight indications of this. As *T. concentricus* varies in this respect it is not too much to suppose *T. radiatus* to be a variety in the same way. The spines, however, are less divergent, and the fringe is invaded in front by the glabella, which too is longer in proportion. In this species not all the pores appear to penetrate the fringe; the outermost and innermost certainly do; the intermediate ones, if they do pierce through, are smaller.

Locality.—Trilobite Dingle, Welshpool [Sir R. I. Murchison.] Coll. Geol. Society.

J. W. Salter.

August, 1853.

Geological Survey of the United Kingdom.

REMOPLEURIDES
(Silurian)

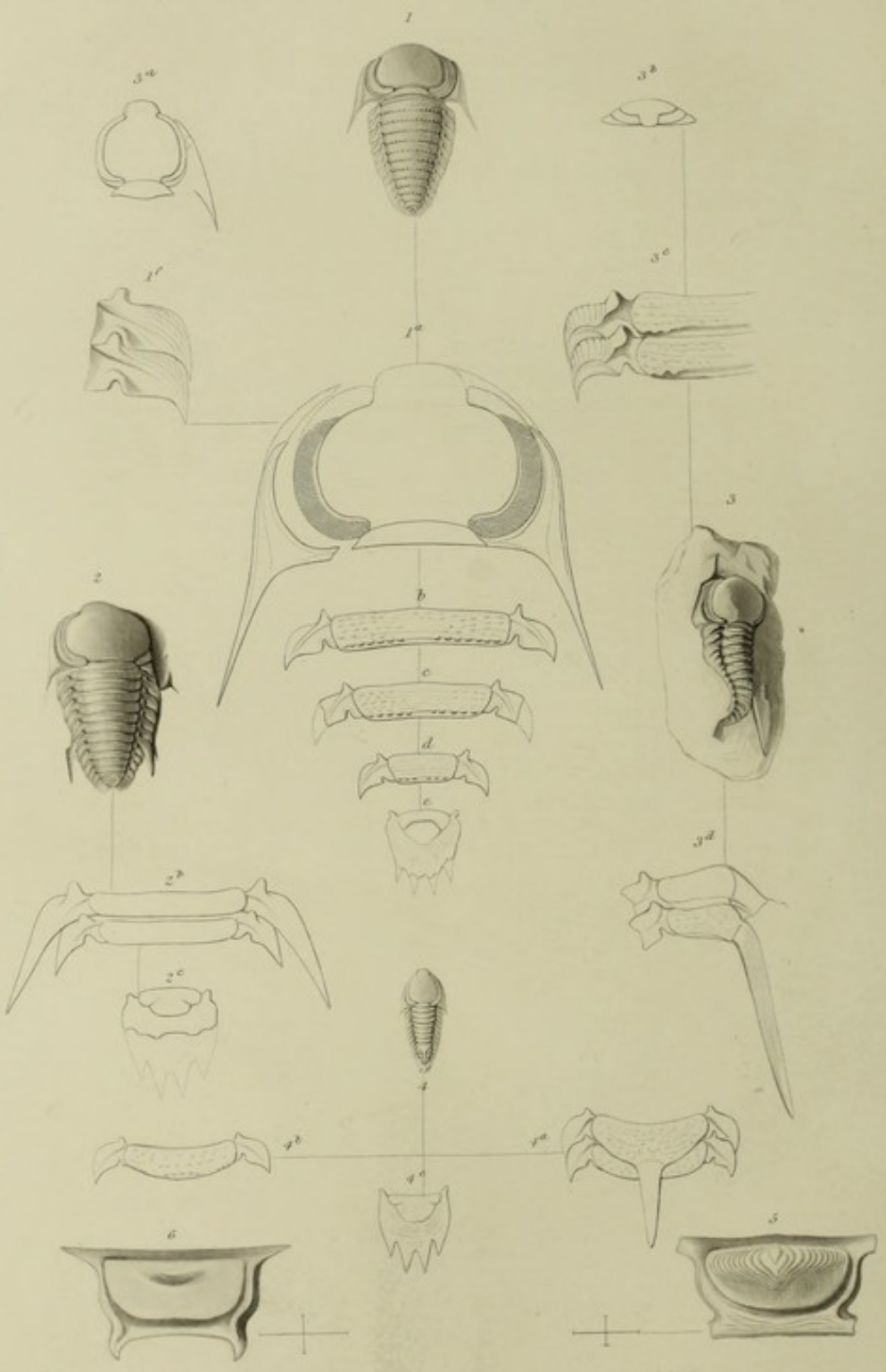


Fig 1. REMOPLEURIDES COLBII *Portlock* | *Figs. 3.4* R. ____ DORSOSPINIFER ___ *Portlock*

2. R. ____ LATERISPINIFER *D.°* | *5.6.* ____ Hypostome of Remopleurides

BRITISH FOSSILS.

DECADE VII. PLATE VIII. Fig. 1.

REMOPLEURIDES COLBII.

[Genus REMOPLEURIDES. PORTLOCK. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Body attenuated behind; glabella circular, occupying the greater part of the head, with an abruptly produced front; its sides closely encircled by the very long smooth eyes; eye line ending posteriorly close to the axis; cheeks small, produced into spines; hypostome truncate in front; body segments 11, the 7th or 8th with appendages, the axis broad, the pleuræ falcate; tail minute, the axis very short, of 2 or 3 segments, the border spinose [4 spined.] *Caphyra*, BARR. *Amphitryon*, CORDA.]

[Sub-genus *Remopleurides*. Glabella furrows quite obsolete.]

DIAGNOSIS. *R. longi-ovatus; glabellâ maximâ, quam longâ latiori, ad frontem inter oculos angustâ; genis parvis, in spinas breves divergentes extensis; thoracis axi latissimo, anterius fere pleuram ter superante; pleuris brevibus (septimo haud producto?) fulcro ad axin appresso, in tuberculum longum valde protenso; caudâ subquadratâ, axi abbreviato biannulato, [margine quadrispinoso, spinis externis brevioribus.]*

SYNONYMS. *Remopleurides Colbii*, PORTLOCK (1843), Geol. Rept., Tyrone, 256, pl. 1. fig. 1. *R. Kolbii*, EMMRICH (1845), Neues Jahrb. 45. M'COY (1846), Syn. Carb. Foss. Irel. 43.

The fortunate discovery by Lieutenant-Colonel Portlock of three or four species of this most remarkable group, enabled its discoverer at once to establish it as a new genus, allied to *Olenus* and *Paradoxides*, a relation borne out by many points of its structure. A more perfect specimen, since found in Ireland by the Geological Survey, enables us to supply some points left doubtful in his descriptions, and we have figured afresh three of his original specimens to illustrate a suggestion thrown out by him, that the variations in proportion observable in these closely allied species may be sexual rather than specific characters. New species have been discovered both in Britain, Sweden, and Bohemia, but except in these countries the genus is not yet known.

Description.—An inch long, and five and a half lines wide, generally convex, of a long ovate form, blunt and rounded in front, narrow and pointed behind. The head occupies not quite one third of the length, and is considerably wider than the body; it is chiefly composed of the large, smooth and convex glabella, which is widely urceolate, the sides strongly arched outwards, so as to form a transverse broad oval, exclusive of the produced and narrow tongue-like front. The produced front is broken off in this specimen, but doubtless existed, as in the other closely allied species; we have indicated its shape by dots. This contraction of the glabella in front, so characteristic of the genus, is due to the excessive prolongation of the eyes, which would meet in front, but for this narrow projection. They completely encircle the sides of the glabella, separated from it only by a narrow rim or eye lobe, and extend their course backwards into the neck furrow, approximating below as they do in front, and indenting a little the base of the glabella. The eyes are of equal width throughout, and are smooth externally, but when decorticated show a closely facetted surface. They are subtended by a raised border along their lower edge.

The wings or free cheeks are small and subtriangular, extending at least as far as the eyes do in front (see fig. 1, *a*); they are striated, have no distinct border, and are prolonged behind into a short and slender spine, which is directed a little outwards, and reaches as far as the third body segment. The eye line is not traceable in front, behind it runs, as in all the genus, vertically beneath the eye, and consequently ends close to the axal furrow. The neck segment is not quite so broad as those of the body, and is separated from the glabella by a sharp furrow.

[At fig. 5, we have represented the hypostome either of this or of one of the two following species. Colonel Portlock has figured this specimen in a reversed position,* as possibly the internal cast of the head; but it is clearly an hypostome, and a comparison of its characters with those of another species of Remopleurides, figured by M. Corda in his work on Trilobites, pl. 6. fig. 58, enables us without doubt to refer it to this genus. From its size it is probably that of one of the three species represented on our plate; and it was found at the same locality with them in Tyrone.

It is four lines broad, and two lines high, nearly rectangular, with the base very broad and quite straight, and its outer angles elongated; it then contracts a little in width, and is strongly notched on the side

* Report, Tyrone and Londond., pl. 24. fig. 10. p. 470.

just before it again suddenly expands to form the broad truncate tip; the front edge is very slightly sinuous. The points of the front angles are broken off, but they appear to have been produced laterally rather than decurved, in which they differ from those of fig. 6. A narrow, but distinct sulcus all round distinguishes the central more convex portion, which is straight at the upper or basal margin, but semicircular in front. A slight prominence rises on the middle of the upper margin, on each side of which strong imbricating striæ descend and meet V fashion along the median line. They extend only along the upper edge, and beneath them fine vertical striæ arise, and cover nearly all the rest of the central space. Concentric striæ run round all the margin, both on the front and sides, and the latter are also marked by a flexuous keel which follows the curve of the lateral notch.

Fig. 6, a specimen from Waterford, where the *R. dorsospinifer* occurs with it, differs very little in size or outline; it has the flexuous keel and notch on the sides, and the expanded angles of the base and apex. But the latter, instead of being extended outwards (as they appear to do in fig. 5), curve down and forwards, forming short falcate lobes *b*, *b*,—the front margin is a little more sinuous. The specimen is more compressed, and the central portion therefore less convex, though of the same shape. The large imbricating striæ too are not preserved. The differences above pointed out are, however, very trifling; and we believe both are of the same species, fig. 5 having the falcate lobes broken off.]

Body segments 11; the axis is convex, and very broad, and in front nearly three times the width of the diminutive pleuræ; posteriorly it is narrowed to one third of its width in front, and in the last segment is not quite twice as broad as the pleuræ, which diminish but little as they recede from the head. The seventh pleura on each side is broken; but enough remains to show that it was not in this specimen materially larger than the rest. All are short, falcate, directed backwards and downwards, with a very short oblique furrow, and furnished on the forward edge close to the axis, with a strong projecting fulcral tubercle; the hinder edge with a corresponding deep notch, the margin of which is raised all round. The pleuræ are striated obliquely. The segments of the axis are crossed by tranverse lines, and covered with faint tubercles; a row of strong tubercles along their hinder edge gives a serrate margin to each segment. There is no appearance of any enlargement of the eighth segment of the axis. Tail squarish, wider in front than

behind; the axis short, its length less than half that of the tail, composed of two joints, an upper ring, which is very narrow in the middle and is produced downwards at the side, and a rounded terminal joint. On the forward edge, and close to the axis on each side, is a strong and prominent fulcral tubercle like those of the pleuræ. The flat limb terminates in four rather short teeth all directed backward, the two lateral ones, though nearly equal in size with the others, not being produced so far back. These teeth are broken off in the specimen figured, but the description is taken from well preserved specimens found in North Wales, and apparently of the same species; the surface of the limb and of its teeth is finely striated across with close waved lines.

British Localities and Geological Position.—LOWER SILURIAN; Desertcreat parish, Tyrone, in argillaceous schist, fig. 1. Bala limestone, North Wales.

REMOPLEURIDES LATERISPINIFER.

Fig. 2.

DIAGNOSIS. *R. longiovatus, glabellâ maximâ quam longâ latiori, ad frontem inter oculos angustâ; genis parvis, in spinas breves extensis; thoracis axi latissimo, anticè pleuram ter et plus superante, pleuris brevibus, septimo utrinque longè producto, fulcro appresso elevato; caudæ axi abbreviato biannulato; (margo omnino caret, ut in præcedenti habendus.)*

SYNONYMS. *R. laterispinifer*, PORTLOCK (1843), l. c., pl. 1. fig. 2. M'COY (1846), Syn. Carb. Foss. Irel. 43. CORDA (1847), Prodr. Böhm. Tril., 113. t. 6. fig. 59 [mala].

Description.—Length fourteen lines, width eight lines. The general shape and convexity, the size and form of the glabella, cheeks and eyes, are the same as in the preceding description. But the head is rather more than one third the whole length of the body, and the width of the tongue-like front of the glabella (which could not be accurately determined in the foregoing species), is somewhat less than half that of the entire glabella.

The axis of the body is in front nearly four times as wide as the short pleuræ, in the last ring it is only one third of this width, and about twice the width of its pleura; its segments are each tuberculate along their hinder edge, as in the last species, and show some faint traces of granulation over the surface; the seventh pleura on each side is abruptly lengthened and produced backwards (not

so much outwards as in our figure) as far as the origin of the tail. In all other respects the body rings agree with those of the *R. Colbii*.

The tail is broken, and has lost all but the anterior margin and the axis; the latter is of two rings, and their shape is as in the last species. Immediately beneath the axis there is an emargination like that represented in Portlock's figure; but it is, I believe, a fold of the incurved under portion, and is certainly not a part of the margin of the tail, which indeed, from the proportions of the fragment left, would have been of just the shape of that of *R. Colbii*.

British Locality and Geological Position.—Lower Silurian. Townland of Bardahessiagh, Tyrone, in micaceous sandy schist.

REMOPLEURIDES DORSOPINIFER.

Figs. 3, 4.

Diagnosis. *R. elongatus longiovatus, glabellâ maximâ quam latâ longiori, ad frontem inter oculos angustâ; genis parvis, in spinas breves extensis; thoracis axi latissimo, anticè pleuram ter superante, segmento octavo incrassato, in spinam fortem extenso; pleuris brevibus, fulcro ut in præcedenti; caudæ margini quadrispinoso, spinis externis brevioribus.*

Synonyms. *R. dorsopinifer*, Portlock (1843), l. c., pl. 1. fig. 3. also fig. 4. M'Coy (1846), Syn. Carb. Foss. Irel. 43.

Description.—Length one inch. The general shape is more elongated than in the two foregoing species, and the anterior produced portion of the glabella is scarcely more than one third its entire width; otherwise the proportions of the head and its parts are very similar. The body rings, except in the narrower axis, agree in structure with those of *R. Colbii*, and *R. laterispinifer;* the rings of the axis have their posterior edge serrated, and their surface granulose; and the pleuræ are similar in shape, and in the position of the fulcrum. The chief difference is in the comparative width of the axis, which is not three times the width of the pleuræ in front, and posteriorly is not so much narrowed, being little less than half the width it has in the anterior part. The seventh pair of pleuræ, too, are not at all elongated, at least not in the young and perfect specimen, fig. 4 (in fig. 3, Portlock's original specimen, this portion is broken off). The eighth segment of the axis is incrassated, and gives birth to a short spine which extends backward, lying closely on the segments, nearly to the end of the tail; the tip of the spine is a little recurved, and its surface striated. The incrassation of the

eighth segment is only seen in the exterior crust (fig. 4, *a*); the interior cast of the same segment (see figs. 3 and 4) shows nothing of it. The tail is oblong, the posterior edge cut into four strong teeth, the two outermost shorter than the others. The axis two-ringed, as in the other species.

British Locality and Geological Position.—LOWER SILURIAN; Desertcreat parish, Tyrone (fig. 3.), in fine micaceous sandy schists; Tramore, Waterford (fig. 4), in arenaceous slate.

Variations.—These three supposed species have purposely been described and figured together, in order to show how very trivial the variations are between them, except, of course, in the remarkable appendages to which the specific names refer. *R. laterispinifer* has the general axis somewhat broader than *R. Colbii;* and this again than *R. dorsospinifer*. The two first-named species, indeed, agree very nearly in its proportions, as it tapers in the body segments rapidly from front to back. In the last form, which is more elongate and narrow than either, this tapering is not nearly so rapid. But the general shape, configuration of the glabella and cheeks, the extent, size, and position of the eyes, the broad axis of the body rings, and the short hatchet-shaped pleuræ, are the same in all; each has the remarkable produced fulcral point, placed close to the axis—and the tail, as far as it is preserved in each species, shows no difference in character. The surface, too, appears granulose in all, and the posterior edge of the body segments is serrated by a projecting row of tubercles.

The only striking peculiarities reside in the appendages, the first having neither lateral or dorsal spines; the second having the seventh pair of pleuræ produced into spinous points; and the last, together with a more elongate general form, is furnished on the eighth segment of the axis with a strong dorsal spine.

Sex.—How far these variations may be regarded as differences of sex, is a point worthy of consideration. It is well known that a narrower form, and additional ornament frequently characterizes the male of other Crustacea. In the former Decade we have endeavoured to apply this to the observed differences between certain species of *Phacops*,—and in the present one to *Cyphaspis*.

M. de Barrande has, indeed, shown that there generally exists among the Bohemian Trilobites a broad and narrow form of each species; and he has particularly noticed this in the case of *Acidaspis (Odontopleura)*, and considered the narrower form that of the male.

He also mentions a variation in the number of spines, but this does not appear to be connected with the variation in form. We are not, therefore, yet warranted in supposing that very considerable difference in the appendages may be referred to sex. It is, however, we think, allowable to look for independent characters in a group that has no exact living representatives. Burmeister has shown us that we cannot tell at what segment of a trilobite's body the thorax really terminates, as that is determined by the position of the generative pores. But, as it is extremely likely this should have some external mark, we venture to suggest that the seventh or eighth segment in this genus is the point where the thorax terminates and the true abdomen begins.

Unfortunately, among those Entomostraca most nearly allied to Trilobites, we have not instances of such variation. The sexes of Apus do not appear to differ much externally, and in Limulus a notch in the front part of the shield of the head, and some trifling differences in the feet, are all that mark the male.

But if we turn to the *Isopoda* we have a direct analogy, at least in one group. In *Serolis*, it is true, there are but slight differences in the feet, the external form remaining the same. But in several species of *Sphæroma*, *S. armata*, &c., the last or last but one ring of the thorax is prolonged into a spine, very like that on the fossils; and in one species, *S. diadema*, if not in others, it is the characteristic mark of the male; in the female it is absent, or reduced to a mere tubercle.

Without, therefore, prematurely attempting to alter the nomenclature applied by their discoverer, I may state it as my belief, that in the *Remopleurides dorsospinifer* may be recognized the narrow form and dorsal spine of the male; in *R. laterispinifer*, a mature broad female form, with the eighth pair of pleuræ dilated as ovigerous supports; *R. Colbii*, which is intermediate in form, and destitute of these appendages, I would suggest to be the immature female; and should further observation confirm this view, the species should be re-united under the name of *R. Colbii*.

Affinities.—*R. longicostatus*, Portlock, of which we have given the characters further on, differs at a glance from each of the foregoing species, not only by the great width between the eyes in front, but by the narrow body axis, which is scarcely wider than the large falcate pleuræ. This is the only species with which they can be compared; for the *R.* (*Caphyra*) *radians* has the glabella strongly marked by three segmental furrows on each side, and belongs to a different section of the genus. *R. platyceps*, M'Coy, besides having

a glabella (the only part known) considerably wider, which might be due to pressure, has this portion tuberculate, as I found by examination of the original specimen, in 1845.

History.—Very little has been contributed to the history of these species since Col. Portlock's account, for the simple reason that the species are very rare in Britain, and have not yet occurred in other countries; and the author himself did not clearly make out either the number of body rings or the structure of the tail, and he overlooked the eyes. The genus was at once admitted in the classification proposed by Dr. Emmrich in 1845, and placed at the end of the Olenoid group; but the number (12) of body rings proposed there, although an improvement upon Col. Portlock's enumeration (who included the neck segment and the first of the tail) was erroneous, and the distinction between it and *Olenus* very obscurely defined, owing chiefly to the original mistake about the eyes. M. Corda, too, in his general descriptions and figures of the Trilobite genera, corrected the description of the eyes in *Remopleurides laterispinifer*, which he, however, represented with thirteen body rings and a bifurcate tail. A closely allied species from Bohemia is there more correctly figured and described. The genus appears to be entirely Lower Silurian.

Explanation of Plate VIII.

Fig. 1. *Remopleurides Colbii.* Col. Portlock's original specimen, Tyrone; and the same magnified, and dissected; in fig. *a*, the left free cheek or wing is represented as separate, but it is not known whether the wings were connected in front—the front portion of the head is restored in dotted lines; at *b*, the 3d or 4th thorax segment showing the prominent fulcra * *; at *c*, the 7th segment, the broken pleuræ appearing not to have been produced into spines; at *d*, the last segment; *e*, the tail, its serrate edge restored from better specimens; *f* shows the striated external surface, and the groove and fulcrum of two of the pleuræ. Several portions of the crust are preserved in this specimen.

Fig 2. *Remopleurides laterispinifer.* The original specimen; an internal cast only; at 2 *b*, the 7th and 8th thorax segment magnified; at 2 *c*, the broken tail; the outline restored in dots.

Fig. 3. *Remopleurides dorsospinifer.* Original specimen; at 3 *c*, two of the thorax segments in the front pleuræ, internal cast, showing the grooves deeper than in fig. 1 *f*; 3 *d*, the 7th and 8th segment of the axis, the latter with the long dorsal spine.

Fig. 3 *a*, 3 *b*. Two views of the head of another specimen, same locality; also figured by Portlock.

Fig. 4. A young perfect specimen, Tramore, Waterford; somewhat elongated by cleavage; 4 *a*, 8th and 9th thorax segments, external surface; 4 *b*, internal cast of the 8th, showing no enlargement; 4 *c*, the perfect tail, magnified.

Fig. 5. Hypostome of a species of *Remopleurides*; in all probability of one of the above species, with which it is associated in the rock; it shows the lateral indentations, but not the projecting outer angles; they appear to be broken off. Desertcreat, Tyrone.

Fig. 6. Probably the same species, from Tramore, Waterford; the lateral notches and projecting outer angles are very perfect.

Other British species of the Genus.

Section Remopleurides. Glabella furrows quite obsolete.

Sp. 4. *R. platyceps*, M'Coy, Synopsis Sil. Foss. Ireland, p. 44.

R. glabellâ (adhuc solum cognotâ) ut in præcedentibus, sed bis quam longâ latiori, tuberculatâ.

Locality.—Carrickadaggan and Greenville, Enniscorthy, county Wexford (M'Coy), in Lower Silurian rocks.

5. *R. longicostatus*, Portlock (1843), Geol. Rep. Tyrone, pl. 1. fig. 6. *R. longicapitatus*, ib. fig. 5.

Diagnosis. *R. ovatus, glabellâ undique lineatâ magnâ rotundatâ, nec totum capitis latâ, quam longâ latiori, ad frontem inter oculos latâ; genis modicis triangulatis, in spinas longissimas paullo incurvatas extensis; thoracis axi postice attenuato, anticè nec pleuram bis excedenti, segmentis octo primis inermibus (reliqua absunt); pleuris satis longis falcatis, nunquam productis, fulcro proximo elevato.*

This fine species, with a rounded form of glabella, somewhat like the foregoing species, has the eyes much less extended forwards, the portion between being very large and broad. The pleuræ too are as wide as the axis, or nearly so, and the long head spines are produced backwards at least as far as the 8th body segment; beyond this, the specimen is imperfect. Fine wavy lines cross the glabella, and by these even portions of the head may be distinguished from the *R. Colbii* and its allies, which all appear to have this part smooth. *R. longicapitatus*, from the same ocality, is a glabella only, somewhat elongated by lateral pressure; it agrees in all the other characters with the present species.

Localities.—Tirnaskea, Tyrone, in sandy schist; Tramore, Waterford, in dark slate; Chair of Kildare, county of Kildare, in limestone. Llandeilo or Bala Beds.

Sp. 6. *R. obtusus*, sp. nov.

R. parvulus, glabellâ lyratâ subconvexâ elongatâ, anticè latissimâ, oculis abbreviatis vix curvatis; thorace (segmentis primis) pleuris læviter sulcatis axi paullo angustioribus, fulcro haud eminente nec ad axin appresso.

Although imperfect, this is evidently quite distinct from any of the rest; the obtuse and wide front of the glabella and the consequently reduced size of the eyes readily distinguish it. The glabellar furrows are only just indicated, if at all existing. The fulcral segments are remarkable, for the fulcrum, instead of being strong and projecting, and placed close to the axis, is at some little distance from it, and does not project more than in ordinary trilobites.

Localities.—Desertcreat, Tyrone. [Survey Coll.]

Section II. Caphyra.

Glabella moderate, not inflated, with three pairs of furrows.

Sp. 7. *R.* (*Caphyra*) *radians*. *Caphyra radians* (glabella solum). Barrande, Notice Prelim. Syst. Sil. Bohême, p. 32. (1846). Sil. Syst. Bohême, 1853, pl. 43. fig. 33–39. *Amphitryon Murchisonii*, Corda (1847), Prodr. Böhm. Tril., t. vi. f. 58.

R. sesquiuncialis (in exempl. Brit.) *depressus, ovatus, glabellâ late urceolatâ, quam longâ latiori, antice angustissimâ; sulcis sursum curvatis, nec marginem attingentibus; oculis longissimis; genis dilatatis, angulis in spinas latas extensis; thorace segmentis* 10, *pleuris falcatis, fere axin convexiorem æquantibus, fulcro proximo; caudâ longâ, quadrispinosâ, spinis externis longioribus.*

M. de Barrande, when in England, agreed with us in identifying this species; and we adopt the above specific name, believing it to be but common courtesy, when correcting the mistake of a careful and judicious author, to retain the name he imposed. M. de Barrande, it is true, described as a tail the reversed glabella of this species, but he carefully distinguished it from all other Bohemian trilobites; and M. Corda has conferred no advantage on science in changing both the genus and species, although he had fortunately obtained a perfect specimen. He has figured the eyes much too short; they curve round the glabella, and nearly meet in front, as may now be well seen in the lately published figure of M. Barrande, quoted above.

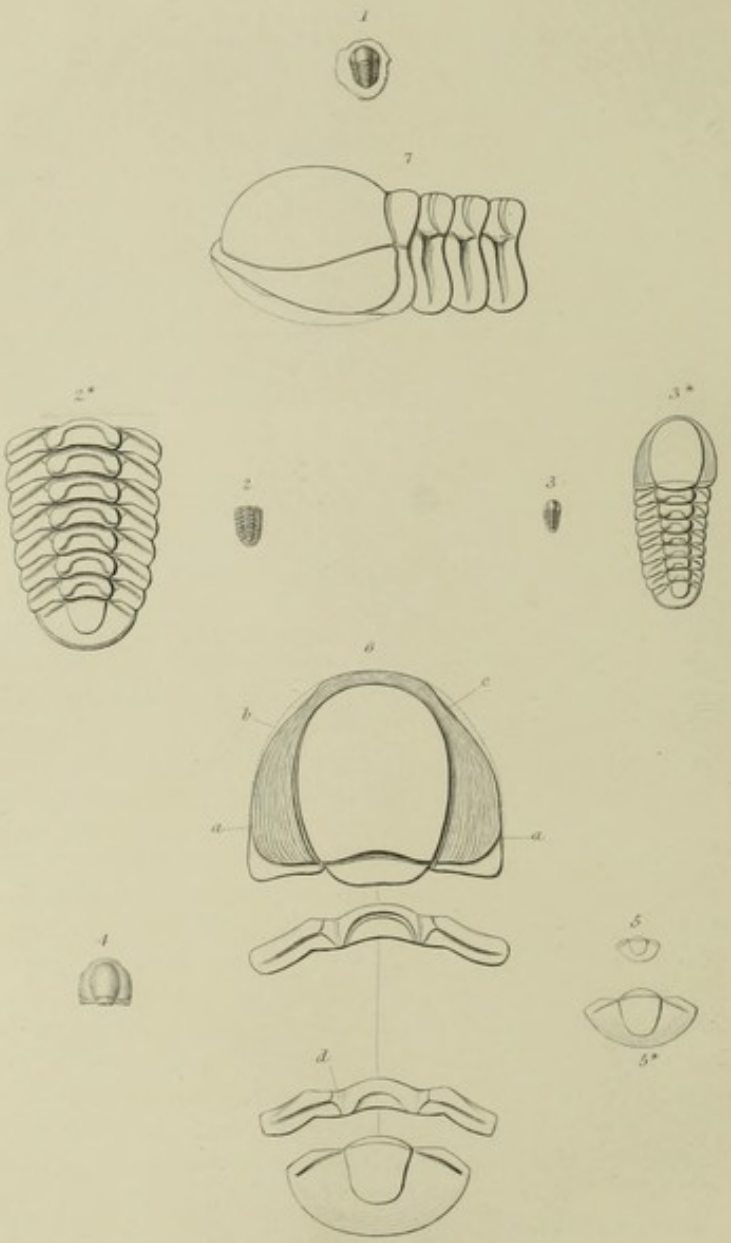
Localities.—Rhiwlas, near Bala, not unfrequent. We have specimens from Koenigshof, Bohemia, in the uppermost part of the Etage D. of Barrande.

J. W. SALTER.

August, 1853.

Geological Survey of the United Kingdom.

CYPHONISCUS
(Silurian)



CYPHONISCUS SOCIALIS — *Salter*

W. H. Baily Lith.
E. Forbes direxit
J.W. Lowry Sc

BRITISH FOSSILS.

DECADE VII. PLATE IX.

CYPHONISCUS * SOCIALIS.

[Genus CYPHONISCUS. SALTER. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Body oval, convex; head large; glabella oval, gibbous, without lobes; facial sutures marginal in front, then in an oblique and nearly straight line to the *outer* margin; free cheeks very narrow. [Eyes very forward, minute, linear.] Thorax with seven convex segments, the pleuræ with fulcrum and groove, their ends truncate, not produced; tail small, of few (1?) segments, its axis entire.]

DIAGNOSIS. *C. minutus, glabellâ lævi, genis undique lineatis multo majore; sulco verticali profundo, per genas tracto, et ad angulum posticum obtusum sursum curvato; thoracis axi pleuras æquante; fulcro paullo intra dimidium posito; caudæ axi integro.*

SYNONYMS. *Cyphoniscus socialis*, SALTER (1852), Report Brit. Assoc., p. 57.

This minute crustacean literally swarms in certain reddish patches of the limestone at the Chair of Kildare, but has not yet been observed in other localities. It is evidently a member of the Olenoid group, to one genus of which, *Triarthrus*, it bears a strong resemblance in certain particulars. But it differs from it and all its congeners in the inflated form of the glabella, which is also destitute of lobes, in the small obscure eyes, and the fewness of the segments of the body. The eye has not been yet discovered, and there is so little indication of its place, that the animal might be supposed to be a blind trilobite, but that there is no instance known of a species with separable facial sutures being destitute of these organs. In the very few trilobites now admitted to be without eyes, *Agnostus*, *Ampyx*, some *Trinuclei*, &c., the facial suture is soldered. The converse however does not hold good, several genera with soldered sutures having large and well-developed eyes.

Description.—Length about one fourth of an inch. The general form is long oval or long ovate; the head, which is the broadest

* Name from κύφος, a convexity, and ὀνίσκος, asellus. Linnæus has used 'Oniscus' for small Crustacea of somewhat similar form.

part, occupies two fifths of the entire length; it is regularly and highly convex. The glabella is encircled by a distinct furrow; it is smooth, almost gibbous, broadest in the middle, and forming a complete oval, if the neck segment be included: there are no traces of glabella lobes, but the neck furrow is strongly marked.

The cheeks are not half the width of the glabella, steeply bent downwards, and seen without the free cheeks, much narrower forwards than towards the blunt squarish posterior angle. They are confluent in front with a narrow anterior margin. Their posterior side is traversed by the continuation of a deep neck furrow. This furrow runs near the edge at first, but soon diverges, and towards its end turns abruptly upwards to the outer margin of the cheek (fig. 6, *a*). The posterior margin, thus separated, is rendered conspicuous by being, like the glabella, quite smooth, while the rest of the cheek is covered by a lineation parallel to the edge, which also continues round the front.

The facial suture (see figs. 6 and 7) is marginal for a less distance than the width of the glabella in front, then turning downwards in a gentle curve, it crosses the cheek very obliquely, and ends on the *outer* margin at the point where the neck furrow turns up to meet it. There is a slight indentation in it opposite the front end of the glabella, indicating the place of the very forward eyes, but its general course is but very little bent or sigmoid. The free cheeks are absent in all our specimens, but from the shape of the rest of the head, and analogy with similar forms of trilobites, they must have been quite linear, rather broadest in front to complete the half-elliptic form of the head, and attenuated behind. We have restored them, *b*, and indicated the probable position of the small eyes at *c*, in fig. 6.

The thorax is nearly parallel-sided, often partially coiled up, of seven* convex rings, the axis of which is prominent and as broad as the sides, in front rather broader. The sides of the axis in each segment are not sharply defined by a longitudinal furrow, but run out a little into the groove of the pleuræ, as in fig. 6, *d*. These latter are truncate and square at the ends, facetted anteriorly for rolling up, and have the pleural groove very deep, and reaching nearly to the tip, where it ends abruptly; it divides the pleura unequally,—the anterior portion is the largest. The fulcrum is placed at less than half distance from the axis, and from a little beyond this point

* At least in the only specimen (not a full-grown one) which has still the parts in *situ*. One specimen has the appearance of possessing another ring, but it is indistinct.

the pleuræ are bent downwards. The convexity of the body rings, however, though considerable, is much less than half that of the head.

Tail semicircular, the axis is entire and convex; it is marked above, like the thorax joints, by a strong articular furrow, but has no other visible segments; it occupies fully one third the width of the tail, in some specimens more,—and is surrounded by a distinct furrow. The sides are convex to their edge, the upper furrow strong and abruptly terminated; and no others are visible. The axis is smooth, the sides lineated parallel to the margin of the tail.

Variations.—We have not a sufficient number of perfect specimens to ascertain what may be the amount of variation in proportionate width, &c.; but it is evident that some have a longer and wider axis to the tail than others, and this would probably accompany a similar difference in the head and thorax; fig. 4 shows a specimen, full grown, in which the axis is considerably larger than in figs. 2 or 5.

Affinities.—We have already mentioned the close relation this has with the American genus *Triarthrus*, and the relation is perhaps the most intimate in those points in which they differ from the rest of the *Olenidæ*. Indeed were it not for *Triarthrus*, of whose affinity with *Olenus scarabæoides* there can be no doubt, it would have been very difficult to assign a systematic place to this minute and anomalous Crustacean. It has neither the parabolic glabella with its shallow parallel furrows, the long smooth eyes connected to the glabella by an ocular ridge, or the numerous body rings of many *Olenidæ*, but in the shape of the pleuræ, and in the short rounded tail, *Triarthrus* agrees with it, and they are similar too in a peculiar character quite anomalous in the group, viz., that the maxillary portion or free cheek is so reduced in size and length, that the facial suture ends on the *external* margin, and the posterior angle of cheek is turned upward to meet it, and supply its place. Of course in this case there can be no spine to the hinder angle, and thus another usual character of the group is lost. The inflation of the glabella, the minute eye, which does not seem to possess even the usual covering lobe (very distinct in *Triarthrus*), and the few body rings, 7 instead of 16,* fitted much better than *Triarthrus* for coiling up, give so distinct a character that we conceive it to form a very natural genus.

* Hall says 13, but there are as many as 16, exclusive of 4 or 5 in the tail, in a fine specimen presented to us by Dr. Bigsby.

There is one genus, however, to which, though perhaps not identical, our fossil has a very great similarity, we mean *Tiresias*, described by Professor M'Coy, from the head only. The species *T. insculptus*, found also in the Chair of Kildare, differs from ours by its greater size, the glabella pyriform instead of half-egg-shaped, and marked on the sides by two pair of glabella furrows; the posterior angles of the head too are prolonged. But in the general form, lineation of the cheeks, &c., the two are very much alike, and when more specimens are found, it is quite possible that *Cyphoniscus* may be found to be a sub-genus only of *Tiresias*, distinguished by its lobeless glabella and blunt not produced head angles. That genus, like ours, certainly had a minute maxillary portion or free cheek, and judging from the description, the eyes appear to have been also linear and very forward.

British Localities and Geological Position.—Llandeilo Flags; Limestone of the Chair of Kildare, county of Kildare, Ireland.

Explanation of Plate IX.

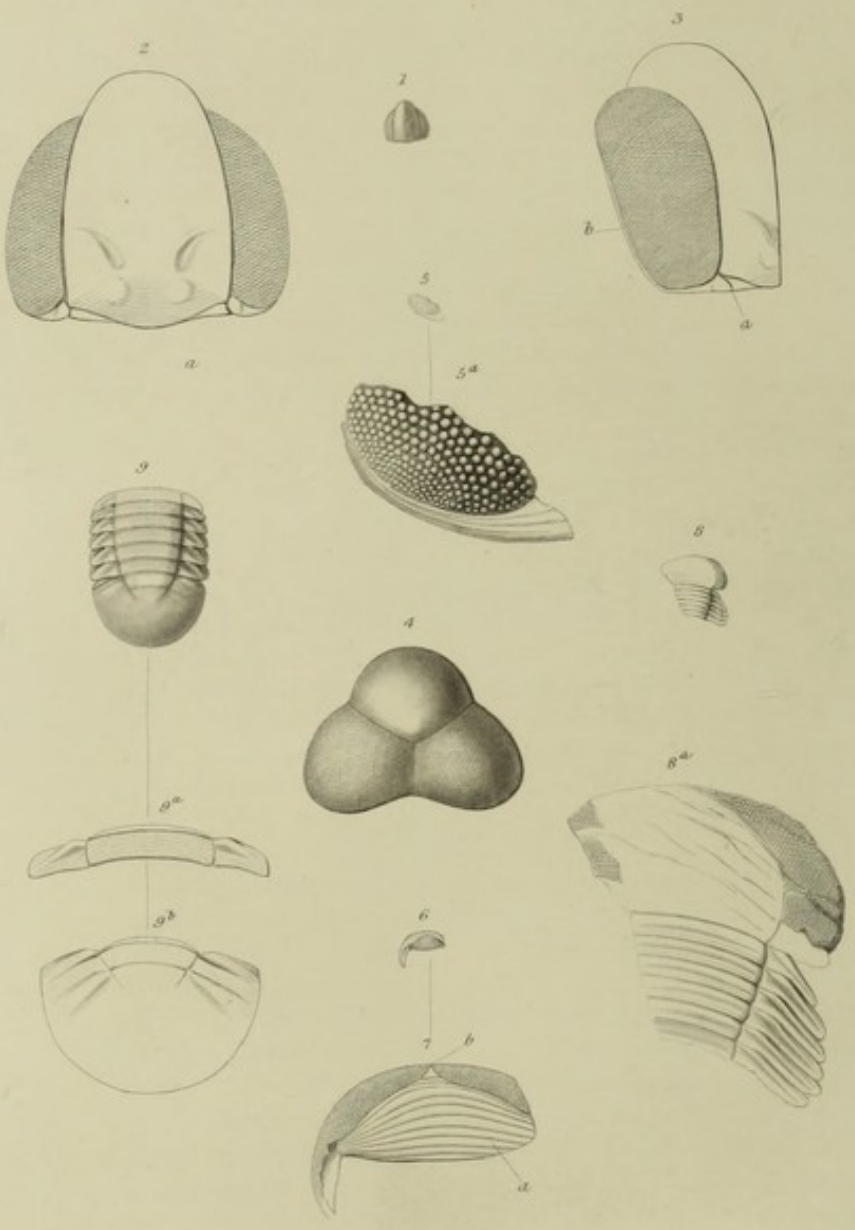
Fig. 1. Small specimen, partly coiled.
Fig. 2. Young individual, with tail and seven thorax joints. In this specimen there is a portion of an eighth segment above the others, but this is probably part of the neck segment.
Fig. 2*. The same, magnified, the axis of the tail not very large.
Fig. 3. Young imperfect specimen, seven body rings.
Fig. 3*. Do., magnified.
Fig. 4. Full grown head.
Fig. 5. Full grown tail of a variety with larger axis than usual.
Fig. 5*. The same, magnified.
Fig. 6. Magnified figure of the head, two thorax rings, an anterior and posterior one, and tail. At *a*, the neck furrow curves upward, and terminates against the outer margin; *b*, is the restored free cheek (lost in all our specimens); *c*, the position of the eye indicated; *d*, the side part of the axis of the thorax rings, running out into the pleural groove.
Fig. 7. Lateral view of the head and three first thorax rings; the free cheek and eye are indicated as in the last figure.

J. W. Salter.

August, 1853.

Geological Survey of the United Kingdom.

ÆGLINA
(Silurian)



Figs. 1–7. ÆGLINA MIRABILIS — *Forbes*

8 — *sp* (Æ. MIRABILIS?)

9 — MAJOR — *Salter*

T. B. Wilson del. E. Forbes direx. J. W. Lowry lt.

BRITISH FOSSILS.

DECADE VII. PLATE X. Figs. 1 to 7.

ÆGLINA MIRABILIS.

[Genus ÆGLINA. BARRANDE. (Sub-kingdom Articulata. Class Crustacea. Order Entomostraca. Tribe Trilobitæ or Palæadæ.) Body oblong, the extremities equal, rounded; head convex, glabella large, parabolic, not distinctly lobed; eyes very large, occupying the whole or nearly the whole cheek, coarsely granulated (externally?); facial suture ending on the posterior margin close to the axis, no rostral shield; thorax with 5 or 6 rings, the axis broad, the pleuræ facetted and grooved; tail large, the axis of 2 or 3 rings, abbreviated; the sides few-ribbed, or nearly smooth. *Cyclopyge*, CORDA.]

DIAGNOSIS. *Æ. capite gibbo, glabellâ parabolicâ longâ, frontem impendente, et retrorsum lobum cervicalem fere excludente; oculis maximis, totam genam occupantibus, et sub margine glabellæ frontali connatis.*

Æglina mirabilis, FORBES, MSS.

Of all trilobites with eyes, this has the largest and most conspicuous ones, for they cover not only a large part, but the entire side of the head, leaving scarcely a margin. All the species, and there are four or five described, are furnished with these disproportionate organs of vision, but in that which forms the subject of our plate they are more largely developed than in any other, for the two eyes meet in front of the glabella, dividing that portion altogether from the front margin, and occupying therefore the whole length of the facial suture.

The genus was first sufficiently described in M. Barrande's "Notice Préliminaire sur le Système Silurien de Bohême," and is much more fully treated of in his lately published work. Previous to his visit to England, the group was supposed to be a new one; but he kindly showed us in his unpublished figures several forms of this remarkable group, none, however, in which the development of the eyes is carried to such an extravagant degree as in the British species. It is thought better, therefore, to figure so conspicuous a

genus from the materials already acquired, rather than to wait for the chance of finding a perfect specimen.

M. Corda, in his voluminous but most inaccurate work, has given a drawing of this genus under the name of *Cyclopyge*,* in which the large reticulated eyes are mistaken for a granulated glabella, and the facial suture made to travel through the middle of them !

Description.—The head is three lines long by about four wide, very gibbous, almost as deep as broad. The glabella is of a parabolic form, and projects forwards beyond the eyes so as to break the oval contour of the head ; behind it invades the neck segment, and almost obliterates it, leaving only a small portion on each side, which is separated from the glabella by a rather strong furrow. Lobes none, but a short oblique oval indentation on each side occurs at about the lower third of the glabella, the pair of indents being placed as far from the sides as from each other ; a gentle swelling occurs beneath each impression. Some transverse arched striæ run across the base of the glabella, which otherwise appears to be smooth. Eyes very large, and occupying every part of the cheek except the lower inner angle ; they are very convex, and bent round towards the under surface on the sides ; they are still more convex in front, where the two eyes meet and coalesce along a median line, and are there overhung by the gibbous point of the glabella ; they occupy, therefore, the entire length of the facial suture, and quite shut out the usual anterior margin. When the head is viewed on the under side, there is a short triangular space (see fig. 7, *b*) unoccupied by the lenses, which is a prolongation of the rostral portion ; but except this small space, and the lower corner before mentioned, there is nothing to be seen of the anterior segment but that portion which is on the lower surface. It is not very easy to reckon the number of lenses in the eye, but they are rather large in comparison with *Asaphus* or *Illænus*, and there are not more than 1,100 or 1,200 in each eye. They were probably convex externally (as in *Phacops* and *Cheirurus*), and not covered up by a level cornea ; when they have fallen out, concave pits with prominent interspaces are left upon the cast of the inner surface. The facial suture must of necessity follow the outline of the glabella in this species, and accordingly we have one specimen in which the cheeks, that is the eyes, are absent, and a thin rim only surrounds the glabella. At its posterior termination, however, this suture leaves the inner and lower angle of

* Prodrome Monogr. Böhm. Trilob. (1847), f. 32. (*Cyclopyge megacephala*, Corda. *Ægle redivica*, Barr.)

the eye, and cuts the small triangular neck segment in a line which turns obliquely inwards (see fig. 3, *a*). The inner corner, therefore, of this free cheek has a projecting angle inwards, and this has a prominence just at its tip. The under side of the head (fig. 7) shows a flat and rather broad rostral portion of a transversely elliptical shape, pointed at the ends; it is crossed by distant strong sharp-edged striæ, about nine or ten in number.

British Locality and Geological Position. — LLANDEILO FLAGS. Limestone of Portrane, county of Dublin (Coll. Geol. Survey).

ÆGLINA—SP. Fig. 8.

The specimens from Ireland just described show only the head, and for thorax and tail we have recourse to two specimens from Wales, which are certainly referable to the same genus, but only doubtfully so to the present species. The first (fig. 8), measuring four lines in length, shows the characteristic head and eyes of the genus joined to a thorax of six rings. The segments are narrow in proportion to their width, but this is in part due to slaty cleavage. The axis is not much arched, it is by far broadest in front, where it is two or three times the width of its abbreviated pleura; it is narrower backwards, and the pleuræ on the other hand increase in length; a strong axal furrow separates the wide axis from the sides. The pleuræ are grooved rather more deeply, owing to pressure; they are facetted anteriorly, and have the fulcrum placed at about one third from the axis, from which point they bend a little backwards and downwards. The front pleura is more strongly facetted, more bent back, and has the fulcrum nearer the axis than any of the rest, it is also somewhat wider than the others; all are blunt at the terminations.

The entire thorax in this specimen is equal in length to the head, but this latter part is so imperfect, that we cannot tell whether the glabella was prominent, and divided by a strong sulcus from the eyes; it appears not to have been so, and if this be the case, it must belong to a different species; it is however too imperfect to name.

Locality and Geological Position.—LLANDEILO FLAGS. Black slate underlying the limestones, at Stoneyford, near Haverfordwest, Pembrokeshire; (in company with Graptolites).

The other and more perfect specimen, found in Anglesea, North Wales, is so much larger than the *Æ. mirabilis*, that in the absence

of the head for comparison, we are compelled to regard it as a distinct species. It may be called—

ÆGLINA MAJOR. Fig. 9.

DIAGNOSIS. *Æ. uncialis et ultra, lævigata; thorace regulariter convexo, sulcis axalibus haud profundis; axi lato, antice ter, postea bis pleuras superante; pleuris truncatis obtusis, paullum deflexis, fulcro ad tertiam posito; caudâ magnâ, semicirculari, regulariter convexâ nec marginatâ; axi latè conico, ad apicem obscuro, annulis binis; lateribus trisulcosis, suleo antico profundo, reliquis obscuris.*

This specimen has lost the head and first thorax ring.* The remaining portion measures three quarters of an inch in length, by seven lines in breadth, and of this the tail is four and a half lines long, and equal to the thorax. The general convexity is considerable, and equal over all parts; the axis is separated from the pleuræ by a sharp but not deep sulcus, and is broader in front than behind, in the proportion of four to three. The anterior ring being broken off, however, we can only compare the axal portion with the second pleura, and it appears to be rather less than three times its width. The last pleura is half as wide as the axis of that segment. The pleuræ are blunt at their ends, facetted anteriorly, and have the fulcrum placed at one third from the axis, from which point they bend a little backward and downwards with the general convexity. The pleural groove is less deep than in the former specimen, probably because this one has not suffered longitudinal pressure.

The tail is a semicircle, equally and regularly convex, with no raised border. The axis is but very slightly marked, it is broad above, then rapidly narrowing, and soon lost before reaching one third down the tail. One distinct ring is marked off on its upper portion. The sides have the usual facetted external angle, and the equally constant strong upper furrow (which might be called the articulating furrow, being always present in some form or other); below this there is a second much fainter one, at the distance of a thorax segment's breadth, parallel to the upper furrow; and a third closely approximating to the second at its origin, and then diverging downwards. These furrows, except the uppermost one, are faint. The tail is marked in some parts with a tranverse lineation, otherwise it is smooth.

* Unless this may be a 5-ringed species, which is quite possible.

Locality and Geological Position.—LLANDEILO FLAGS, (lower portion?) Glan-y-gors, three miles south-east of Llanerchymedd, Anglesea, in nodules among black shale, containing also Graptolites and Lingula.

Affinities.—Æ. rediviva, the first described species of this genus, differs from *Æ. mirabilis* by a much broader glabella, and smaller eyes which do not meet in the front; nor is this latter remarkable character known in the other Bohemian species. In other respects, in the tail and six thoracic rings of the same general form, *Æ. rediviva* is very like our species, the axis of the thorax being very wide in front, while the corresponding pleuræ are small; it has also a similar pair of glabella furrows. *Æ. pachycephala* has large but angular eyes, and only five thoracic segments; the other species, *Æ. speciosa*, Corda, does not require comparison.

The affinity of the genus itself is pretty clearly with the Asaphoid group, with which, especially with such forms as Nileus and Illænus it has many points in common. The form of the thorax rings and the smooth almost lobeless glabella are indications of this; and on the under side of the head, the tranverse striated rostral portion strikingly recalls the analogous part of Illænus (see Decade II., pl. 2. fig. 4), although the rostral shield is not separate. The grooved pleuræ, facetted for rolling up, and truncate at their ends, are more like those of Asaphus; and the tail, with its abbreviated axis and few obscure lateral ribs, reminds us of Ogygia Portlockii. Its affinities seem, therefore, more evident with the Asaphoid group than with Bronteus, to which in other respects the genus does not seem very closely allied. But in the extraordinary development of the eyes at the expense of the cheeks, it has no analogue that we know of, except the Remopleurides, as figured in our plate 8 of this Decade. With that group it appears to have no real affinity.

The genus is only yet known in the Lower Silurian rocks.

EXPLANATION OF PLATE X.

Fig. 1. Perfect head of *Æ. mirabilis*. Portrane; natural size.

Fig. 2. The same, magnified; at *a*, the small prominences beneath the glabella furrows are seen.

Fig. 3. The same, side view; at *a*, the posterior termination of the facial suture; *b*, the scarcely perceptible outer margin of the cheek.

Fig. 4. Front view, showing the large reticulated eyes meeting in front.

Fig. 5. A portion of the lower end of the eye, and inner angle of the free cheek ; same locality.

Fig. 5 *a*. The same, magnified, and showing the convex lenses closely set together.

Fig. 6. Under surface of the head ; same locality.

Fig. 7. The same, magnified ; at *a*, the broad striated rostral shield or clypeus ; *b*, its forward prolongation between the eyes.

Fig. 8. *Æ. sp.* (*Æ. mirabilis?*) from Stoneyford, Haverfordwest ; much distorted and pressed into a shorter form by cleavage ; 6 thorax segments.

Fig. 8 *a*. The same, magnified.

Fig. 9. *Æglina major*. Llanerchymedd, Anglesea ; natural size.

Fig. 9 *a*. Shows the penultimate thorax ring, magnified ; the axis but little more than twice the width of the pleura ; in the anterior ones the axis is wider ; *b*, the tail, similarly magnified.

J. W. SALTER.

August, 1853.

MEMOIRS

OF THE

GEOLOGICAL SURVEY

OF

THE UNITED KINGDOM.

Figures and Descriptions

ILLUSTRATIVE OF

BRITISH ORGANIC REMAINS.

DECADE XI.

TRILOBITES.

(CHIEFLY SILURIAN.)

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PREFACE.

THE plates of this Decade were engraved a year ago, but the pressure of other duties compelled Mr. Salter, the late Palæontologist of the Geological Survey, to postpone the descriptions. That gentleman has now completed the work at my request, he being at present engaged on a Monograph of all the British Trilobites for the Palæontographical Society.

Following our usual plan, those genera only have been illustrated which are rich in material for the engraver, or those which, though less perfect, are so rare and interesting as to render it desirable to publish them, even from fragmentary materials. The genus *Olenus*, characteristic of the lowest Silurian rocks of all the northern parts of Europe, is an instance in point. All the British species, save one or two, are fragmentary, but these fragments illustrate several of the important sub-genera into which this genus of the primordial Silurian of Barrande is divisible; hence a second plate of it is given. *Æglina*, pl. IV., is another case of the same kind. The genus was previously illustrated in Decade 7, from imperfect pieces of the head and body. We now possess the entire form of this genus, which is eminently Lower Silurian in its range.

The genera *Stygina*, *Salteria*, *Trimerocephalus*, *Angelina*, *Agnostus*, and *Staurocephalus* have not before been illustrated in the Decades. *Asaphus*, before given in Decade 2 as to one of its sub-generic groups, now presents us with a British type of the sub-genus *Isotelus*, which is so common in America, but rare in Europe. Lastly, a fresh discovery, by the author of this Decade, of a gigantic *Paradoxides* in the Lingula flags of Pembrokeshire, has made it possible to figure this characteristic genus from perfect materials.

RODERICK I. MURCHISON,
Director-General.

Geological Survey Office,
28, *Jermyn Street, London,*
November 1864.

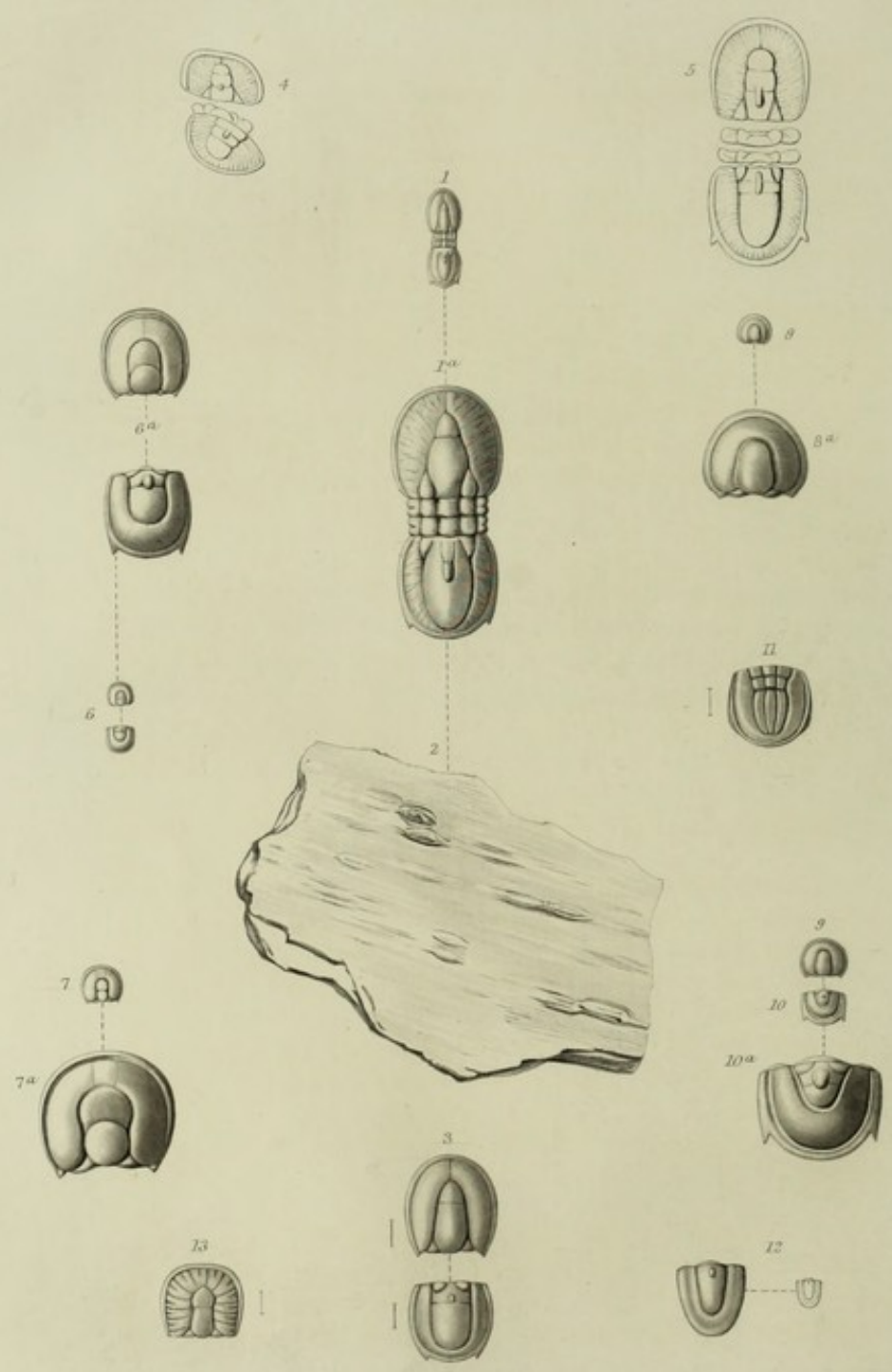
NOTE.

The reader must understand that the numerous references to Memoirs Geol. Survey, vol. iii. (ined.) throughout this Decade apply to the forthcoming Memoir on the "Geology of North Wales," by Professor Ramsay; with an Appendix on the Fossils by Mr. J. W. Salter.

Geological Survey of the United Kingdom.

AGNOSTUS

(Lingula Flags and Lower Silurian)



Figs. 1–5 AGNOSTUS PRINCEPS, *Salter.*
6–7. —— McCOYII, *id.*
8–10. —— TRINODUS, *id.*
Fig. 11 AGNOSTUS TRISECTUS, *Salter.*
12 —— SP.
13 —— MOREA, *id.*

C.R. Bone del.t. J.W. Salter direx.t J.W. Lowry sc.

BRITISH FOSSILS.

Decade XI. Plate I. Figs. 1—5.

AGNOSTUS PRINCEPS.

[Genus AGNOSTUS. Brongniart. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Agnostidæ.) Minute trilobites, with caudal and cephalic shields nearly equal. No eyes, no facial suture. Two body rings.—Ranges from Lingula flags to Caradoc rocks.]

Diagnosis. *A. latus, 7 lineas longus, scutis rotundato-quadratis, ad limbum rugoso-radiatis. Glabella subconica, tuberculo centrali antico, sulcis duobus transversis, lobis basalibus magnis instructa; sulcoque verticali ad marginem ducto. Annuli corporis valde nodosi. Cauda axe magno rotundato, fere per totum caudæ extenso; margine edentulo.*

Synonyms. *A. pisiformis*, Salter (1859), in Siluria, pp. 45, 53, foss. 4 and 9; *A. princeps*, id., * Memoirs Geol. Survey, vol. iii. (ined.), pl. 5.

Certainly the lowest and most rudimentary form of Trilobite, and greatly resembling in some respects the young stages of higher groups. But *Agnostus* shows at once its mature character in the possession of a large caudal shield, well developed, and generally quite as large as the head. The surface is sometimes much ornamented, especially the border, and the lobes are often well marked out both in the cephalic and caudal portions. The leading character of the Trilobite family, the facial suture, is altogether absent, and there are no eyes in any of the species.

When Brongniart described this fossil for the first time, he evidently could not tell what to make of it. To describe the head and tail as distinct animals was natural enough, but when he turned the hinder part of the head forwards, and suggested that the basal lobes of the glabella might be eyes, and the forehead lobe the abdomen, &c., one feels that he was justified in saying, "*On ne sait à quelle classe des règnes organiques le rapporter.*" Beyrich first gave the entire form in his treatise, "Ueber einige Böhmische Trilobiten," 1845.

* The reader must understand that the numerous references to Memoirs Geol. Survey, vol. iii. (ined.) throughout this Decade apply to the forthcoming Memoir on the "Geology of North Wales," by Professor Ramsay; with an Appendix on the Fossils by Mr. J. W. Salter.

It is instructive to find this, the most rudimentary form, associated with other genera in which all the characters of the group are fully developed, in the same primordial zone. But it is to be noted, that either by excessive reduction, as in *Agnostus*, or excessive multiplication of segments, as in *Paradoxides*, the genera at this early period exhibit a defective organization as compared with those of later formations. There is no sort of equality between an *Agnostus* or *Olenus* and a *Phacops* or *Phillipsia*.

The figures we give of *A. princeps* possess more than an usual interest, for they represent some of the oldest fossils known in N. Wales which occur in the lower part of the "Lingula flags," considerably below the characteristic *Linguloe* of the formation. They are in countless numbers in the black slates near the waterfall of Felyn Rhyd, near Maentwrog, and are there associated with a new *Olenus*, and with rare specimens of *Lingula*. That they are characteristic of the formation is evident from the fact that with the reappearance of black earthy slate in the upper division of the formation, the *Agnostus* reappears also in abundance, and our figure 3 is from that part of the series. In S. Wales other and new genera accompany the *Agnostus* in the lowest portions of the deposit.

Description.—Not half an inch long, though frequently elongated by pressure beyond that length. The general form of the head and tail is about two-thirds of a broad oval, truncated next the thorax, pretty regularly convex, and strongly trilobed; the thorax joints do not together occupy one-third the length of the head, and are narrower than its width.

The head is a little longer than broad, smooth, with a narrow distinct border. The glabella about as wide as the cheeks below, but tapering forwards; and divided, at more than two-thirds its height, by a transverse furrow which separates it into two parts, the lower oblong oval smooth, without lateral indentations, and the upper a spherical-triangular lobe, from the end of which a dividing line runs forward to the margin. A conspicuous pair of triangular lobes lie at the base of the glabella, in part subtending the convex cheeks, which are narrow below, broadest above, but narrower again in front, where they are separated by the dividing line.

Thorax of two nodose joints, the anterior largest. Each is strongly trilobate; the pleuræ convex, and with a strong groove toward the tips, making them appear notched (fig. 1 *a*). The axis too is trilobate, the central lobe very prominent, and strongly dis-

tinguished from the lateral and more forward portions; these are obliquely ovate,—the centre lobe is pyramidal.

Tail nearly of the same shape as the head; the margin furnished, toward its hinder edge on each side, with a prominent tooth. The axis is very broad and convex, somewhat clavate, and reaching nearly to the margin, a space the width of the latter being left between; it is of greater breadth than the sides (even including the narrow margin). The front pair of lobes are distinct, rounded-triangular, and their own diameter apart; the second pair (fig. 3, 4) occupy a less width, are not very distinctly circumscribed, and are divided from the large terminal lobe by a faint transverse furrow. The tubercle on the intermediate pair is prominent but short; it scarcely invades the terminal lobe, and is of nearly the same shape in all our specimens, however distorted.

Variations.—Our larger specimens fig. 1, 4, (fig. 5 is magnified) from the lowest and upper *Lingula Flags* have the axis of the tail rather longer and somewhat more pointed than in fig. 3, but this may be entirely due to elongation from pressure. The terminal lobe of the glabella too is shorter in proportion in the former, but there seems to be no other real difference. The rugose veins which ornament the limb are always conspicuous in well-preserved specimens, but are much obliterated in less perfect ones, as our figures will show.

Affinities.—Compared with Angelin's incorrect figures of *A. pisiformis* and *A. planicauda* (I have Swedish specimens of those species before me), *A. princeps* has the axis of the tail (though Angelin's figures have it too short) decidedly longer, and reaching so far as to leave a space, between it and the margin, of only the breadth of the latter; and the tubercle, which Angelin represents as elongated and reaching far down the middle of the axis in his *A. planicauda*, is very short and prominent in our species. In both these respects they agree better with Swedish specimens of *A. pisiformis* than with Angelin's figure; and if it were not for the longer glabella and tail axis, the larger size and the decided radiation of the limb in our fossil, we should have united ours with the well-known Scandinavian form. Our second variety β is more like it than the first and more ornamented one, α.

In size *Agnostus princeps* nearly rivals the largest of the Swedish forms, *A. reticulatus* and *A. aculeatus*, Angelin, pl. 6, fig. 10, 11. These, however, show a strong reticulation of the

surface, instead of the more or less faint radiations of the British fossil. And *A. exsculptus* (fig. 8), which is still more like ours, has no posterior spines, and a very short glabella.

We may notice two distinct varieties, possibly species.

1. *A. princeps, α. ornatus,—glabellâ fere trilobâ antice obtusâ, limbo radiato-sculpto,* pl. 1, figs. 4, 5.
2. *A. princeps, β. rudis,—glabellâ bilobâ, anticè acutiori, limbo vix radiato,* pl. 1, figs. 1, 2, 3.

British Localities and Geological Position.—Var. *α.* Lower and Upper Lingula Flags, figs. 4, 5, from Carreg Wen, near Borth, Portmadoc. Var. *β.* Lower Lingula Flags, figs. 1, 2, Pen-y-foel, a hill close to the Waterfall, Maentwrog, N. Wales (in great abundance). Upper Lingula Flags, fig. 3, Penmorfa Church, near Tremadoc. The species is also found in the Upper Lingula Flags (Black Shales) of Whiteleaved Oak, Malvern, where it was first collected by the late Mr. Hugh Strickland. Upper Tremadoc Slate, Portmadoc. Lower Llandeilo, St. David's Head, rare.

If I were disposed to divide the genus, as Corda and McCoy have done, the *Agnostus tardus,* Beyr., *A. glabratus,* Ang., and *A. trinodus,* Salter, would form a separate group. I prefer to regard them as forming a sub-genus only, *Trinodus,* while the species with transverse lobes to the glabella and caudal axis may stand as *Agnostus* proper, and *Condylopyge,* Corda. Lastly, the smooth forms with all but undivided caudal and cephalic shields (*A. integer,* Beyrich, *A. glandiformis,* Angelin), &c., would form a fourth division, *Phalacroma,* Corda, as follows:

Section 1. *Condylopyge,* Corda.—Glabella distinct and lobed, the forehead lobe wider than, or as wide as, the posterior ones. Ex. *A. Rex,* Barrande; *A. McCoyii, A. Morea,* Salter, &c.

Section 2. *Agnostus,* Brongn.—Glabella distinctly lobed, the forehead lobe narrower. Ex. *A. pisiformis,* Brong., *A. princeps,* Salt.

Section 3. *Trinodus,* McCoy.—Glabella not lobed. Ex. *A. tardus,* Barr., *A. trinodus,* Salter, &c.

Section 4. *Phalacroma,* Corda?—Glabella or caudal axis scarcely marked out at all. Ex. *A. integer,* Beyr. English examples doubtful.

The foregoing Species belongs to *Section* 2.—AGNOSTUS proper.

[AGNOSTUS PISIFORMIS, *Linn.*

I subjoin a description of the Swedish species, as it is necessary to show in what respects this long-known primordial species differs from the preceding, and also from the *A. McCoyii*, under which name I have designated the species common in the Llandeilo flags of Britain, and which was formerly published in the Silurian System as *A. pisiformis.*

SYNONYMS. *Entomostracites paradoxus* and *E. pisiformis*, Linn., Iter Scan. 122 ; Syst. Naturæ, ed. 16, vol. iii. 160 ; *E. pisiformis*, Wahl. ; *Agnostus pisiformis*, Brongn. (1822), Crust. Foss. pl. 4, fig. 4 ; Angelin, (1852), Pal. Suec. t. 6, fig. 7 (*A. planicauda*, ib. t. 6, fig. 9, variety).

DIAGNOSIS. *A. elongatus, 5 lineas longus, valde trilobus, capite et pygidio ovali-truncatis, lævibus. Glabella longiconica, in duas partes, anticam trigonam parvam, posticam oblongam, divisa. Cauda axi magno, longo, lobato, apice obtuso ; marginibus angustis brevidentatis.* Locality. —*Lingula flags of Sweden.*

Comparing, then, the Swedish figure with that given of our next species, it will be seen that the general shape of *A. pisiformis* is much longer, and the glabella narrower and more pointed ; its upper lobe, instead of being larger than the lower, is much smaller, and from its apex a longitudinal furrow runs to the front margin. In these respects it agrees with our *A. princeps*, as before said, but differs from the Llandeilo fossil *A. McCoyii.*

There are also considerable differences in the caudal shield, as will be seen by referring to the following figures.]

Section 1.—CONDYLOPYGE.

AGNOSTUS MACCOYII.

PLATE I. FIGS. 6, 7.

DIAGNOSIS. *A. oblongus, depressus, capite pygidioque rotundatis, et ad thoracem contractis. Glabella oblonga, antice vix incrassata, in duas partes sub-æquales, posticam circularem, anticam lunatam, sulco curvo divisa. Limbus undique æqualis, lineis impressis radiatis sæpe notatus, margine angusto. Cauda capiti simillima, sed axi clavato brevi, lobo terminali majori semielliptico, mediano transverso brevituberculato, lobis anticis prominulis. Margo distinctus, brevidentatus.*

SYNONYMS. *A. pisiformis?* Murch. (1837), Sil. Syst. pl. 25, fig. 6 (fig. 4 in text), not of Brongniart ; *Diplorrhina triplicata*, McCoy

(1851), Pal. Foss. Woodw. Mus. pl. 1 E., fig. 11 [not of Corda]; *Agn. McCoyii*, Salter (1854), in Morris's Catal. Brit. Foss., 2nd ed.; id., Mem. Geol. Surv., vol. 3 (ined.), pl. 13, fig. 8.

A very frequent fossil in the black Llandeilo flags of Builth, in Radnorshire, but, as far as I know, not found elsewhere. It accompanies the *Ogygia Buchii* and *Ampyx nudus*, figured in a former decade, and seems, like many others of the genus, to have delighted in a habitat of black carbonaceous mud, now converted into shale.

Description.—A minute species, never half an inch long, even when head and tail are taken together (the body rings have not yet been found). The head is rounded, not oblong, forming about two-thirds of a circle, the base being contracted where it joins the thorax. The tail is nearly of the same shape, a little more oblong. In both the convex limb is nearly equal all round, and the glabella and caudal axis are short and obtuse. The outer marginal rim is narrow but prominent all round, and the two short marginal teeth are placed far back on the caudal border.

The general shape thus given, we may notice a few details. The glabella in front is remarkably broad and obtuse, always as broad, and sometimes (fig. 7) broader than in the hinder moiety. A curved depressed line separates the front portion from the hinder lobe, and the two portions are about equal in length. The basal lobes are small and inconspicuous.

The limb is gently convex, and slopes equally on all sides away from the central lobe, from which a sharp furrow separates it all round; one or two faint depressed radiating lines occur on the limb. The margin is strong and continuous, but narrowest posteriorly, where it ends on each side with a projecting tubercle or minute spine. The small basal or neck-lobes are transverse.

Body rings unknown. (They might surely be found at Builth by collectors.) Tail of the same shape as the head, broadest posteriorly, margined all round distinctly, and with a pair of spines which occur on the sides, so far back as to be on a level with the hinder margin. The axis is short and obtuse, not reaching much above halfway down the tail, and leaving a broad equal limb. The axis is divided very unequally by a transverse line into an upper and a lower lobe, at the junction of which is the prominent tubercle characteristic of the genus. The lower or terminal lobe of the axis is as broad as long, the upper lobe twice as broad as long; a pair of minute lateral

transverse lobes at the margin of the axis lie above this, one on each side.

Locality and Geological Position.—Upper Llandeilo Flags. Builth, Radnorshire; Llandeilo, Caermarthenshire; Marrington, Wilmington, and Shelve, Shropshire.

AGNOSTUS MOREA.

Plate I. Fig. 13.

Diagnosis. *A. minor, capite radiato, radiis profundis bifidis. Glabella angusta subclavata.*

Description.—A small species, and the only one detected by Mr. Lightbody and myself in the black shales west of the Stiper stones.

It is remarkable for the strong radii on the limb, which are bisected halfway out by intermediate furrows. About seven of these principal radii occur on either side. The glabella is narrow and rather short, somewhat clavate, the sides constricted below the upper third, where the transverse furrow occurs. The basal triangular lobes are of rather large size.

Named after the Rev. J. More, of Linley Hall, under whose hospitable guidance it was found in the following—

Locality and Geological Position.—Lower Llandeilo (Arenig group) of Cefn Gwynlle, W. of the Stiper Stones, Linley, Shropshire.

Section 3.—Trinodus, *McCoy.*

A. LIMBATUS.

Synonyms. *A. trinodus*, Mem. Geol. Survey, vol. ii. pt. 1, pl. 8, fig. 11 (not figs. 12, 13, which belong to *A. trinodus* proper), *A. limbatus*, Salter, Mem. Geol. Surv., vol. iii. (ined.) p. 41.

I only introduce the references to this imperfect fossil to complete our account, and induce collectors to pay attention to a rare form.

Locality and Geological Position.—Caradoc, Wexford. (Survey Coll.)

AGNOSTUS TRINODUS.

PLATE I. FIGS. 8—10.

DIAGNOSIS. *A. brevis, semiuncialis. Caput suborbiculare, glabellâ convexâ, nec ultra ⅔ capitis extensâ, integrâ; limbo convexo. Cauda transversa, convexa; axi minuto conico, vix dimidium caudæ efficiente; utrinque biloba, tuberculoque magno. Limbus posticus convexus, â margine bispinoso et ab axe profunde sejunctus.*

SYNONYMS. *Trinodus agnostiformis*, McCoy, Sil. Foss. Irel., pl. 4, fig. 3; in Pal. Foss. Woodw. Mus., t. 1 E., figs. 12, 13 (not fig. 11); *T. tardus*, ib., fig. 9 [*A. glabratus*, Angelin, Pal. Suec., t. 6, fig. 5].

The original figure in the Memoirs of the Survey was not quite satisfactory, for the tail segment (from decomposing limestone near Haverfordwest) had lost its axis furrows and its marginal spines. It is replaced by better specimens in our Museum from Ayrshire. The head has been found more abundantly than the pygidium, and is at once distinguished from all other British published forms (except the kindred species, *A. limbatus*) by the simplicity of its glabella, in which, and many other points, the species closely resembles *A. tardus*, Barrande.

There was a wrong reference in my first description of this species, for I quoted Professor McCoy's synonym for the *A. limbatus* next described, regarding both as varieties of the *A. trinodus*, and giving the present one the varietal name, *β. convexus*. McCoy corrected this error in the Cambridge work, where he again figured two imperfect heads of the species. I hope now to have remedied all our deficiencies by these excellent specimens, chiefly obtained by Professor Wyville Thomson from Ayrshire.

Description.—A small species, not above five lines long and three lines broad, very convex for the genus. The head and tail rounded, with a narrow equal border all round, very distinct and separated by a sharp sulcus. In the head the limb is equal in breadth in front and on the sides, separated by a sharp line from the short parabolic glabella, which has no lobes or furrows of any kind. It is a little constricted about the middle, and is rounded at its base, just above a pair of small transverse basal lobes. The posterior angles are contracted and minutely mucronate (fig. 8 *a*).

The body rings are not known.

The tail (fig. 10, 10 *a*) is semioval, the upper angles not contracted like the base of the head, but rectangular. The central lobe is

shorter than the glabella of the head, and hyperbolic rather than parabolic in outline; its breadth at base is greater than the whole length. A sharp sulcus surrounds the central lobe, which has two pairs of furrows faintly marked out; the upper ones transverse and reaching far inwards, the middle pair of furrows rather below the middle. A prominent round tubercle ornaments the centre of the lobe, of larger size than usual in the genus. The limb is very convex, and the marginal rim is broader than that surrounding the head; it has a pair of strong short spines on its outer and lower border, which are placed higher up than in *A. McCoyii* and *A. princeps*, before described.

Affinities.—There is no trace in *A. tardus* (Barr. Boh. Trilob., pl. 49) of the slight lateral indentation in the glabella, which indicates the position of a furrow. Nor are there any traces in his specimen of the lateral spines to the tail, any more than in the allied Swedish form, *A. lentiformis*, Angelin. But the *A. glabratus* of Angelin, a Caradoc form from Besstorp, in Vestrogothia, is far more like, and if I might suppose that his artist had made the form too elongate, and drawn the tail axis too large, I should consider it identical. The body rings in his species are very clearly shown (and ours should be sought for). The second ring differs a good deal from the anterior one.

Localities and Geological Position.—Haverfordwest, S. Wales Bala and other localities in N. Wales; Shineton, near Cressage, Shropshire, &c.; Chair of Kildare, Ireland; Penwhapple Burn, &c., Girvan; Ayrshire.

Foreign.—Probably Vestrogothia (D.), as *A. glabratus*, Angelin.

Section 4.—PHALACROMA?

AGNOSTUS.—*Sp.*

PLATE I. FIG. 12.

We have only the caudal shield of a species resembling the *A. nudus* of Beyrich (more like that species than any British one). The central portion is but faintly marked out; it is, however, smaller in proportion to the limb than in the Bohemian species.

The length of the pygidium is less than two lines. It is long-semioval, the border concave, and is nearly as broad as the axis,

which is half the length of the tail, not very strongly marked out, and has a small anterior prominence.

The Caradoc or Llandeilo flag species, *A. limbatus*, Salter, is somewhat like it in the broad and somewhat duplicated border, but differs in the much smaller axis, and more backward position of the central tubercle. Our species, imperfect as it is, is distinct from and lies midway between this species and the Bohemian *A. nudus*, a primordial form.

Locality and Geological Range.—LOWER LLANDEILO (Arenig group). Tai hirion, west of Bala, collected by J. W. Salter in 1853.

Section 1.—AGNOSTUS?

AGNOSTUS TRISECTUS.

PLATE I. FIG. 11.

DIAGNOSIS. *A. caudâ subrotundâ inermi, axi longo trilobato, multisegmentato. Axis fere percurrens, latus, ad medium constrictus et tuberculatus, sulcisque longitudinalibus binis approximatis exaratus.*

Two specimens only have been sent to Mr. Tennant of this rare species. It is very like *A. princeps*, from which it differs, at first glance, by the central narrow ridge on the axis, running down throughout its whole length. It is, besides, apparently a flatter species, and has no trace of the posterior spines, but in their place a simple swelling of the margin on each side. This character is unusual.

It is a small species, the tail not being above a line and a half in diameter. It is about as broad as it is long, much rounded in outline, very slightly convex, but the flatness may perhaps be due to pressure. The axis is very broad, and the basal lobes—those next the thorax—are broader and longer than usual, and nearly equal and similar to the second lobe of the axis. The large terminal ovate lobe is longer than the other two put together. All three are deeply divided along the middle line by a pair of parallel furrows, which divides the axis into three strong lobes; hence the trivial name.

Locality and Geological Position.—UPPER LINGULA FLAGS. Black Shales of Whiteleaved Oak, Malvern. Probably not uncommon; it is a conspicuous species.

Explanation of Plate I.

Figs. 1–5. *Agnostus princeps*, Salter, specimens from various localities and in different states.

Figs. 1, 2, are from the Lower Lingula flags of Felyn Rhyd Waterfall near Maentwrog, and only show the radiations faintly. [Fig. 1. is the most perfect known, and fig. 1 *a* is the same magnified. Mus. Pract. Geology]. Fig. 2 is a piece of the compressed slate, showing the ordinary condition of the fossils.

Fig. 3. Variety from the Upper Lingula flag of Penmorfa, under the church. A small specimen, magnified. The natural size is indicated by its side.

Figs. 4, 5. Large specimens of the typical form with the radiations. Upper Lingula flag, Carreg Wen farm, near Borth, Portmadoc.

Figs. 6. 7. *Agnostus* (*Condylopyge*) *McCoyii*, Salter, from the Upper Llandeilo flag, Builth. Fig. 6 shows head and tail of a small specimen; 6 *a* the same magnified. Fig. 7 a large head, natural size and magnified. (Mus. Pract. Geology.)

Figs. 8, 9, 10. *Agnostus* (*Trinodus*) *trinodus*, Salter. Fine specimens from the Caradoc rocks of Ayrshire, presented by Prof. Wyville Thomson to Mus. Pract. Geology. Figs 8, 9. Heads, natural size; 8 *a*, magnified. Fig. 10. Tail natural size and magnified.

Fig. 11. *Agnostus trisectus*, Salter. Upper Lingula Flags, Black Shales, Malvern. Mr. Tennant's cabinet.

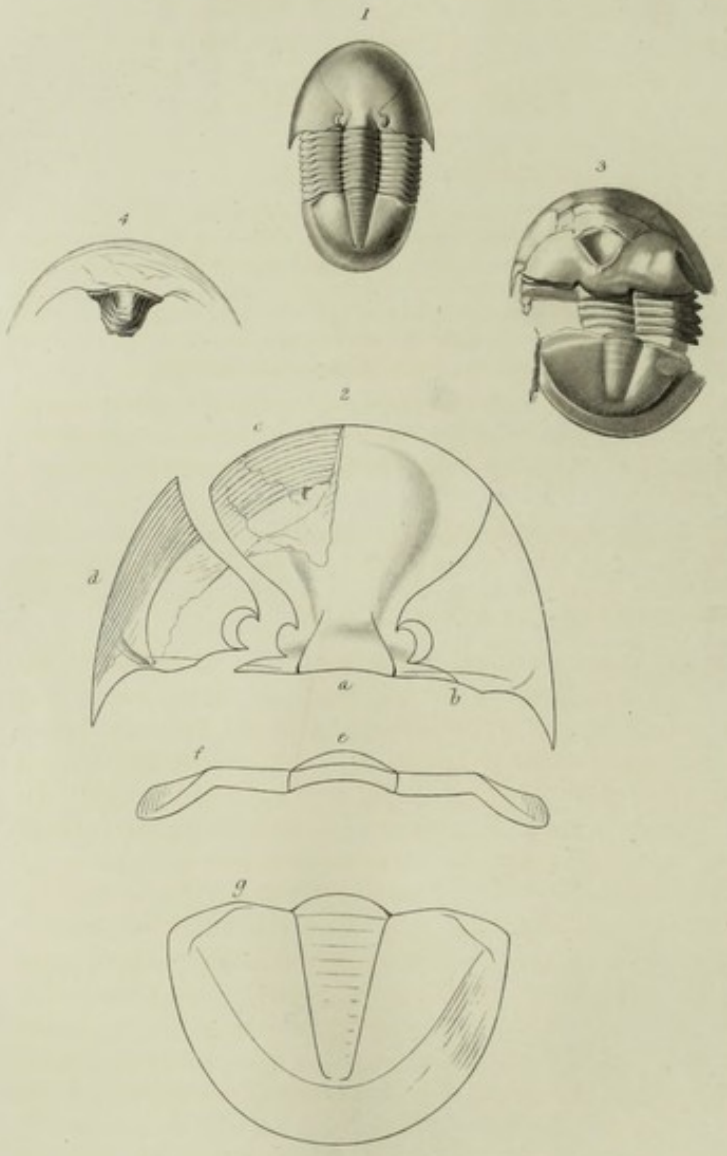
Fig. 12. *Agnostus* (*Phalacroma?*) *sp.* Specimen from the Lower Llandeilo (Arenig group) of Tai hirion, W. of Bala. (Mus. Pract. Geology.)

J. W. Salter.

November 1864.

Geological Survey of the United Kingdom.

STYGINA
(Lower Silurian)



STYGINA LATIFRONS — *Salter.*

C.B.Bone del.

J.W.Salter direx.

J.W.Lowry lc.

BRITISH FOSSILS.

Decade XI. Plate II.

STYGINA LATIFRONS.

[Genus STYGINA. Salter, 1852. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Asaphidæ.) Body ovate, flattened; head and caudal shield nearly equal; body of nine rings; eyes small, placed far backward and inward, near the base of the glabella, which is quite distinct above, and much contracted below. Facial suture marginal along a wide space in front, and below the eyes curved outward and ending on the posterior margin. No rostral shield. Labrum convex, entire. Axis of body narrow. Pleuræ without furrows. Caudal shield with a long axis.]

Diagnosis. *S. sesquiuncialis, ovalis, axi angusto; spinis capitis brevissimis. Caput semiovale, obtusum, glabellâ ad basin angustissimâ, oculis retrorsis, fere ad basin capitis retractis. Cauda semiovalis, obtusa, axi subannulato.*

Synonyms. *Asaphus latifrons*, Portlock, Geol. Rept. Londonderry and Tyrone, pl. 7, figs. 5, 6. *A. marginatus*, ib., fig. 7. *Stygina latifrons*, Salter (1852) in Rep. Brit. Assoc. Trans. Sect. p. 59. Id. "Siluria," 1st ed. 18, and 2nd ed. 1859, p. 184, Foss. 26, fig. 2.

Among the many new and interesting forms of Trilobites described by Colonel Portlock in his work on Londonderry and Tyrone, a small species of *Asaphus* is recorded from the Lower Silurian of Tyrone, which he named *A. latifrons*, distinguishing it from some other species by the breadth of front included within the curve of the facial suture. The species is remarkable for the position of the eyes, which are placed far backward and inward, so as to be close to the base of the small and narrow glabella. This peculiarity of habit is associated with some other characters which will remove the species from *Asaphus*. The flattened oval form, long axis to the tail, and the head spines, much resemble those of *Asaphus*, from which the nine ungrooved pleuræ effectually distinguish it. In the partial obliteration of the glabella, number of body rings, and course of the facial suture, it is closely allied to *Illænus*, from which its habit differs so much; and there is enough of the under side preserved to show there was no rostral shield, which last is an essential character of *Illænus*.

Description.—The general form is depressed and elliptical, the length about 1½ inch, the breadth 1 inch. The contour of the head, which is exactly as long as the caudal shield, and more than one-third the whole length, is nearly a true semi-oval, evenly convex except on the median line behind (which is abruptly raised), and slopes on all sides to a concave border. The glabella, scarcely defined at all in front, though faintly indicated (more strongly so in young specimens), is of a pyriform shape. Posteriorly it is much contracted, and again suddenly expanded upon the neck border. Its greatest width behind is not above one-fifth that of the head. The eyes are small, convex, much curved, placed at less than their own length from the hinder margin, opposite the contracted part of the glabella, and rather further apart than the width of the thoracic axis. The facial suture runs out nearly at right angles beneath the eye, and in front of it describes a large arc, diverging from the eyes at an angle of 70°, and cutting the anterior border far outwards, in a line overhanging the fulcral points. The facial suture is strictly marginal in front, and the hypostome, fig. 4, appears to be quite continuous, without a rostral shield as in *Illænus*, or a vertical suture, as in some *Asaphi*.

Two good specimens in Dr. Wyville Thomson's cabinet show the labrum, but its margin is broken off. It is wide at its attachment, considerably convex in the middle, more so than in *Asaphus*, and is marked with concentric lines on the sides. There is not enough to show that there was no marginal groove, or whether the tip was rounded and entire, as in *Illænus*, which is most probable.

Thorax of nine rings, not so long as the head, and with its axis only two-thirds as wide as the pleuræ, convex. Pleuræ flat as far as the fulcrum, which is about the width of the axis remote from it. Thence the pleuræ are bent down and a little back, and facetted for rolling up. There is no groove whatever to the pleuræ, which thus resemble those of *Illænus*.

Tail semi-oval, blunt, not convex, the conical axis about half the width of the sides, and reaching fully two-thirds the length of the tail. Our figure 2 *g*. has it too long. The axis has about eight faint furrows. The sides are gently convex at first, and then broadly concave, with a somewhat sharply defined margin; it is without any furrows,—even the usual upper one is obsolete, or nearly so. The apex is very blunt, more so than the front of the head. The incurved striated portion is broad, and not indented by the point of the axis.

By some accident my name is attached to this species on the plate. Our specimens are those figured and described by Portlock.

Locality and Geological Position.—CARADOC of Desertcreat, Tyrone.

OTHER SPECIES OF THE GENUS.

I only know one other British species, and no foreign ones.

S. **MURCHISONIÆ**, *Murch.*—*S. convexus, trilobus, capite longo semi-ovato, spinis productis. Cauda longa, axe prominulo lævi.*

SYNONYMS. *Ogygia Murchisoniæ*, MURCH., Silurian System, 1837, pl. 25, fig. 3. *Stygina Murchisoniæ*, SALTER in Siluria, 2nd ed. 1859, pl. 4, fig. 1. Morris, Catal. 2nd ed. p. 115, 1854.

Although only a single specimen of this has been found, there can be little doubt of the genus to which it should be referred. The contracted axis of the head and body, and the smooth tail with its strong axal lobe, are at all events extremely like those of *Stygina*.

Locality.—In LLANDEILO FLAGS? Mount Pleasant, Carmarthen. It is, however, probable these are Caradoc strata.

J. W. SALTER.

November 1864.

EXPLANATION OF PLATE II.

Fig. 1. Portlock's original specimen figured in the Geological Report on Tyrone.

Fig. 2. Dissected head of the same, showing obscure pyriform glabella, its base (*a*) only convex, and part of the striated incurved portion *c*, *d*, continuous with the hypostome to the short posterior angle, where it is obliquely folded. At *b*, the termination of the facial suture beneath the eye.

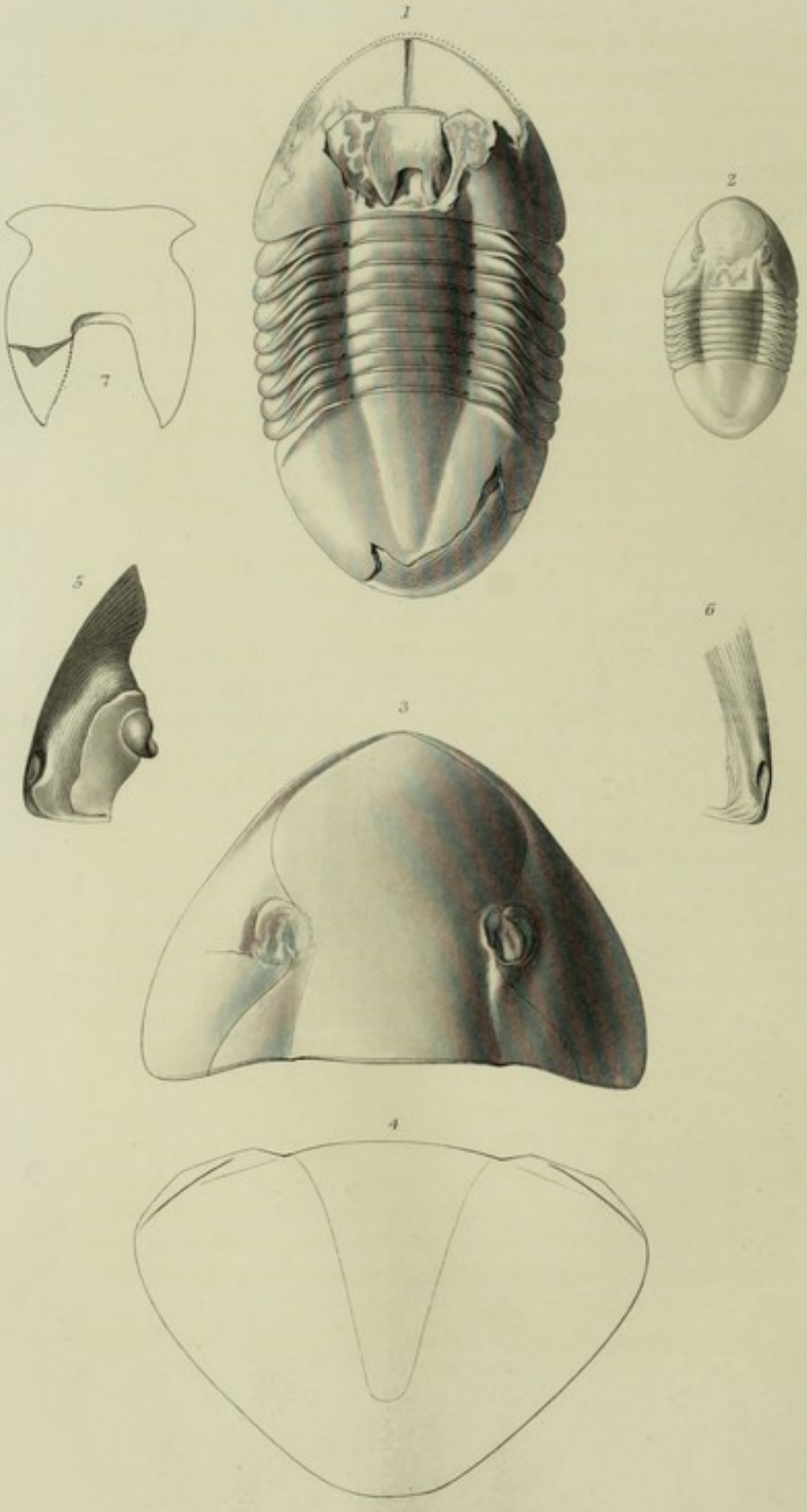
Fig. 2. *e*, *f*, thoracic rings of the same; *g*, tail showing the fulcrum.

Fig. 3. Larger specimen (the figured specimen of *A. marginatus*, Portl.), showing impression of the labrum *in situ*.

Fig. 4. Under surface of one of Prof. Thomson's specimens, with broken labrum showing concentric lines.

Geological Survey of the United Kingdom.

ASAPHUS
Lower Silurian



ASAPHUS (ISOTELUS) GIGAS — *De Kay.*

C.R.Bone del.t J.W. Salter direx.t J.W.Lowry fc.

BRITISH FOSSILS.

DECADE XI. PLATE III.

ASAPHUS GIGAS.

[Genus ASAPHUS. BRONGNIART. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Asaphidæ.) Eyes large, smooth. Facial suture marginal or supramarginal in front, and ending on the posterior margin. No rostral shield. Labrum strongly bifurcate. Body rings eight.]

[Sub-genus *Isotelus*. DE KAY. Facial suture intramarginal in front, and with a vertical suture beneath; head scarcely at all lobed; pleuræ much bent down; tail large, with faint axal furrows and no lateral ribs.]

DIAGNOSIS. *I. ovali-oblongus lævis, lateribus rectis; capite pygidioque æqualibus subtrigonis hyperbolicis. Caput sulcis axalibus minime profundis. Oculi modici pone medium capitis positi. Sutura facialis intra marginem frontalem parallela; labro* ad basin angusto, furcis longis parallelis. Thoracis axi pleuris æquali, fulcro ad tertium posito. Cauda axi indistincto angusto conico longo, limbo sulco unico superiore, reliquis nullis.*

SYNONYMS. *Asaphus platyceph.*, STOKES (1822), Trans. Geol. Soc., London, i. 8, p. 208, pl. 27. *Isotelus gigas* and *I. planus*, DE KAY (1824), Annals of the Lyc. of Nat. Hist. of New York, vol. i. p. 176, pl. 12, 13, fig. 1. *Asaphus gigas*, DALM. (1826), Palæad. 71. *Isot. gigas*, GREEN (1832), Mon. of Tril., p. 67; also *I. planus*, p. 68, *I. stegops*, p. 71, *I. cyclops*, p. 69, and *I. megalops*, p. 70. *Brongniartia isotela*, EATON (1832), Geol. Text Book, pl. 2, fig. 19. *Asaph. platyceph.* BRONN. (1835), Leth., vol. i. p. 115, pl. 9, fig. 8. *Asaph. gigas*, EMMR. (1839), Dissert. 32, 12. *Isotelus gigas*, MILNE-EDW. (1840), Crust., vol. iii. p. 298. *Asaph. platyceph.*, BUCKLAND (1840), Bridg. Treat., vol. ii. p. 76. *Asaph. platyceph.*, BURM. (1843), Org. Tril., pl. 2, fig. 12, Ray, ed. (1846), p. 110. PORTL. (1843), Geol. Rep. *Isot. gigas*, pl. 7, figs. 1–4, pl. 8, fig. 7; *I. planus*, pl. 7, figs. 2, 3 (except pl. 8, figs. 2, 3); *I. ovatus*, pl. 8, fig. 5; *I. sclerops*, pl. 10, fig. 2; *I. Powisii*, pl. 6, fig. 1. *I. megistos*, LOCKE (1842), Amer. Journ. Science, vol. xlii. p. 366; Trans. Assoc. American Nat. and Geologists (1843), vol. i. pl. 6. *I. gigas*, HALL (1847), Pal. New York, pl. 60, fig. 7; pl. 61, figs. 3, 4; pl. 62, figs. 1, 2; pl. 63. *I. gigas*, BILLINGS (1863), Geol. of Canada, p. 184, fig. 182 (and *I. platycephalus*, ib. fig. 183?)

* I prefer this term to hypostome, used in the former Decades. The hypostome of Dalman is the incurved front margin.

I have figured this fine species from General Portlock's original specimens, and I follow most writers in adopting De Kay's name, because it must have been contemporary with the publication of Stokes' paper (though the latter was read early in 1823). Even were *A. platycephalus* a little the earlier name, it was published without any description. And it is just possible that the fossil described by Stokes may belong to a different species.

Description.—General shape oval-oblong, with the sides rather straight, the head and tail nearly equal, and both subtriangular, the head pointed, the tail more obtuse at the tip. The surface is convex when the fossil has not undergone compression, a line taken from the snout to the apex of the tail being a regularly convex one, uninterrupted by any neck furrow, depression, or convexity of the smooth and even body rings, or furrows on the axis of the tail. The axal furrows are very obscure in the head; they are neatly marked but shallow along the body, and only very faint along the tail. All the surface is smooth. The sides are strongly deflected, but not steep.

The head has the shape of a broad and pointed Gothic arch, the breadth at base being to the length as three to two. The margin is very narrow and flat, rather than recurved. The facial suture forms a broad ogive arch in front, running for some distance close within and parallel to the front margin; and, beneath the eyes, which are large, placed near the glabella, and rather behind the middle of the head, the suture curves gently out and cuts the posterior margin midway from the axal furrow. The hinder angles are blunt pointed, not rounded. On the under side of the cheek near the point is a convex space, containing an oval depression, which receives the apices of the front pleuræ in rolling up (fig. 6, and see also fig. 5 for the cast of this depression on the matrix). The labrum (fig. 7) has a narrow base, then a strong constriction, and thence the sides are parallel. The apex is deeply furcate, the parallel forks occupying nearly half the entire length of the organ. Body rings smooth, rounded at the apices, deflexed at the fulcrum, which is placed rather beyond one-third, and with a broad strong groove. Tail subtrigonal, with straight sides, and rounded blunt tip. The faint axis rapidly tapering, broad conical, and reaching three-quarters the length. Sides quite smooth.

In young specimens, says Hall, the caudal extremity is more pointed, and exhibits marks of eight articulations; in older specimens these increase in number. But the crust presents many

traces of them when viewed from within; they are often distinct (Hall, l. c. 231). Burmeister also calls attention to this character. It appears to be frequent in the genus and its allies, for I have seen Swedish specimens, both of *Asaphus* and *Illænus*, which exhibited it strongly, chiefly on the axis. In like manner the lobes of the glabella often show internally, though quite obliterated on the external crust. I have not seen them in this species, but Burmeister gives them in his figure, of which he boasts the absolute accuracy. We can at least say as much for ours, so far as the specimens exhibit character; and our plate of this species is alike creditable to the artist, Mr. Bone, and the engraver, Mr. Lowry.

Variations.—There seems to be some reason to think there may be two species in the American limestones; one rarer, of broad form and with small eyes—the true *A. platycephalus* of Stokes; the other very common, of elongate form, and with variably large eyes, to which nearly all the above synonyms belong. See figures of both forms in the "Geology of Canada," 1863, by Sir W. Logan and E. Billings, p. 184. I have quoted these above. On the other hand, I should have no difficulty in referring these differences to sex, the broad *A. platycephalus* being the ♀ form.

History.—It is not necessary to refer to the American authors, who have profusely illustrated this common species. But I feel persuaded that Prof. Hall is right in uniting all Green's casts under one name; the more so as Hall had several hundred specimens at command in every degree of perfection. Prof. Green's species are chiefly due to differences of position, and in attempting too closely to identify each of these, Gen. Portlock separated the Irish specimens he described into more forms than can be now admitted. *I. gigas* and *I. planus* of Portlock he himself considers identical. *I. ovatus*, id., differs in nothing but its size; the head is really not more elongate than in his specimens of *I. planus;* and with regard to his *I. Powisii*, the more depressed form is entirely due to pressure; and the fulcrum is at the same proportional distance,—about one-third from the axis (not more distant, as stated); the appearance is due only to the before-mentioned cause. The true *A. Powisii*, Murch., has distinct ribs to the tail, square ends to the pleuræ, and a swelled glabella, but the Irish specimens all resemple *I. gigas* in these respects. I do not know that the true *A. Powisii* occurs in Ireland, while *I. gigas* is not known in England.

The large *Isotelus megistos*, which is certainly the same species with *I. gigas*, has been reconstructed in the form of a cast by

American authors, as of enormous size. The cast which is commonly sold for lecture purposes indicates a form 21 inches long; but there is no pretence for making it more than two-thirds this length. *Asaphus gigas* is not one of the largest of Trilobites.

Locality and Geological Position.—CARADOC of Tyrone (Portlock). The species ranges from Canada to Tennessee, and it is rather remarkable that it should abound in N. Ireland without reaching further to the eastward. Some other American species appear to range to Ireland, but are not otherwise members of the British Silurian fauna.

OTHER BRITISH SPECIES OF THE SECTION ISOTELUS.

2. *I. rectifrons*, Portlock, Geol. Report, 1843, pl. 9, fig. 1 *a*, *b*; also pl. 8, figs. 2, 3, 7, only referred to under *I. planus*. These belong to the head. *I. arcuatus*, ib., pl. 9, figs. 2, 3 (tail of same species). *I. intermedius*, ib., pl. 9, fig. 5.

Head semicircular convex; the angles rounded, and showing the characteristic pit for the pleuræ some distance above the angle. Glabella between the eyes about equal in width to the cheeks. Eyes large, placed much behind the middle of the head, and very much curved. Eye-line straight and directed outwards above the eye to the front margin, along which it runs. Beneath the eye it runs outwards, nearly parallel to the posterior margin. In the front of the head there is no vertical suture, the front being striate and showing rather a narrow base for the attachment of the labrum.

The tail and body Portlock called *I. arcuatus*. The body segments have the axis broader than the pleuræ, which have the fulcrum close in, and are bent back from it and rounded at the ends. The tail is wider than a semicircle; the upper angles are much bent down for the facet. The axis is marked out at its origin by two rather deep impressions, and is here rather wider than the side lobes. Thence it is not indicated, except by a slight prominence at its apex, which reaches to three-fourths the length of the tail. A broad shallow furrow beneath the fulcrum is all the marking that shows on the smooth convex sides.

Incurved portion narrow, concave; its edge not indented by the point of the axis; strongly lineate, the lines abutting sharply against the margin.

I. intermedius is too like the species just mentioned to be catalogued as distinct. It is much pressed out of shape and

obscured. But the *I. læviceps* of this author, though not the same as the *As. læviceps* of Dalman, is probably a member of the section *Cryptonymus*, a group which has the axis and glabella lobes well marked out, and often has very prominent eyes. It is very rare in England and absent in America, but is the common form of the genus in the Swedish area.

Asaphus lævigatus, Angelin., Pal. Succ., pl. 29, fig. 1, in many respects resembles *A. rectifrons*.

Locality.—Caradoc of Desertcreat, Tyrone.

3. *I. sp.* Salter, in Quart. Geol. Journ., vol. vii. pl. 8, fig. 2. A caudal portion of an undetermined species has been figured by Sir R. I. Murchison in his paper on the Silurian Rocks of the S. of Scotland. It is probably distinct from *I. gigas*.

4. ? Another is quoted in Prof. Nicol's paper on the Peeblesshire Silurians, Quart. Journ., vol. iv. p. 205, which is lost now, but was stated by myself to be allied to *Asaphus* (*Isot. megistos*) *gigas*. Both these species require further illustration; but they seem to show the gradual dying out of the American type *Isotelus* in its range eastward, as above noticed. Possibly both are referable to *Megalaspis*.

The distribution of subgenera over the northern zone is as follows:—

N. American Types.	*British Types.*	*Scandinavian Types.*
	Isotelus, rare, N. and N. West only.	[*Isotelus*, absent.]
Isotelus, common.	*Basilicus*, common, also in Mid-Europe.	*Basilicus*, rare.
	Cryptonymus, very rare, in N.W. area.	*Cryptonymus*, common.
Ptychopyge, rare.		*Nileus*, common.
		Megalaspis, do.
		Ptychopyge, do.

Explanation of Plate III.

Fig. 1. *Asaphus gigas*, De Kay, the original specimen figured by Portlock as *Isotelus planus*, De Kay. It shows the vertical suture to the hypostome and the labrum in place.

Fig. 2. Do. (Portlock's original of *I. ovatus*.)

Fig. 3. Do. (Portlock's figured specimen of *I. sclerops*.)

Fig. 4. Tail of do.

Fig. 5. Cast of under surface of side of head, showing the eye, and the pit for the reception of the ends of the pleuræ.

Fig. 6. Gutta percha cast of the same specimen, showing the real under surface.

All the above are from the Caradoc of Desertcreat, Tyrone, and are in the Mus. Pract. Geology.

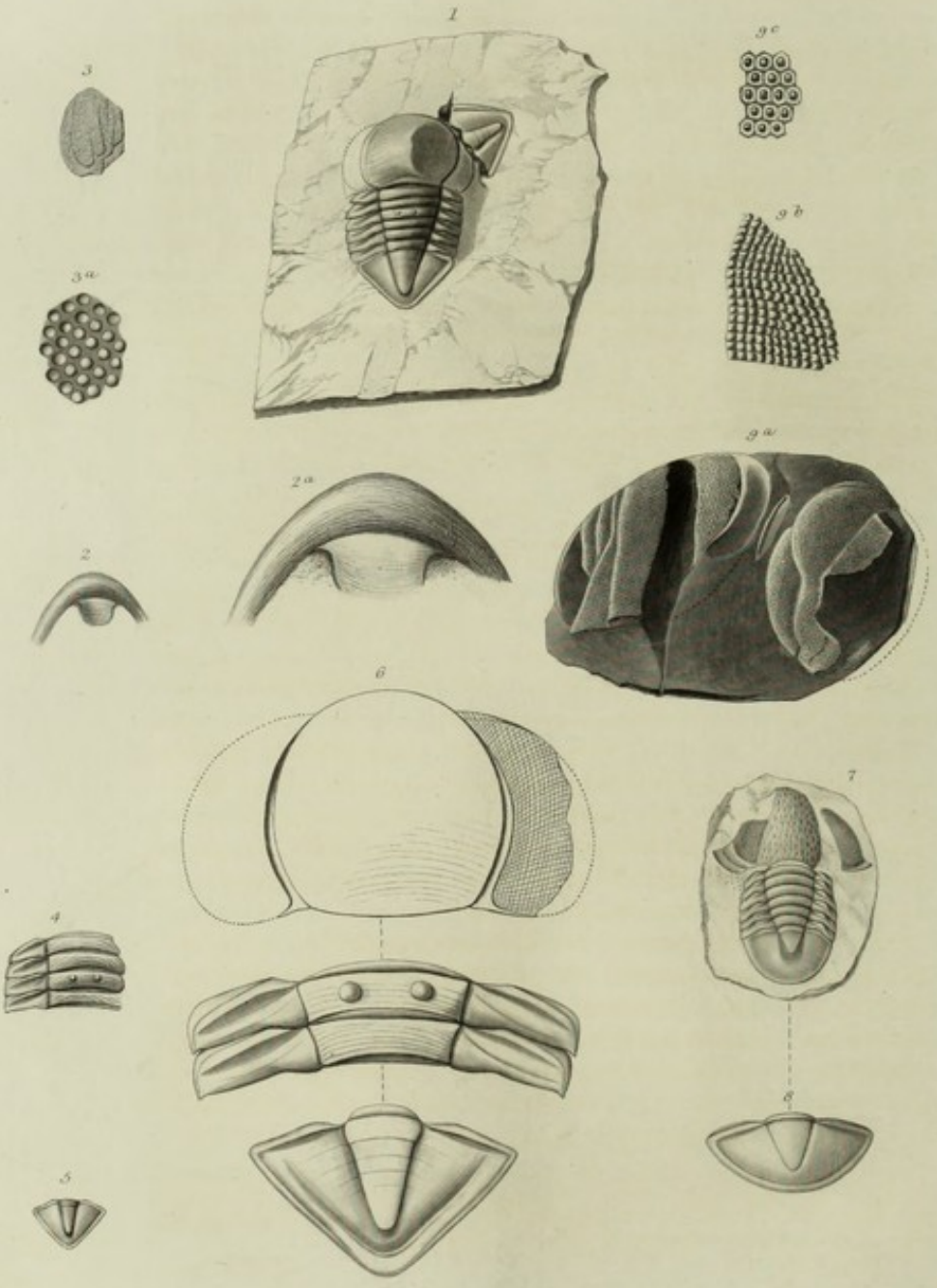
J. W. Salter.

November 1864.

Geological Survey of the United Kingdom.

ÆGLINA.

(Lower Silurian)



Figs 1–6. ÆGLINA BINODOSA *Salter*
7–8 —— GRANDIS ? *id.*
9 —— SP.

C.B.Bone del.t J.W.Salter direxit J.W.Lowry fe.

BRITISH FOSSILS.

Decade XI. Plate IV. Figs. 1–6.

ÆGLINA BINODOSA.

[Genus ÆGLINA. Barrande, 1847. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Asaphidæ.* Body oblong, the extremities equal, rounded. Head convex, glabella large, rounded or parabolic, not distinctly lobed; eyes very large, occupying the whole, or nearly the whole cheek, coarsely granulated (externally?); facial suture ending on the posterior margin close to the axis. No rostral shield. Thorax with five or six rings, the axis broad, the pleuræ facetted and grooved. Tail large, the axis of two or three rings, abbreviated; the sides few-ribbed, or nearly smooth. *Cyclopyge*, Corda.]

Diagnosis. *Æ. lata, biuncialis et ultra, convexa, capite grandi inflato, lævi; segmento thoracis tertio binodoso; caudâ triangulatâ profundè marginatâ.*

Synonyms. *Æglina binodosa*, Salter, Siluria, 2nd ed., p. 50, Foss. 8, fig. 6. Id. Mem. Geol. Surv., vol. iii. ined., pl. 11 B. fig. 3.

The genus has been previously illustrated in Decade VII., but from less perfect materials.

Description.—About an inch long, and three-quarters broad in the widest part; the head very blunt in front, and the tail tapering acutely. The glabella is round and inflated; the axis of the body tapers quickly backwards, and the tail is truly triangular. These characters and the tubercles on the third body segment will easily enable the collector to identify it.

The head is seldom perfect, but, from many specimens, must have been transverse-oblong, while the glabella is perfectly round, inflated, and showing no trace of lobes or furrows. It has a narrow border down the sides, marking the course of the facial suture, and separating the glabella from the broad lunate eyes, which are coarsely granular (fig. 3) and occupy the whole cheek. As usual in the genus, the inflated glabella shows no trace of a neck segment.

* For the present I do not wish to cut up this large natural group. But a better knowledge of the primordial forms of it will doubtless render it necessary to do so bye and bye. *Æglina* has some relation to *Remopleurides* (*Olenidæ*).

Beneath the head the hypostome is continuous (fig. 2 *a*) and tumid, without rostral shield or any suture, and the convex labrum has rather a broad base, as in *Illænus*.

The thorax is convex, and has a wide and much tapering axis, broader than the sides. It is greatly wider in front than its pleuræ, and behind is not quite so wide as these. Its rings are gently arched, and the third one bears a pair of those enigmatical tubercles which are of so common occurrence along the central lobe of Trilobites.* The front pleuræ are very short, and the hinder elongated. They are more curved forward than our figure indicates, at least in the central and hinder rings. The fulcrum is near the axis, the groove broad, not deep; the apices truncate, and a little pointed behind. The facet is long and narrow.

The tail is truly triangular, and except that the apex is rounded off, would be an equilateral triangle, deeply and strongly margined all round, and with a narrow conical axis which reaches two-thirds and rather more of the length. Its tip is rounded, and it is marked by a single broad ring at the base, and very faint traces of two or three others.

Variations.—Young specimens, which I have seen since the plate was engraved, in the choice cabinet of Mr. H. W. Edgell, show the metamorphosis. In a specimen which is barely two lines in length, the number of rings to the body is only four, and the fourth ring is scarcely separable from the caudal shield. The axis of the latter is narrower than in full-grown specimens; but I do not see much other difference.

This is one of the most conspicuous species of the genus, and in great plenty in the black slate of one locality. It differs so markedly from all the other species, in the triangular tail with a prolonged axis, that it is unnecessary to compare it with any. It appears to have grown to a less size than *Æ. grandis* next described.

Locality and Geological Position.—Lower Llandeilo Flags (Arenig group), Cefn Gwynlle, in the district west of the Stiper Stones, Shropshire; in black slate, abundant. My friend, Dr. A. Fritsch, of Prague, tells me he has found the same species in the Lowest Llandeilo beds (d. 1) of Prague. I suppose it a closely allied, not identical, form.

* They have been specially noticed in my memoir on the *Phacopidæ*, Palæont. Transact., vol. for 1862, p. 52. And they are conspicuous under various forms in *Encrinurus*, *Cheirurus*, *Sao*, and a host of other genera. Probably they indicate the places of cutaneous glands, but their purpose is not yet evident.

ÆGLINA GRANDIS.

PLATE. IV. FIGS. 7, 8.

DIAGNOSIS. *Æ. ovalis, 2-3-uncialis, depressa, tuberculatâ, axe corporis angusto; caudâ rotundatâ lævi, lateribus unisulcatis.*

SYNONYMS. *Æglina grandis*, SALTER, Siluria, 2nd ed., p. 53. Foss. 9, fig. 6. Id. Mem. Geol. Surv., vol. iii. (ined.) pl. 12, fig. 11.

Description.—Oval (rather depressed?) 1¾ inch long; head more than two-fifths the whole length, with a large glabella without lobes, covered with rather prominent tubercles. This character is so remarkable in the genus that no long description is necessary to enable us to recognize the species. The eyes are very large, as long as the head, and there appears to be a larger border beyond them than usual in the genus.

Body of six rings, the axis narrower than in most of the species, broadest in front, contracted behind, where it scarcely equals the pleuræ in width. These are bent at the fulcrum, which is placed rather more than one-third out from the axis in the front rings, and nearly at half in the hinder ones.

The tail is semicircular, and has rather a conical axis of two joints, rather long in our figure 8, which I believe is the same species. One obscure lateral furrow (the uppermost) is all that is visible on the smooth sides. A distinct margin runs all round the tail, neatly defined, but not by a broad or deep furrow. The shape of the tail in fig. 7 is much rounded, and more than a semicircle. In fig. 8 it has been compressed longitudinally, and has a shorter aspect; but I believe this is only due to compression in the slaty rock.

The largest specimen I have seen appears to have the fulcrum of the pleuræ further inwards, but agrees in other respects with the remaining specimens; at least it has the tubercular glabella, a character in which our species differs from all others.

Of the two British species previously described; *Æ. mirabilis*, Forbes, has a parabolic and lobed smooth glabella. *Æ. major*, Salter, has a wide body axis, and two lateral furrows in the tail.

All Barrande's species have a smooth glabella, and are very much smaller than ours, except his *Æ. speciosa*, which has a very broad axis and short marginal eyes.

Locality.—LOWER LLANDEILO FLAGS (Arenig group?), South side of St. David's Head, Pembrokeshire.

ÆGLINA, sp. (EYES OF).

PLATE IV. FIG. 9.

This large species is perhaps not the largest *Æglina* known; M. Barrande has an enormous one from the Llandeilo rocks of Bohemia, with a projecting front to the head. Ours probably was six inches long, and the great eyes an inch and a quarter long (no other part occurs with them). The eye of this species lay for a long while in the Museum as an undescribed *Bryozoon* from the Llandeilo flag. Contrary to the usual arrangement in the eyes, the lenses are in quincunx, instead of hexagons (see fig. 9 *b*), and very closely set; but in some parts the normal hexagonal arrangement is seen (fig. 9 *c*).

Locality.—UPPER LLANDEILO FLAGS of Abereiddy Bay, Cardiganshire. The rest of the body should be sought for there.

EXPLANATION OF PLATE IV.

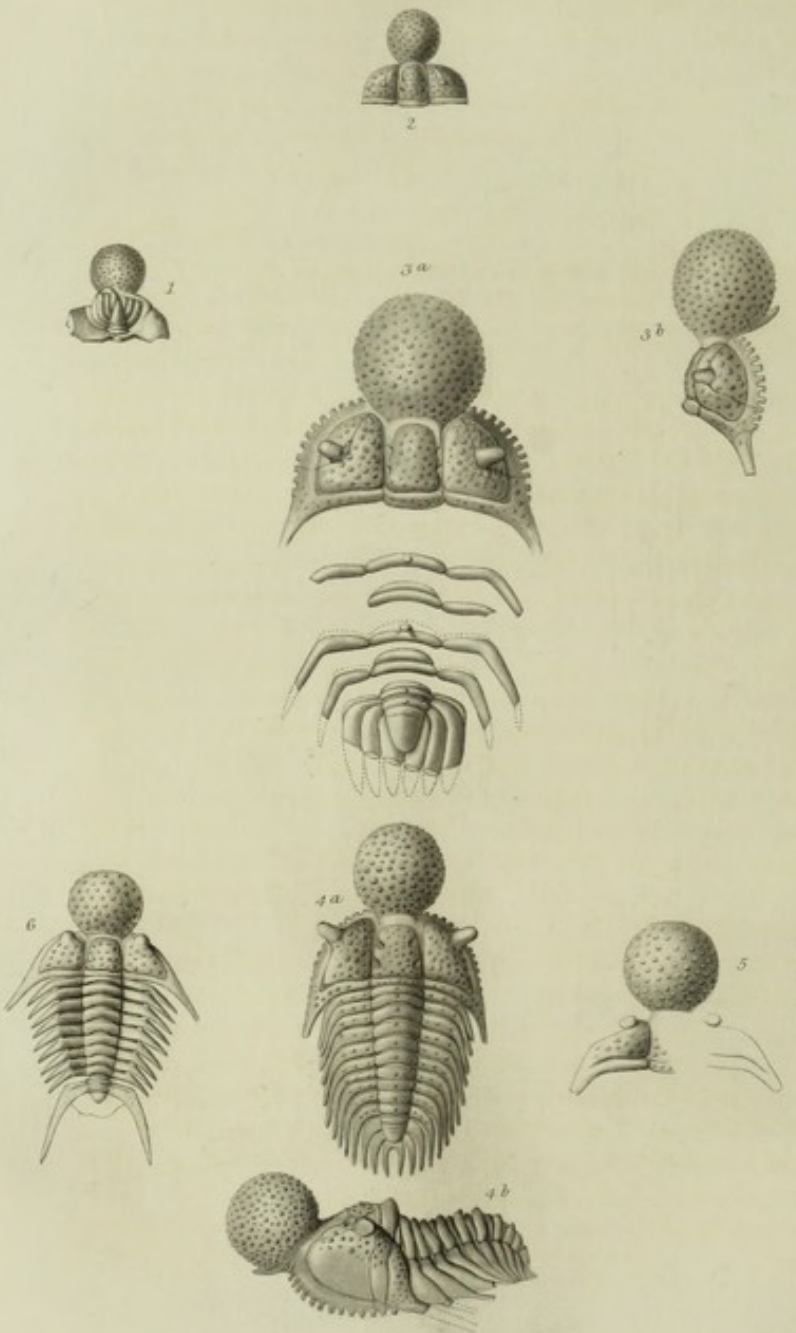
Fig. 1. *Æglina binodosa*, Salter, nat. size, Lower Llandeilo (Arenig) group of Cefn Gwynlle, Stiper Stones, Shropshire.
Fig. 2, 2 *a*, magnified. Labrum and hypostome of do. Same locality.
Fig. 3, 3 *a*, magnified. Eye of do.
Fig. 4. Body rings, showing the tubercles on the third segment.
Fig. 5. Tail, nat. size.
Fig. 6. All the above portions are enlarged in this figure.
Fig. 7. *Æglina grandis*, Salter. A small specimen from the Lower (?) Llandeilo rocks of Whitesand Bay, St. David's, Pembrokeshire.
Fig. 8. A compressed tail. Same locality.
Fig. 9 *a*. *Æglina,—sp.* An enormous species, of which we have only the great eyes in their natural position. The slate is much compressed and folded. 9 *b*, *c*, magnified parts of the eye. Upper Llandeilo, Abereiddy Bay, Pembrokesh.
All the above are in the Mus. Pract. Geology.

J. W. SALTER.

November 1864.

Geological Survey of the United Kingdom.

STAUROCEPHALUS
(Silurian)



Figs. 1 4 [5?] STAUROCEPHALUS MURCHISONI — *Barr*
6 —— GLOBICEPS — *Portlock*

C.R.Sowe del.

J.W.Salter Lithd.

J.W.Lowry Sc.

BRITISH FOSSILS.

Decade XI. Plate V.

STAUROCEPHALUS MURCHISONI.

[Genus STAUROCEPHALUS. Barrande, 1847. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Cheiruridæ.) Head cruciform, with long clavate glabella, greatly swelled in front into a hemispheric lobe, the base narrow cylindric, with three pairs of furrows. Cheeks convex, with pedunculate eyes and serrate margin. Facial suture ending on the external margin. Body rings 10, without pleural grooves, pointed. Tail of few segments, the apices of the pleuræ free. *Barrande.*]

Diagnosis.—*S. ovatus, tuberculosus, oculis remotiusculis, margini genarum spinoso. Cauda quadrata, pleuris omnibus æqualibus retrorsis parallelis, haud divaricatis.*

Synonyms. *Staurocephalus Murchisoni*, Barrande (1852), Syst. Sil. Bohème, pl. 43, fig. 28–32. *S. Murchisoni*, Salter, in Siluria, 2nd ed. 1859, p. 540; Id., Morris's Catal., 1854, p. 115.

One of the most curious, though not most conspicuous, of our British species. The globular head, or rather glabella, set on its narrow stalk-like base, the gibbous cheeks, projecting eyes, serrate border, and spiny comb-like pleuræ and tail, combine to give an extravagant and unusual appearance to the fossil. It is seldom found perfect. But the skill of the Dudley naturalists has long been exercised on it, and specimens are now to be found in many cabinets. Mr. Hollier's specimens are the principal ones figured. Mr. Ketley has some fine ones, and our figs. 1, 2, are from the Museum of Practical Geology. They were formerly part of Mr. E. Davis's collection at Presteign.

Description.—About an inch long, of which the gibbous head occupies more than two-fifths. This is longer than broad, roughly triangular in general outline, but not truly so. It appears rather four-lobed, or like the heraldic "*fleur de lis*," the truly globular front occupying more than half the length of the glabella, and being at least three times as wide as its semi-cylindrical base, from which it is abruptly cut off by a transverse furrow; the base is marked by two distinct lateral lobes besides the neck furrow. The cheeks reach forward about half way up this globular portion, and the

central part is necessarily raised, so as to be nearly on a level with the glabella.

The cylindrical eyes are on the most convex part of the cheeks, and are directed outwards, scarcely forwards. The margin is distinct in front of the head as a very narrow prominent ridge, and furnished on each side with about 14 truncate spines; the cheek spine is directed backwards, and but slightly outwards, abrupt at its origin, and not reaching beyond the two or three first body rings. The facial suture cuts the outer border in a direct line from the base of the eye.

All the prominent parts of the head are covered with larger and smaller tubercles; they only fail on the deeper furrows, and the truly vertical outer half of the cheeks. They are conspicuous on the border, and even on the cheek spines.

The body and tail united are slightly longer than the head, the thorax of 10 rings many times longer than the short square tail, and the axis about one-fourth the whole width, and highly convex, especially in front. There are no axal furrows to separate the gibbous axis from the horizontal portion of the pleuræ, and these soon curve downward, and are abrupt and steep on the sides.

The pleuræ are semi-cylindrical, the front portion, separated by the pleural groove being very narrow in this and allied genera, placed on the forward margin, and scarcely visible.* The apices curve much backward, and in the hinder pleuræ a little outward again, and are produced into strong spines beyond the ovate facetted portion. And all along these pleuræ and over the axis tubercles are placed at equal distances, except that the central prominent tubercle fails on alternate rings of the axis, and the intervening ones, especially the ninth, are stronger than any other tubercles, and remind us of the spines on *Encrinurus*.

The tail is nearly square, concave rather than flat, the short conical axis, of four rings, not easily distinguishable from the sides, which are composed of three flat broad spinous pleuræ directed backwards, and quite parallel, so as to give a comb-like appearance. A few tubercles are scattered on the surface.

Locality and Geological Position.—Caradoc Rocks, near Bala, N. Wales (fig. 5); Woolhope Limestone and Shale, Corton, Presteign (figs. 1, 2); Wenlock Limestone, Dudley and Malvern.

* Yet I doubt the propriety of making this character so important in classification as Barrande has done. The pleural groove is always present in one form or another. In this case it is anterior, in *Cheirurus* it is very short and oblique.

STAUROCEPHALUS GLOBICEPS.

Pl. V. Fig. 6.

Synonyms. *Ceraurus globiceps*, Portlock (1843), Geol. Rep., Tyrone, 257, t. i. f. 7. *Staurocephalus globiceps*, Salter, in Morris's Catal., 2nd ed. (1857), p. 115.

Diagnosis. *S. ovatus granosus, caudâ elongatâ, spinâ utrinque unicâ divergenti. Glabella stipite brevi vix lobato. Oculi approximati. Spinæ genales et pleurales diffusæ. Cauda brevis, pleuris primariis longè extensis, latis; reliquis—?*

A much smaller species than the preceding, and distinct from it by abundant characters of shape and habit. The divergent spines of head, thorax, and tail enable us at once to recognize it; and of the latter, the remarkable extended first pair of pleuræ (the rest of the tail is lost) show a near connexion with the *S.? Maclareni*, afterwards described.

Only one good specimen, 10 lines long, is known. The head is equal to the thorax in length, and longer than the caudal portion. It has a very large globular front, longer than the square stipes, and granular all over. This stalk or base seems to be without furrows. The cheeks granular, gibbous, with a prominent eye on the front edge, near the glabella, and directed forward, not outward; a broad plain margin, and widely divergent spines.

The axis of the thorax is cylindrical, and as wide as the stalk of the glabella. The pleuræ flat as far as the fulcrum, which is less remote than the width of the axis, with patent not recurved spines as long as the portion within the fulcra. The thorax tapers backward rather rapidly to the tail, which has a short three-ribbed axis, and the upper pair of its pleuræ are very much expanded, widely divergent, and more arched than in our figure, which also represents the thoracic pleuræ as less curved than they really are. The hinder portion of the tail is absent on our specimen; and I know of no other.

Locality and Geological Position.—Caradoc Rocks of Desertcreat, Tyrone (Mus. Pract. Geology).

A third form, very abnormal in its characters, and of large size, has been named *S. Maclareni* by Prof. Wyville Thomson, after the veteran Scotch geologist, in whose company he found it. It is, however, Prof. Thomson's previously described *Acidaspis unica*. As he has mislaid his own full description, I may supply the following notes, from his specimens and others presented to the Museum of Practical Geology by himself.

Staurocephalus? unicus.

Diagnosis. *S.* $1\frac{1}{4}$ *uncialis, oblongus, sparsè granulosus, glabellâ gibbâ eminentissimâ, corpore plano, caudâ expansâ transversâ. Caput latum, glabellâ clavatâ elevatâ frontem longè impendente, a genis punctatis distinctissimâ; margine crasso utrinque bispinoso. Pleuræ subplanæ, sulcatæ, rectæ, apicibus abruptè recurvis. Cauda lata brevis, axi appendiculato, pleuris primariis latissimis spatulatis, margine postico truncato.*

[Synonym. *Acidaspis unica*, Wyv. Thomson, Quart. Geol. Journ., vol. xiii. pl. 6, fig. 13.]

In the absence of a figure sufficiently complete (for the one quoted above is very defective), it is necessary to give a rather full diagnosis of this remarkable form, which tends to show the passage of the *Cheirurid* into the *Acidaspid* family. Indeed, if Prof. Thomson be correct in figuring 12 segments to the body, the species is abnormal for either *Acidaspis* or *Staurocephalus*. The shape of the head clearly enough shows that it is to *Staurocephalus*, or else to one of the sections of *Cheirurus*, that this strange fossil must be referred. *Cheirurus* often has 12 segments, *Acidaspis* 9 or 10, *Staurocephalus* only 10. The grooved pleuræ are unlike *Staurocephalus*, but like the section *Eccoptochile* among the genus *Cheirurus*. But no *Cheirurus* has so clavate a glabella, though a tendency towards it is exhibited in some species, and *Sphærocoryphe* of Angelin is very near to ours.

There is an evident analogy too in this form with *Lichas*, both in the shape of the tail and the character of the pleuræ. But the external position of the facial suture far up the cheek easily distinguishes it from that genus. I do not further describe it, as it will appear in a very early plate in the volumes of the Palæontographical Society.

Localities.—Caradoc Schists, at the base of the "Orthoceratite and Graptolite flags," Penwhapple Glen, Ayrshire (W. Thomson).

Explanation of Plate V.

Fig. 1. *Staurocephalus Murchisoni*, Barrande, coiled specimen, natural size. Woolhope Shale, Presteign. (Mus. Pract. Geology.)

Fig. 2. Head of ditto, same locality and cabinet.

Fig. 3. Magnified figures from the above specimens, completed from Dudley specimens.

Fig. 4 *a*, *b*. Magnified specimen from Dudley. Mr. E. Hollier's cabinet.

Fig. 5. Lower Silurian specimen. Rhiwlas, Bala (Mus. Pract. Geol.), nat. size and magnified.

Fig. 6. *Staurocephalus globiceps*, Portlock (his original specimen, magnified three diameters).

November 1864. J. W. Salter.

Geological Survey of the United Kingdom.

SALTERIA
(Lower Silurian)

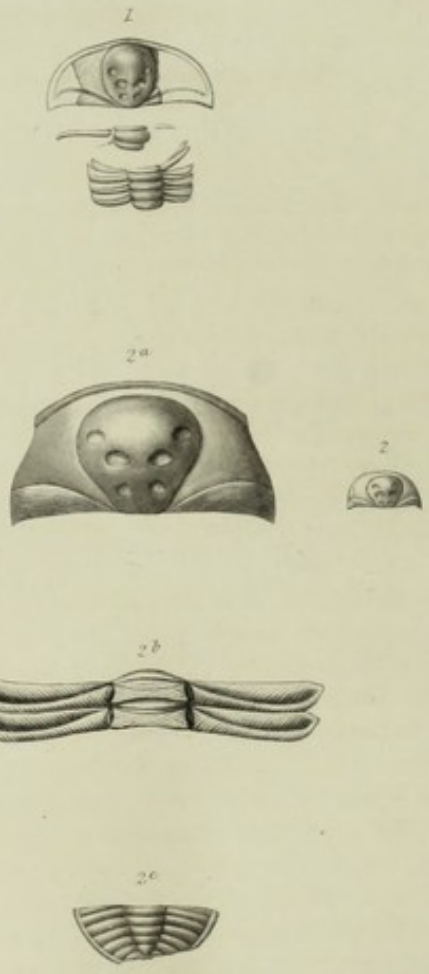


Fig. 1, 2. SALTERIA PRIMÆVA — *Wyv Thomson*

C.R.Bone del.t J.W.Salter direx.t J.W.Lowry lt.

BRITISH FOSSILS.

Decade XI. Plate VI.

SALTERIA PRIMÆVA.

[Genus SALTERIA. Wyv. Thomson. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Trinucleidæ.) Body oval, tapering backwards. Head large, semi-lunar, margin very narrow, simple, surrounding a broad limb. Glabella inflated, furrowed. Facial suture following the edge, except through a small portion on either side, where it becomes nearly vertical and slightly emarginates the upper surface, cutting off a narrow free cheek. [Eyes minute, linear.] Thorax of few segments. Tail of many segments.]

Diagnosis. *S. fere uncialis, lata, ovata. Caput semilunare limbo angusto brevi convexo marginato; glabellâ ovatâ pyriformi depressâ, genis multo majori, utrinque puteis tribus brevibus notatâ; sutura facialis sub fronte ambitui parallela, dein per quartam partem externam limbi conspicua subverticalis. Thorax articulis truncatis. Cauda triangularis multisegmentata.*

We have no hesitation in placing *Salteria* among the *Trinucleidæ*. It is evidently closely allied to *Dionide*, especially to Angelin's species *D. euglypta*. They have nearly the same form of glabella with longitudinal grooves; the same narrow, smooth, concave limb; the same structure of body rings and tail. The great difference between them consists in the presence in *Salteria* of a distinct though linear free cheek, and apparently of a true eye in its normal position. In these characters our fossil at once recalls *Cyphoniscus*, placed by Mr. Salter, apparently with much reason, among the *Olenidæ*. It also resembles this genus in the peculiar character of a delicate striation on the cast of one portion of the head, while the remainder is smooth. We have a specimen of *Cyphoniscus* from the same beds in Ayrshire retaining the free cheek, and showing a well marked narrow rim, ending in a long, straight, genal spine. The specimen is unfortunately too imperfect to show the eye. In *Cyphoniscus* the structure of the body rings is quite characteristic, and the small Olenoid tail is very different from the compound tail of *Salteria*.

Description.—Length of adult about three-quarters of an inch. Form broadly oval, tapering backwards. Head large, semi-lunar, slightly but regularly convex. The central shield, composed of glabella and fixed cheeks, is widely semicircular, emarginate externally, with a contour nearly corresponding with that of the head. The head is bordered by a distinct but not very broad, smooth, slightly concave margin, which is continuous with the central shield through the anterior half of the margin, but is cut away at the exterior fourth on each side by the curving inwards of the facial suture. The glabella is rounded-trigonal, in front transversely oval and very convex, and slightly prolonged and contracted behind, where it is much flattened; the crust is perfectly smooth. The two posterior glabella furrows on either side are represented by shallow pits, arranged nearly in a square, and occupying the posterior third of the glabella; the anterior pair of furrows by similar depressions more remote, placed near the anterior and outer angles of the middle third. Two longitudinal grooves connect the posterior glabellar depressions with the neck furrow, only shown in our upper figure. The tergal portion of the neck segment is small and convex. The fixed cheeks are large, slightly arched, coalescing before the glabella in a narrow ridge, bordered by a still narrower margin. The lateral portion of the occipital groove passes forwards and outwards two-thirds across the fixed cheek, then slightly backwards to the lateral margin, cutting off nearly one-third of the cheek. The portion of the cheek before the groove is smooth like the glabella, the portion behind it (the neck segment) is marked with delicate striæ parallel to the furrow and to the posterior margin.

In all our examples the free cheeks and the eyes are absent, but from the portions which we possess, and from the analogy of closely allied forms, we may safely supply a facial suture coinciding with the outer edge of the anterior margin, appearing upon the upper surface nearly midway between the centre of the frontal edge and the genal angle, passing gently inwards, and then outwards and backwards through the limb, slightly emarginating the semicircular contour of the head, and so curving downwards and outwards towards the genal angle.

The linear free cheek, bearing probably a linear eye, is absent. In our specimens the posterior angles have an imperfect truncated look, and we should be inclined to believe that, following the analogy of *Trinucleus, Dionide, Cyphoniscus,* &c., the lower edge

of the free cheek was prolonged into a genal spine. The labrum is unknown.

The body rings are few? in number. The axis is rather wide and more convex than the pleuræ (epimerals). A deep groove passes diagonally across them, curving slightly backwards from behind the anterior and inner angle of each epimeral portion to the outer and forwards to the outer angle.* The distal ends of the pleuræ are truncated obliquely forwards.

Of the tail we have only a fragment, but enough to show that it was somewhat triangular, marked with many segments, but fewer than in the tail of *Dionide* (*Polytomurus* of Corda).

We regard the structure of the head in *Salteria* as intermediate between that of *Trinucleus* and some of the *Olenidæ*. We may expect to find a series, beginning with the distinct facial suture and crescentic eye of *Remopleurides*, then the suture gradually approaching the edge of the head, passing through its position in *Salteria*, *Ampyx*, and *Cyphoniscus*, till it reaches the edge in *Dionide* and *Trinucleus*, the eye becoming more and more linear as it approaches the margin, till when it reaches it, the suture being constantly immersed in mud, and its function in abeyance, it becomes altogether obsolete, and is sometimes replaced by stemmata? jutting out on the epimerals of some of the other head segments.

We have much pleasure in dedicating this remarkable genus to our friend, lately the Palæontologist to the Survey.

Varieties.—The only variations which we possess of this species depend on age and size. Our largest specimen (fig. 1) may have been about an inch in length. The glabella is slightly carinated on the posterior third, and the longitudinal grooves are well marked. In smaller examples the glabella ridge is absent, and the longitudinal furrows scarcely perceptible.

Locality and Geological Position.—We procured about half a dozen specimens of the head from Schists forming the base of the "Graptolite and Orthoceratite flags," Penwhapple Glen, in the Girvan district;—the equivalents of the "Upper Bala or CARADOC ROCKS."

P. WYVILLE THOMSON.

* The groove is more forward than in our figure, so as to leave a larger posterior half to the pleuræ, but the direction of the groove is correctly given.

Other Species of the Genus.

2. In the Museum of Practical Geology there is a head of a small species with a smaller and more pyriform glabella, a wider and more deflected limb (almost involute) in front of it, and a narrow neck segment. It was not found till after the plate was engraved, or should have been added to it. It may be called

S. INVOLUTA.

Diagnosis. *S. minutus, capite vix 3½ lineas lato, convexissimo, ad frontem decurvo gibbo. Glabella pyriformis, dimidium capitis efficiens, sulcis transversis. Sulci cervicales vix arcuati. Oculi haud remoti.*

The involute limb in front is really about as broad as the width of the glabella, but is so much curved down that only a part of its breadth is seen on an upper view. The glabella, not equal to the width of the free cheeks at their base, is pyriform in outline, and marked by two pairs of transverse furrows, which indent it far inward, and one pair, the upper one, which is minute and very far outward. The furrow surrounding the glabella is very sharp and deep, but not broad. It separates an extremely tumid limb, which comprises the broad front margin and the convex cheeks. The facial suture cuts the front margin far outward, as in *S. primæva*, but, unlike that species, it then turns sharply inwards very near to the glabella, and then again abruptly outwards, in a wide curve to what must be the extreme end of the cheek.

The neck furrow is sharp and deep, and reaches nearly to the end of the facial suture. It is nearly parallel to the posterior margin, instead of curving forwards as in that species.

The species looks like a dwarfed variety of *S. primæva*, but is really a very distinct one.

Locality.—Llandeilo Flags, Newtown Head, Waterford, in the cabinet of Major Austin.

Explanation of Plate VI.

Fig. 1, 2. *Salteria primæva*, Wyv. Thomson; specimens, natural size, from the Caradoc schists of Penwhapple Glen, Ayrshire. (Mus. Wyv. Thomson.)

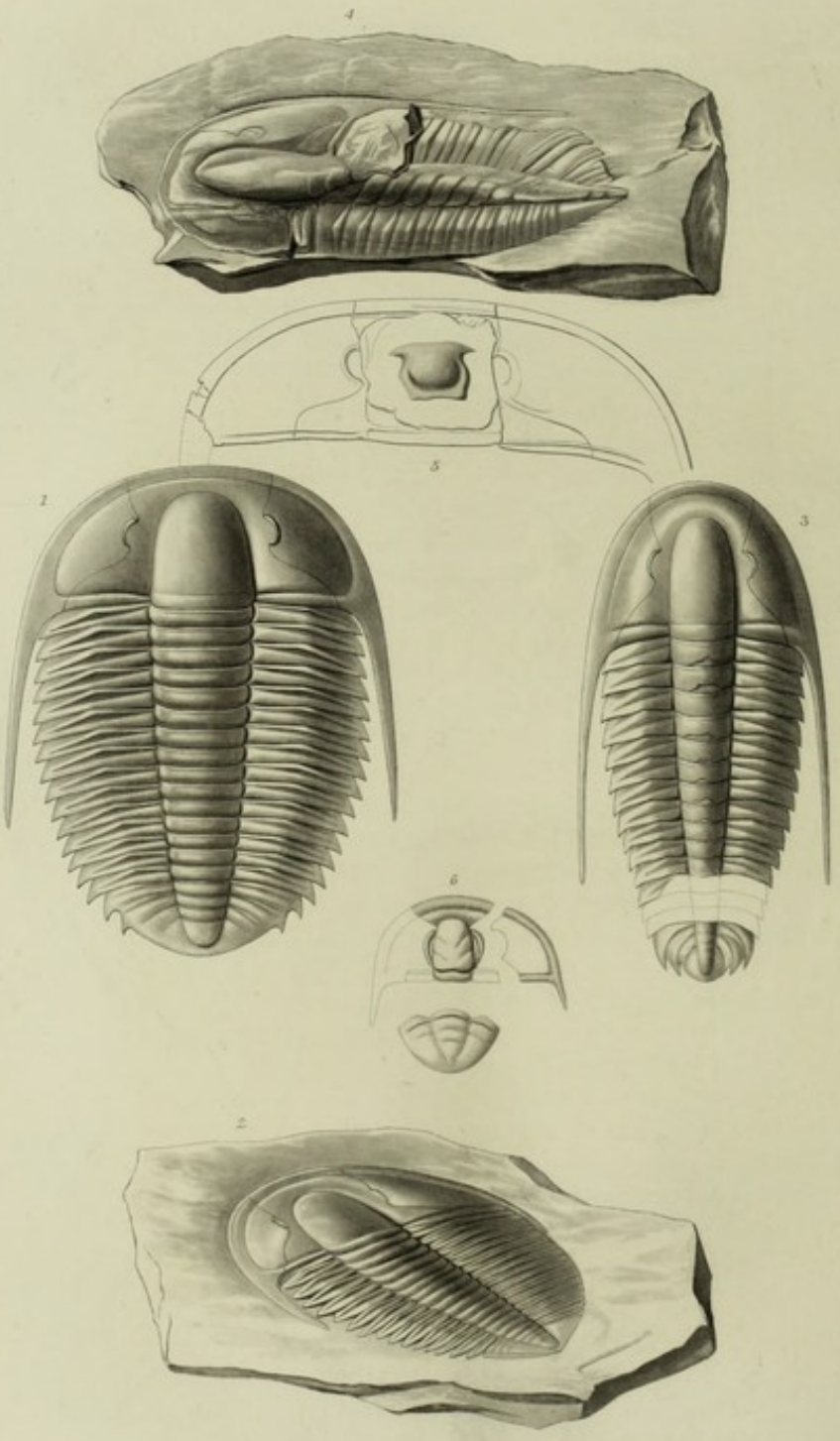
Fig. 2 *a*, 2 *b*, 2 *c*. The same magnified.

J. W. Salter.

November 1864.

Geological Survey of the United Kingdom.

ANGELINA
Tremadoc Slates



1-5 ANGELINA SEDGWICKI, *Salter* [*Tremadoc Slate*]

6 CONOCORYPHE INVITA. *id.* [*Up. Lingula Flags*]

C.H. Evans, Lith. J.W. Salter, del. et lith. J.W. Lowry, Imp.

BRITISH FOSSILS.

DECADE XI. PLATE VII. FIGS. 1–5.

ANGELINA SEDGWICKI.

[Genus ANGELINA. SALTER. (Sub-kingdom Articulata, Class Crustacea. Order Trilobita. Family Conocephalidæ.*) Depressed, head smooth, and with long posterior spines; eyes small, sub-median, without ocular ridge; glabella lobeless. Body segments 14–15, with an angular fulcrum, facetted for rolling up. Tail of few (four or five) segments. Labrum emarginate.]

DIAGNOSIS. *A. ovata, segmentis trunci* 15, *axi quam pleuris paullo angustiori. Caudâ utrinque bispinosa.*

SYNONYMS. *A. Sedgwicki*, SALTER, Siluria, 2nd ed., 1859, p. 53, foss. 9, fig. 2. *A. subarmata*, ib., fig. 3 (specimens pressed laterally and lengthened). *A Sedgwicki*, Memoirs Geol. Surv., vol. iii. (ined.) pl. 7.

The new forms illustrated on our plate were part of the results of a survey by myself in 1853 of the "Lingula Flags" and overlying beds in the mountain region extending from Tremadoc to Ffestiniog, and thence to Arenig-fawr, west of Bala. They have since been collected by the hundred, and are really common fossils.

The affinities of the genus are equally balanced between *Olenus* and *Conocoryphe*. *Angelina* differs from *Olenus* by having the pleuræ grooved and facetted for rolling up, instead of flat and produced into points; nor do we know of any *Olenus* that is totally without glabella furrows. It is this latter character, with the occasionally spinose tail, which distinguishes it from *Conocoryphe;* but this is combined with some characters of habit, such as the long head spines, less marked cephalic furrows, both axal and marginal (indicating probably a thinner crust), and much less deflexed pleuræ, with the fulcrum nearer the axis. *Angelina*, too, wants the ocular ridges of *Conocoryphe*. From *Arionellus* the less number of body

* The *Conocephalidæ* (Salter) differ essentially from the *Calymenidæ* by the variable but larger number of body rings, and the course (posteriorly) of the facial suture. They seem to have had a thinner crust, and, as a character of habit, resemble the *Olenidæ* in the long head spines and often sub-spinous tail border.

rings separates it, and that genus has so broad and expanded a margin, which is without a furrow, and the facial suture so far outwards, that there evidently is but little affinity with *Angelina*. The genus is named in honour of the Swedish paleontologist, who is carefully illustrating the old rocks of Christiania. Two fasciculi of his quarto work are already published, and we wait anxiously for the remainder. His *Calymene? leiostraca*, Pal. Suecica, t. xix. fig. 3, may very possibly belong to this genus.

Description.—Usually three or four inches long (one specimen fully six inches), of a broad oval contour, the head blunt, and the tail only moderately pointed. The head occupies less than one-third of the length, and is semicircular, but rather truncated forwards; a narrow equal margin, not raised or thicker in front, runs all round, scarcely broader than the occipital border of the cheek, and continuous with it; an equal space separates this margin in front from the glabella, which is parabolic, much longer than broad, and quite destitute of any lobes. It is about equal in width to the cheeks (exclusive of their margin). The cheeks themselves are gently convex, smooth, and bear the small curved eye midway, but nearer the glabella than the marginal furrow. The facial suture is nearly vertical to them above, and then turns sharply outwards to cut the posterior margin at its outer third.

The labrum is seen on one or two specimens. It has a central raised portion, separated by rather a deep groove from a flat margin, which is broadly and abruptly truncate at the apex.*

Thorax of 15 segments; the axis narrower than the sides, gently convex, and tapering quite regularly backwards. The pleuræ are nearly direct, slightly produced and bent back at their ends, and grooved throughout. They are bent down a little from the angular fulcrum, which is placed at rather more than one-third in front (our figure shows it too far out at this point), and at much less than one half in the middle segments. The hindermost segments are scarcely at all produced or curved backwards; and all the segments are facetted for rolling. The pleural groove is deepest beneath the fulcral point, and as beyond this the facet bounds it in front, and the posterior edge of the segment is convex beyond the fulcrum, the groove becomes an elongated rhomboidal depression: a feature

* It is a little like that of *Lichas*, but is without the terminal notch and the "auricles" or lateral wings, and differs from that of *Olenus* by its broad margin. *Conocoryphe* has a labrum without so broad a margin, and not nearly so truncate.

not often seen in those genera in which the faculty of rolling up is lost or very limited.

The tail is more pointed than a semicircle, the axis not as broad as the sides, with two distinct rings, and a bluntish terminal portion not reaching the tip. The sides are marked by two lateral furrows which just reach the margin, opposite to the two short lateral spines. The upper furrows are duplicated. The *incurved under margin* * is very narrow, but convex.

The compressed and elongated specimens (figs. 3, 4) were formerly considered to be of a distinct species, not, however, on account of the form, which I was aware might be due in great part to pressure, but on account of the spinose border to the tail, a character I had not at the time seen in figs. 1 and 2. A noble series of specimens, distorted in every possible way, have been lately transmitted by Mr. D. Homfray, of Portmadoc, who has collected the fossils of that district with much success.

These specimens show 15 segments (our figured specimens only showed 14), and they prove clearly that the spinose border to the tail occurs in all well-preserved specimens, yet in some more distinctly than others. And the great difference in appearance between figs. 2 and 3 is entirely due to the different direction in which the fossils have been pressed in the stone. The pleural grooves in the one case are all but obliterated (fig. 3), in the other they are deepened (fig. 2), and the spinose border to the tail (in fig. 3) appears to be increased in length; in fig. 2 it is reduced. The somewhat greater space in front of the glabella, and the long head spines in fig. 3, are differences which may possibly (if they be found constant) be referable to sex.

Locality and Geological Position.—Upper Beds of the Tremadoc Slates, Garth Hill, east side of Traeth Bach, Tremadoc, N. Wales; also Portmadoc Quarries, and at the Ynys Tywyn, in similar beds. (Mus. Pract. Geol., and cabinets of Messrs. Homfray, F. Ash, and Mr. E. Roberts, surgeon, and many other collections.)

Genus—CONOCORYPHE.

It is not usual to include more than one genus in a plate; but accident having introduced a *Conocoryphe* upon the plate of

* We want a term for this incurved striated under margin, which is always more distinct in the tail than elsewhere. Being always or most generally parallel-sided in the tail, it might conveniently be termed the "*caudal fascia*;" in the pleuræ, the "*pleural fascia*," but the term is hardly necessary for any portion but the tail, where the relative width of the *fascia* is of specific importance.

Angelina, advantage is taken of it to present the English reader with the characters of a genus which is more common, or at least better known, in Sweden and Bohemia, than in England.

Conocoryphe belongs to the same primordial family as *Angelina*, and differs from it chiefly in the lobed glabella. M. Barrande gives the following characters.*

[Genus CONOCORYPHE. Corda. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Conocephalidæ.) "Glabella shortened, narrowed in front, with three or four pairs of oblique furrows. Axal furrows deep. Eyes (usually present) reticulate. Facial suture ending within the posterior angle. A rostral shield present. Labrum elongate truncate. Thorax segments 10–15, furrowed and facetted for rolling. Tail entire, of two to eight segments." Barr., p. 417.]

[Section *Conocoryphe* proper. Eyes large, approximate. Glabella large, well lobed; 14 body rings; tail small. Lingula flags only.]

The other sub-genera, *Solenopleura*, &c., will be illustrated in future decades.

CONOCORYPHE* INVITA.

Decade XI. Plate VII. Fig. 6.

Diagnosis. *C. capite (adhuc solûm cognoto) lati-marginato, angulis brevispinosis; glabellâ urceolatâ, utrinque bisulcatâ; oculis longis, ad glabellam appressis; caudâ angustâ, axi conico 4-annulato.*

Synonym. *Conocephalus invitus*, Salter, in Siluria, 2nd ed., 1859, p. 47, foss. 7, fig. 1. Id. Mem. Geol. Surv., ined. pl. 4, figs, 5, 6, 7; pl. 7, fig. 6.

Description.—Of the head we have only fragments, but they show that the facial sutures converge greatly from the margin to the eye, which is very long, reaching two-thirds the whole length of the glabella, from the middle of the large basal lobe to above the upper lobe. The glabella furrows nearly unite in the centre and both pairs are very oblique, the basal pair almost meeting the deep arched neck furrow.

This species resembles so nearly *E. Emmrichii*, Barr., that were it not for the glabella having only two pairs of furrows, the frag-

* I think, much as we wish to preserve to M. Barrande all the honour of his careful nomenclature, that we cannot safely use the term *Conocephalus* or *Conocephalites* of Zenker, as the term has been employed in no less than three different genera of plants and animals. It is better to adopt Corda's term, the more so, as it is really likely that the subdivision of the genus proposed by him will be hereafter sanctioned.

ments might readily be mistaken for that species. The glabella, however, is longer, of an urceolate shape, and with the furrows reaching much further into it. The eyes are not quite so long, as they do not reach to the base of the lower lobes, and they are set quite close to the glabella, which is not the case in *E. Emmrichii.*

The tail is longer and narrower; the axis conical, with the terminal segment developed. Our species is altogether an excellent British representative of a genus common in Bohemia and Sweden.

Locality and Geological Position.—Upper Lingula Flags. Penmorfa Church and Carreg Wen, Tremadoc, N. Wales. Ogof ddu, near Criccieth. (Mus. P. Geol.)

It may be as well to mention here that 10 species of *Conocoryphe* are already known in Britain. Nine are described in the forthcoming Memoir of Professor Ramsay on the Geology of North Wales; and a fine species, with highly developed ornament, is found in the Lower Lingula Flags of St. David's. As the genus must be illustrated hereafter, I only give the names and references.

C. invita, Salter, Mem. Geol. Surv., vol. iii., ined., pl. 4, figs. 5, 6, 7; pl. 7, fig. 6, above described.
C. abdita, id. pl. 5, fig. 13, Upper Lingula Flag, Ogof ddu, near Criccieth.
C. sp. id. pl. 5, fig. 14 (fig. 15 tail ?), same locality.
C. sp. id. pl. 5, fig. 16, same locality.
C.? simplex, id. pl. 5, fig. 17, Upper Lingula Flag, Penmorfa Church.
C. vexata, id. pl. 8, fig. 7, Lower ? Tremadoc Slate, Penmorfa village.
C. depressa, id. pl. 6, fig. 1, 2, 3, Lower Tremadoc, near Penmorfa Church, and Wern, Portmadoc.
C.? verisimilis, id. pl. 6, fig. 13, Lower ? Tremadoc, above Penmorfa village.
C.? olenoides, id. pl. 8, fig. 6, Upper Tremadoc, Garth, Portmadoc.
C. variolaris, id. Quart. Geol. Journ., vol. xx., pl. xiii., figs. 6, 7, Lower Lingula Flags, St. David's, Pembrokeshire.

Explanation of Plate VII.

Figs. 1–4. *Angelina Sedgwicki*, Salter, in various states of compression, according to the position in the slaty beds. (Mus. Pract. Geol.)
Fig. 5. Labrum of ditto in Mr. Homfray's cabinet. Upper Tremadoc, Garth Hill, opposite Portmadoc.
Fig. 6. *Conocoryphe invita*, Salter. Upper Lingula Flag, Penmorfa Church, Tremadoc, N. Wales.

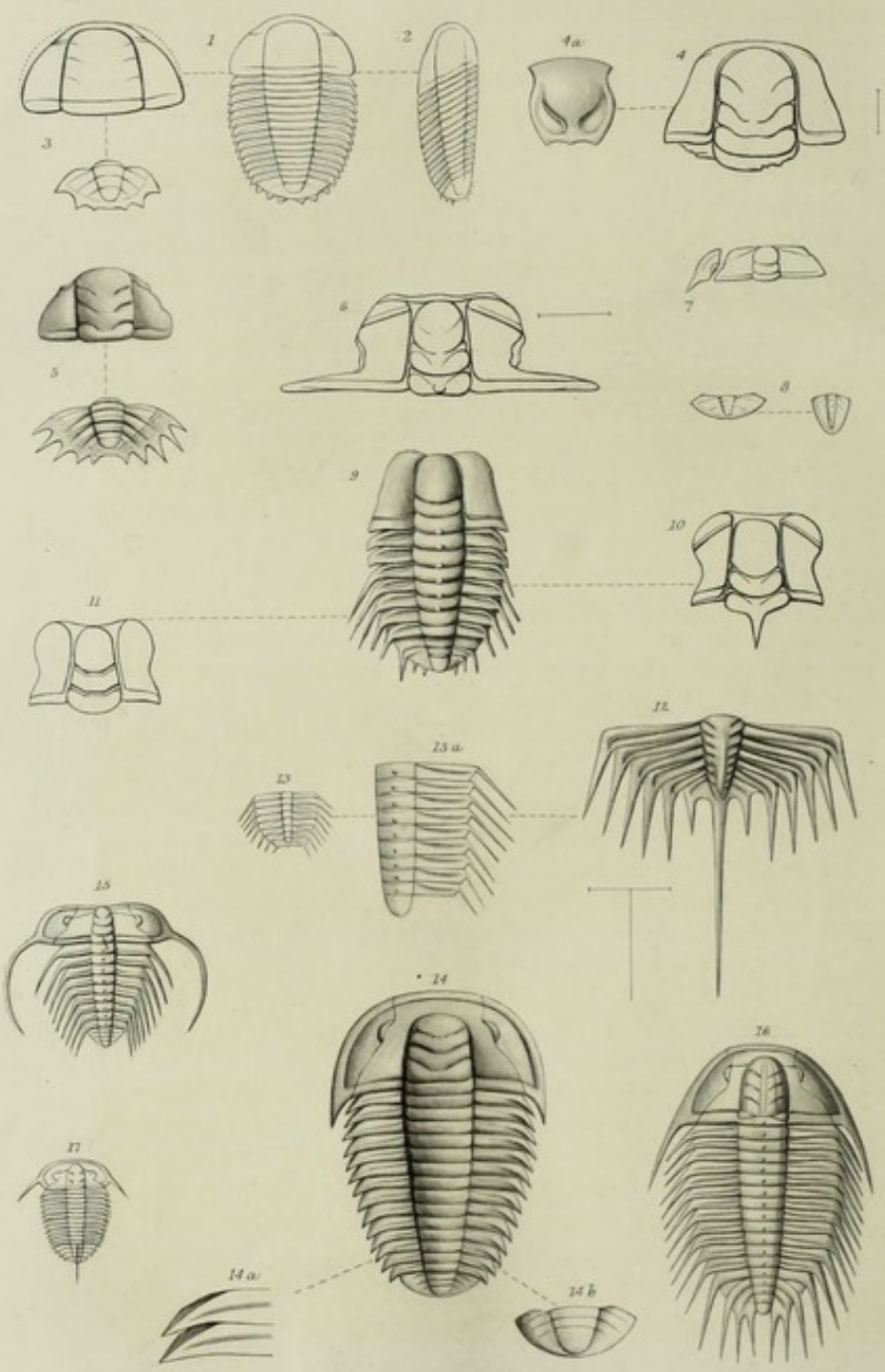
J. W. Salter.

November 1864.

Geological Survey of the United Kingdom.

OLENUS

(Lingula flags)



Figs. 1-3 OLENUS SCARABÆOIDES. *Wahl.*
4 —— SP.
5 —— SERRATUS. —— *Salter.*
6 —— BISULCATUS. —— *Phillips.*

Figs. 7-8 OLENUS FLAGELLIFER. *Angelin?*
9-11 —— HUMILIS. —— *Phillips.*
12-13 —— PECTEN. —— *Salter.*
14 —— CATARACTES. —— *id.*

Figs. 15, 17 are Swedish species for comparison.

C. B. Bunt del. J.W. Salter dirext. J.W. Lowry lt.

BRITISH FOSSILS.

DECADE XI. PLATE VIII. FIG. 14.

OLENUS CATARACTES.

[Genus OLENUS. DALMAN, in part. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Olenidæ.) Glabella oblong, or usually narrowed anteriorly, lobed; eye smooth, with a narrow prominent ocular ridge (*Costula facialis*, Angelin) connecting it with the upper part of the glabella; facial suture marginal in front, and cutting the posterior margin behind; cheeks spinous, no rostral shield; hypostome? labrum oblong, narrowed at base; pleuræ 7–15, (14 typically), pointed and curved; tail with articulated axis and sides.]

[British sub-genera. *Olenus*, DALMAN. Body rings 11-15, head semicircular, spines moderate, tail entire.—*Sphærophthalmus*, ANGELIN (including *Eurycare*, id.) Body rings 7–15; head transverse, with remote eyes and widely curved long spines.—*Parabolina*, SALTER. Body rings 12; head semi-lunar; eyes approximate; spines diverging; tail spinose.—*Peltura*, ANGELIN (not Milne-Edw.). Body rings 12; head narrow, with approximate eyes, and no spines; tail spinose.]

DIAGNOSIS. *O. ovatus* $1\frac{1}{2}$ *uncialis et ultra, capite magno semilunari, spinis brevissimis. Glabella sulcis tribus fere perfectis. Oculi antici. Thoracis axis latus, pleuræ vix recurvæ brevispinosæ, fulcro remoto. Cauda minuta, transversa, semicircularis, axi latissimo.*

Several species of the well-known *Olenus* of Dalman are now added to the British list. The originally described British form is *Olenus micrurus*, in our Decade II., plate 9 (1849), also "Siluria," 2nd ed., p. 45, foss. 4, fig. 2. That is not, however, by any means a common fossil, and it is necessary now to distinguish from it the present species, which appears to be the ordinary form in the lower black shales of North Wales.

Description.—Nearly an inch and a half long, ovate, blunt at both ends, the head wide, nearly one inch broad, the body much narrower, tapering regularly to the tail. The head is sub-truncate, the glabella moderate in size, parabolic, not so broad as the cheeks, reaching forward nearly to the narrow front margin, and about the width of that margin distant from it, furnished with three pairs of furrows, of which the lower two are complete across. The eye is nearly as far forward as the front of the glabella, and somewhat

remote from it. The hinder angles of the head with the spines abrupt, short, scarcely reaching the fourth segment, directed backward, not outward as usual in the sub-genus.

Body rings 15 (our artist has only represented 14 rings), their axis convex, nearly as broad in all the rings as the pleuræ, which decrease regularly, not abruptly, in length from before backwards; they are obliquely pointed, with short spines directed outwards, but very little backward. The fulcrum of the pleuræ is placed beyond the half, even in the hinder rings.

Tail short, semi-oval, with a very wide axis, of three rings, and the sides with two furrows.

O. micrurus is easily distinguished from *O. cataractes* by the oblique lower glabella furrows, the shape of the small smooth subtruncate tail, and by the abrupt narrowing of the hinder body rings, which also have the fulcrum placed nearer than half way out from the axis. The tail is even more easily distinguishable, the width of the axis being greater than that of the sides, and having three rings, including the terminal portion; there are two lateral furrows, not one only. *O. cataractes* has 15 body rings. *O. micrurus* 14.

The head is much like that of *O. micrurus*, but the lower glabella furrows run quite across. Compared with the Swedish *O. truncatus*, the greater breadth of the cheeks, and the longer, more parabolic form of the glabella, will distinguish it. I do not compare the caudal portions, for Angelin's figure looks as if there were some mistake in this part. Possibly two of the caudal rings as figured by him belong to the body, which otherwise would have but 13 rings—a difference hardly to be expected in such closely allied forms.

O. truncatus is, I think, from higher beds, at Andrarum in Scania, than our Lower Lingula flags, but this is a point not yet sufficiently investigated.

Localities and Geological Position.—Lower Lingula Flags, Maentwrog Waterfall, Merionethshire, in black shaly strata full of *Agnostus princeps*; also at Treflys, E. of Criccieth, Carmarthenshire, N. Wales, where I found the figured specimen in 1859. Specimens probably identical are found at the Dolgelly gold mines.

OLENUS (SPHÆROPHTHALMUS) FLAGELLIFER.?

PLATE VIII. FIGS. 7, 8.

SYNONYMS. *Sphæroph. flagellifer*, ANGELIN, Pal. Suecica, pl. 26, fig. 7.? SALTER, Mem. Geol. Surv., vol. iii. ined. pl. 5, figs. 8, 9.

The only difference I can see between the Tremadoc specimens and the figure by Angelin is, that the glabella furrows in ours run quite across, while Angelin gives them as only lateral. But as this character of the complete transverse furrows seems to belong to the whole of the *Sphærophthalmi*, perhaps the Swedish artist has not sufficiently represented it. The other characters of the sub-genus (for it can, I think, only be so regarded) are the short and wide transverse head, the cylindric glabella reaching the front margin, and the very large curved head spines.

Again, *Eurycare*, Angelin, which I regard as only *Sphærophthalmus*, has a somewhat broader front, and wider and more parabolic glabella, thus leading from *Sphærophthalmus* to the true *Oleni*, of which *O. gibbosus* may be taken as the type. The characters seem to me not to be absolute in any of these sub-genera, and hence they may all, I think (and Barrande seems to be of the same opinion), be conveniently retained in *Olenus*.

Description.—Our specimens are so imperfect, that I do not pretend to give a true diagnosis, nor do I feel quite sure I have identified it rightly.

The head is very transverse and has parallel edges. The glabella is nearly square, and has only two pairs of furrows. The lower reach far across, and appear quite complete in some specimens; the upper, not represented in our scanty figure, only lateral and short. The ocular ridge is distinct and oblique. The margin very narrow. The neck segment also narrow. The free cheeks rotund, the eye large and prominent; the spine seeming to start from the outer edge above the angle. The thorax rings are strongly furrowed, their axis moderately broad.

The tail is entire, sub-triangular, with a conical axis, and furrowed sides. Our specimen shows no trace of a spine such as Angelin figures and describes.

I think the species is a distinct one, but in the absence of more complete materials, do not think it worth while to separate it from its near ally. Our figure is necessarily imperfect, but might have

shown more clearly the upper pair of glabella furrows and the outwardly placed head spines; the eye is also too small.

Locality and Geological Position.—Upper Lingula Flags, Carreg Wen, Borth, Portmadoc. (Mus. Pract. Geology.)

OLENUS (PARABOLINA) SERRATUS.

Plate VIII. Fig. 5.

Diagnosis. *O. modicus, 1½-uncialis, convexus. Glabella oblonga æquilata, haud parabolica, anticè subtruncata, sulcis utrinque binis longis fere medium glabellæ attingentibus, paullo obliquis. Sulcus cervicalis vix continuus. Oculi valde antici. Genæ angustæ. Cauda (hic haud dubiè referta) semicircularis axi prominulo 4 costato, obtuso; lateribus utrinque 5-dentatis, dentibus patulis limbo brevioribus; hôc 4-sulcato, sulcis omnibus distinctè interlineatis.*

Synonyms. *Olenus (Parabol.) serratus*, Salter, Mem. Geol. Surv., vol. iii. ined. pl. 5, figs. 6, 7.

Description.—Glabella quite as wide in front as behind, with a broad neck segment, equal in breadth to the basal lobe. The second or middle lobe somewhat narrower. Fixed cheeks broad, sub-trigonal, equal to more than half the width of the glabella, the eye placed very far forwards, opposite the forehead lobe. Free cheeks not known, probably narrow.

Tail, most likely of the same species, semicircular, serrate, with short, somewhat radiating spines. Axis thick, of four prominent rings and a blunt terminal piece; sides four-ribbed, the ribs duplicate, and produced on the margin into strong spines of less length than the limb, five on each side, the fifth pair of spines being set rather wide apart beneath the axis.

Affinities.—I much wish I could identify this with the common *O. spinulosus*, Wahl., for the head is very like. But the caudal shield is decidedly different, and as it in all probability belongs to the same species as the head, I feel bound to keep the two distinct. The glabella, moreover, differs, as above described, from that of the true *O. spinulosus*, which tapers a little forward. In that species the tail spines also are greatly lengthened.

History.—The section *Parabolina*, regarded as a genus by Angelin, was proposed by me in 1849 to distinguish the species of *Olenus* which have 12 body rings and a laciniate tail. *O. scarabæoides* might perhaps belong to this sub-genus as so defined, but

it has 13 body rings, and clearly belongs to a different natural group, in which the cheeks are much contracted, and the glabella enlarged; in the majority of *Oleni* the reverse is the case.

I believe Angelin has good reasons for supposing there are several distinct genera included under *Olenus*, but I do not quite see the way to their definition yet. The term *Peltura* can only stand by courtesy, for it was founded on a species of *Lichas*, as may be seen by reference to Capt. Fletcher's description of the British Upper Silurian species of that genus.*

Locality and Geological Position.—Upper Lingula Flags, Carreg Wen, Borth, Portmadoc.

OLENUS SCARABÆOIDES.

Plate VIII. Figs. 1–3.

Synonyms. *Vermiculites vagipennis*, Bromell, in Act. Lit. Upsal., 1729, pp. 525, 528, cum icone. *Entomostracites scarabæoides*, Wahlenb., Nova Act. Soc. Upsal., vol. viii. t. 1, f. 2. *Olenus scarab.*, Dalman, Palæadæ, p. 257. *Olenus scarab.*, Hisinger, Lethæa Suecica, t. 4, f. 4. *Paradox scarab.*, Brongniart, Crustaces, foss. p. 34, t. 3, f. 5. *Peltura scarab.*, Milne-Edw., Crustaces, vol. iii. p. 344 (1840). *Peltura scarab.*, Angelin, Palæont. Suecica, pl. 25, f. 8 (mala), 1855. [*Olenus spinulosus?* Phill., Mem. Geol. Surv., vol. ii. pt. 1, pp. 55, 239.] *O. scarab.*, Salter, Siluria, 2nd ed., Appendix, p. 540. *O. scarab.*, Id., Mem. Geol. Surv., vol. iii. ined. pl. 5, figs. 2–5.

In size, as well as form, these pressed and distorted Trilobites agree pretty well with Christiania specimens presented by Dr. Th. Kjerulf to the Mus. Pract. Geology. But ours show only one ring to the axis of the tail besides the terminal lobe. Wahlenberg's fossil has two rings to the axis. The marginal spines are only clearly seen in one British example; they do not differ from the Swedish species except in being shorter (see fig. 3). The glabella in our specimens is broader, and the lobes less distinct. It is manifest, therefore, that there are sufficient differences to render it probable that better specimens will require us to distinguish it. I shall at present call it—

Var. obesus.

The following characters appear to me to be constant, and I find them both in N. Welsh and Malvern specimens.

* Quart. Geol. Journ., vol. vi. p. 235.

General form broad oval, seldom reaching in length above an inch; of this the head occupies fully one-third. It is semi-oval, without the fixed cheeks (fig. 1), but with them (and perfect heads in Mr. Edgell's collection show them well) it becomes transverse-oblong. The broad parabolic flattened glabella is more than equal to the width of the cheeks, and has usually straight sides, sometimes in Malvern specimens a little contracted in the middle (fig. 4). Lobes very slightly marked (our fig. 4 has them too strong). The neck segment enlarged at the sides, and quite distinct across. The three pairs of furrows obscure. A very narrow margin in front of the glabella. The fixed cheeks narrow triangular, the eye very far forward, and connected with the front of the glabella by a low ocular ridge. The neck-furrow on the cheeks very near the hinder margin. Free cheek semicircular, very convex on its outer edge, and with a strong but narrow margin, and no spine, the base closely contracted.

Labrum (fig. 4 *a*), in a Malvern specimen lent by the Rev. W. Symonds, squarish, urceolate, with the base not expanded, the sides convex, the apex broadly truncate; the lateral furrows oblique. broad, not deep.

Body rings 14 (in a specimen lent by Mr. Ash, fig. 1). But this number is somewhat doubtful, as I find my notes say it has only 12 distinct ones. The Swedish fossil has 13, according to Angelin's figure, but his description gives 12, probably the true number. Ours do not show a central tubercle.

Tail semicircular, with broad blunt axis, showing one distinct ring, and a larger terminal portion. The sides as broad as the axis, and with three obscure furrows, the margin distinctly tridentate on each side, with short spines, not much projecting beyond the border, which is not at all marginate.

I believe we may safely identify with this the small species found at Malvern (pl. 8, fig. 4), and described by Phillips under the name of *O. spinulosus*. We have copied his figure, Mem. Geol. Surv., vol. ii. pl. 1, p. 55. It is certainly not Wahlenberg's species of that name. The furrows of the glabella are far too plainly marked in our figure, but the slight contraction visible on the sides of the glabella is correct for Malvern specimens.

Taking all the evidence together, I am inclined to think the British fossil distinct from the Swedish; and I am principally indebted to Mr. Edgell for the specimens which lead to this conclusion. I shall retain the name under which our fossil is usually

known till we have more complete evidence that the var. *obesus* is distinct as a species from the well-known Swedish type.

Locality and Geological Position.—Upper Lingula Flags, Carreg Wen, near Borth, and Penmorfa Church, both near Tremadoc, N. Wales. Abundant at Whiteleaved Oak, Malvern, in the Upper Lingula Flags (Black Shales) of that locality.

OLENUS (SPHÆROPH.) HUMILIS.

Plate VIII. Figs. 9–11.

Diagnosis. *O. (Sph.) minutus, capite angusto antice emarginato, pleuris 7, posticis solum spinosis, caudâ sexcuspidatâ. Glabella convexa angusta parabolica, sulco basali completo, reliquis obsoletis, cervice spinoso. Genæ convexissimæ, oculis omnino posticis, magnis. Thorax 7-costatus, pleuris duobus anticis muticis, reliquis spinosis. Cauda brevis semicircularis, 6-spinosa, spinis externis majoribus.*

Synonyms. *Olenus humilis*, Phill., Mem. Geol. Surv., vol. ii. pt. 1, pl. 55. Salter, Mem. Geol. Surv., vol. iii. ined. pl. 5, fig. 12.

This minute species is well characterized by its very narrow instead of wide cheeks. Yet in other respects it is a perfect *Sphærophthalmus*, and such a copy in miniature of the *Olenoid* type, with nearly all the characters exaggerated or reduced, as to show us that great variation is to be found within its limits, and to induce us to regard the various groups into which *Olenus* has been divided as sub-genera rather than distinct generic types.

Description.—A minute form, not above a quarter of an inch in length, and of an ovate shape; the head broadest, as usual in this sub-genus, but rather squarish-oblong, with an emarginate front, the very convex cheeks projecting on either side so much forward as to bring their greatest convexity in advance of the narrow parabolic glabella! The facial suture follows this convexity in a sigmoid line, cutting the front margin at a short distance outside the axal furrow, then curving outwards widely, and then again at the lower third much contracted inwards to the place of the eye, which is near the base of the cheek. The eye-lobe which covers it is elevated and easily broken away, being divided by a deep furrow from the fixed cheek.

The eyes are large and round, and placed quite at the base of the free cheeks, which are true semicircles, strongly margined, and completely contracted to a point behind, showing (so far as I can see)

no trace of the curved spine characteristic of this sub-genus. Our figured specimens had not the free cheeks in any case. Mr. Edgell's specimens show them well.

Body short, of seven rings only,* with a broad axis, showing in the five front rings the central tubercle. The pleuræ are short, strongly grooved; the two front ones without recurved spines, the rest spinous; the spines bent strongly back and about as long as the pleuræ.

The tail is nearly a semicircle, and furnished with a strong conical three-ribbed axis, which reaches the end. The sides two-ribbed, with three spines on each side, the forward one longest, the other two short, and leaving a rather broad smooth space at the extremity of the tail beneath the axis.

Locality and Geological Position.—Only known in the BLACK SHALES of Malvern, Fowlet's Farm, and Whiteleaved Oak Farm, &c., and very abundant there, with other species of the genus next described.

OLENUS BISULCATUS.

PLATE VIII. FIG. 6.

DIAGNOSIS. *O.* (*Sph.*) *modicus, capite transverso, glabellâ bisulcatâ, genis latissimis. Thorax pleuris latis, profunde sulcatis, spinis validis rectis.*

SYNONYM. *O. bisulcatus*, PHILL., Mem. Geol. Surv., vol. ii. pt. 1, p. 55, fig. 1.

The head of this species is remarkably wide, and thus differs at a glance from *O. humilis*, with which it occurs. The body rings have lately been detected in the cabinet of my friend, Mr. Edgell, and I am thus enabled to improve the description. The species is stouter in all its parts than is usual in the sub-genus.

The species is a small one, not more than eight lines in length, and the width from tip to tip of the stout thorax spines seven lines. The head is very transverse, three times as wide as long, even excluding the free cheeks, which we do not perfectly know, but believe to have extended somewhat further out, and to have been armed with a stout curved spine starting one third or thereabouts above the genal angle. The front is straight, or only slightly emarginate, and the

* The species is abnormal for the genus, abnormal even for the sub-group to which it belongs. It contradicts most of the technical characters of *Olenus*, and yet evidently belongs to it.

margin narrow, the long sub-cylindrical glabella touching it. The axal furrows are deep; the glabella narrower forwards and rounded in front, with a strong neck-lobe, not spinous but with a central tubercle, a pair of complete basal grooves cutting off the lower third of the glabella, and an incomplete upper pair.

The fixed cheeks consist of an oblong convex plate in front of the eye, which is placed far back, opposite the basal furrow, and about the width of the glabella apart from it. The ocular ridge is very oblique, and only reaches the front edge of the broad eye lobe. The facial suture is sinuous, but nearly vertical to the eye, and beneath it turns abruptly outwards in a line all but parallel to the neck margin, and reaches it at a distance from the glabella equal to twice the width of that organ. The neck furrow is narrow, but distinct all along.

[The cheek, in a separate specimen of Mr. Edgell's probably belonging to this, is a quadrant of a circle, with a round prominent eye, and a narrow margin on the outer edge. The spine starts considerably above the angle, and on the level of the eye, and appears to be short and not much curved.]

Thorax of — ? rings. We have only six preserved; they are broad, straight, equal in width to the axis, excluding the strong patent spine, which bends very little backward, and is about as long as the pleuræ themselves. The pleural groove is deep and broad, and reaches the base of the spine. The axis is convex, and has a spinous tubercle on each segment.

Locality and Geological Position.—Upper Lingula Flags, Whiteleaved Oak, Malvern. (Mus. Pract. Geol.)

OLENUS (SPHÆR.) PECTEN.

Plate VIII. Figs. 12, 13.

Diagnosis. *O. parvulus monstrosus, capite contracto longispinoso, thorace multispinoso, caudâ mirâ pectinata et in spinam longissimam centralem producta. Caput ad frontem emarginatum, glabellâ brevi, genâ angustâ spinam medianam curvam gerente. Oculis omnino antrorsis. Thorax pleuris rectissimis, spinis aciculatis. Cauda spinis utrinque sex parallelis, et mediană longissima.*

Oblong, the head contracted in width, emarginate in front, with narrow glabella, and furnished with convex projecting cheeks,

bearing very forward eyes. They are placed on the most prominent part of the cheeks, opposite the front of the glabella, and about midway from it. The fixed cheek is wider than the glabella, but the free cheek is not so wide, and much resembles that of *O. humilis*. And the facial suture, as in that species, is nearly vertical below the eye as well as above it.

The head-spine does not in this species start from nearly the base, but quite up in the middle of the free cheek. It is only slightly curved; but arising from so unusual a position, it has a most odd appearance. It reaches to the seventh thorax ring.

The thorax-rings are much wider than the head, and remarkably straight across. The axis is not above one-third the width of the straight pleuræ, which are even a little curved upward, and grooved throughout; they bear a straight spine, directed obliquely backwards, and longer in the hinder segments. We only know seven rings; there must have been several more.

Mr. Turner, schoolmaster at Pauntley, Gloucestershire, was the discoverer of this curious species, and sent it to the Rev. W. Symonds. It has since occurred in greater plenty. Mr. Edgell has perfect heads and several caudal portions. The Rev. T. B. Brodie has an excellent specimen.

Locality.—With the preceding.

The group of species last described rather fully illustrate the curious sub-genus *Sphærophthalmus*, and show how wide in these ancient genera the limits of variation are in a single group. As we ascend in the geological scale, the law of variation becomes more restricted, and characters which are of family value in the more advanced groups scarcely afford generic distinctions in some of the more ancient and less highly organized ones.

The *Olenidæ* and the *Asaphidæ* have both of them wide limits, and it may be possible bye and bye to subdivide them.

Locality and Geol. Position.—Upper Lingula Flags, White-leaved Oak, Malvern.

Figs. 15, 16, 17.

I have figured the Swedish *O. spinulosus* (fig. 16,) to give the British student an idea of what form to look for when searching for fragments of *O. serratus*. Fig. 15 illustrates perfectly the sub-genus *Sphærophthalmus*, while it is also a common Upper Lingula Flag fossil for Britain (see Mem. Geol. Surv., vol. iii. ined., pl. 4). Fig. 17 is Angelin's sub-genus *Leptoplastus*, which I regard as a form of *Sphærophthalmus*, and may illustrate in part our *O. pecten* and *O. flagellifer*. *Olenus* proper and *Peltura* are sufficiently represented by our own species.

Other British Species.

O. micrurus, Salter, Decade II., pl. 10, (section *Olenus*).

O. *alatus*, Bæck, our pl. 8, fig. 15, and Salter in Mem. Geol. Surv., vol. iii. ined., pl. 4, fig. 3 (section *Sphærophthalmus.*)

Explanation of Plate VIII.

Figs. 1–4. *Olenus* (*Peltura*) *scarabæoides*, Wahl.? (possibly a new species), var. *obesus*, Salter. Fig. 1. Natural size, uncompressed (Mr. Ash's cabinet). Fig. 2 compressed (Mus. Pract. Geology.) Fig. 3, slightly enlarged ; specimens are, however, occasionally found nearly of these dimensions.

Fig. 4. Malvern specimen, the same figured by Phillips in Mem. Geol. Surv., vol. ii., pt. 1, pl. 55. The glabella furrows are far too strongly marked.

Fig. 4 *a*. Labrum, from Malvern. Upper Lingula Flag (Black Shales).

Fig. 5. *Olenus* (*Parabolina*) *serratus*, n. sp., Carreg Wen, Portmadoc.

Fig. 6. *Olenus* (*Sphærophthalmus*) *bisulcatus*, Phill. His original specimen from Malvern, in Upper Lingula Flag.

Figs. 7, 8. *Olenus* (*Sphær.*) *flagellifer*, Angelin.? Carreg Wen, Portmadoc, Upper Lingula flag.

Fig. 9. *Olenus* (*Sphær.*) *humilis*, Phill., Malvern. Dr. Grindrod's cabinet (magnified).

Figs. 10, 11. Heads of the same (the free cheeks lost). Same locality. (Survey collection.) Abundant in the Black Shales.

Fig. 12. *Olenus* (*Sphær.*) *pecten.*, n. sp. Same locality. (Rev. W. Symonds' cabinet.)

Fig. 13. Thorax of do., natural size and magnified. Same locality and cabinet.

Fig. 14. *Olenus cataractes*, n. sp., Lower Lingula Flags, Treflys, near Criccieth (Mus. Pract. Geol.) 14 *b*. Tail enlarged. 14 *a*. Pleuræ.

We have figured three Swedish fossils to illustrate sub-genera imperfectly represented by British specimens. All are from the primordial zone.

Fig. 15. *O.* (*Sphær.*) *alatus*, Bæck, copied from Angelin.

Fig. 16. *O.* (*Parabolina*) *spinulosa*, Wahl. do.

Fig. 17. *O.* (*Leptoplastus*) or *Sphærophthalmus raphidophorus*, Angelin, copied from his Palæont. Suecica, pl. xxvi., fig. 2.

J. W. Salter.

November 1864.

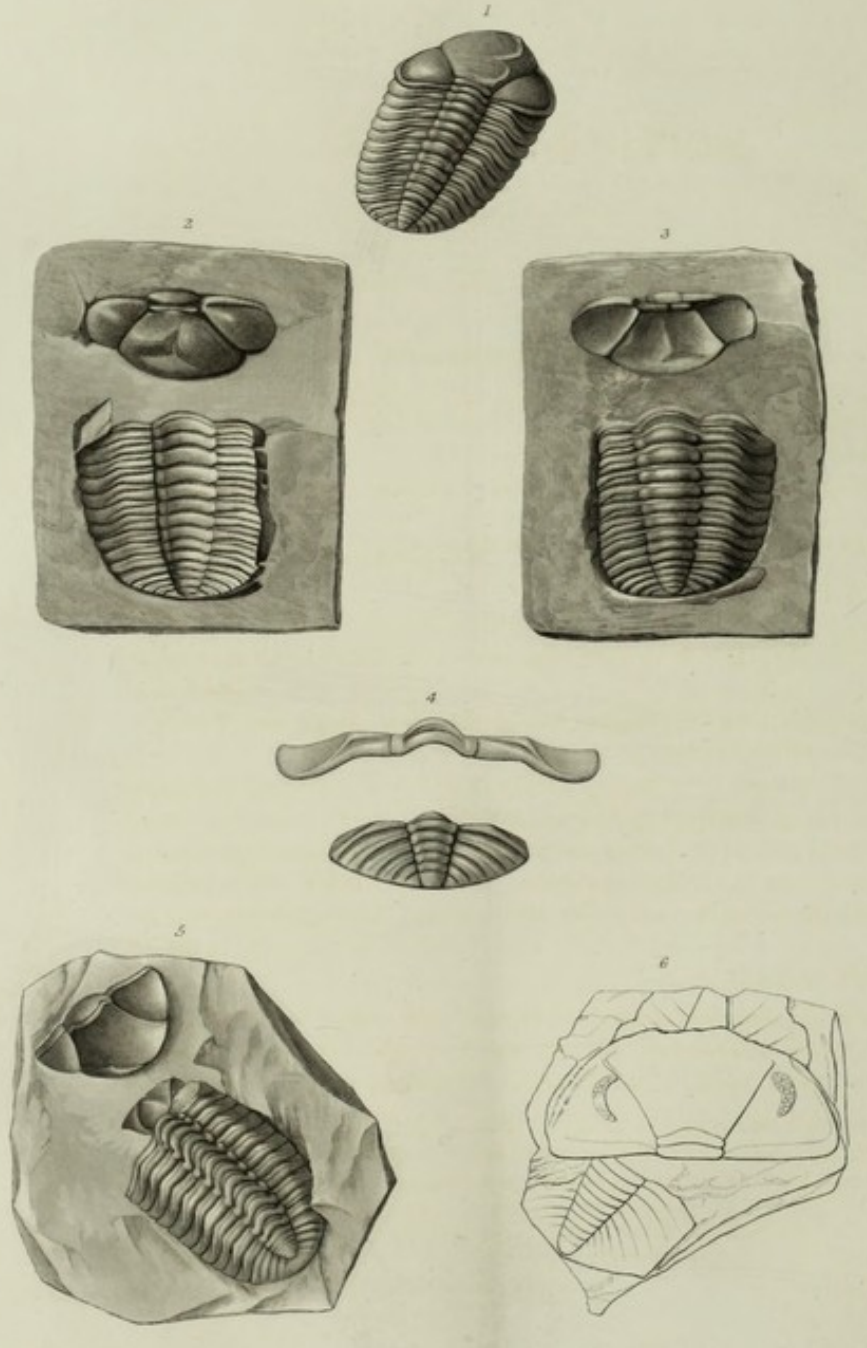
Geological Survey of the United Kingdom.

DECADE II PLATE 9.

PHACOPS

(SUBGENUS TRIMEROCEPHALUS)

(Devonian)



Figs. 1–5 PHACOPS (TRIMEROC) LÆVIS *Münst.*

6 —— CRYPTOPHTHALMUS *Emmr.* (from Sandberger)

BRITISH FOSSILS.

DECADE XI. PLATE IX. FIGS. 1–5.

PHACOPS (TRIMEROCEPHALUS) LÆVIS.

[Genus PHACOPS. EMMRICH. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Phacopidæ.) Eyes largely facetted; facial suture ending on the outer margin; thorax 11-jointed.]

[Sub-genus *Trimerocephalus*. Form compact. Glabella inflated and expanded forwards, the lobes, except the basal ones, obscure. Eyes very small, of few large lenses (often lost by abrasion) or absent. Head angles not spinous. Facial sutures soldered. Thorax with pleuræ all rounded. Tail small, of few segments, with even border, and not at all produced.]

DIAGNOSIS. *P. (Trim.) cæcus, latè ovatus lævis, glabellâ latissimâ, brevi, genas subsphericas trigonas superintendente; lobis basalibus minutis distinctis. Thoracis axis angustus, fulcro pleurarum axin approximato, sulcoque brevi. Cauda latissima brevis, axi longo, 5-annulato, lateribus 4-sulcosis, margini nullo.*

SYNONYMS. *Trinucleus lævis*, MÜNST. Beitr. Heft 5, t. x. fig. 6 (1842). *Calymene lævis*, PHILL., Pal. Foss., pl. 55, fig. 250 (1841), (not *Cal. lævis*, MÜNST., l. c. t. v. fig. 4). *Asaphus* or *Trinucleus*, SOWERBY, Geol. Trans., 2nd Ser., vol. v. pl. 57, fig. 30 (1840). *Trimerocephalus lævis*, MCCOY, Ann. Nat. Hist. vol. iv. p. 404, woodcut (1849). Ibid, Synopsis Woodw. Mus., p. 178 (1851). SALTER, Palæont. Society, Monogr. (1864), p. 16, pl. 1, figs. 5, 6, 7.

It would perhaps be better if a new name were bestowed upon this species. It is clearly enough the *Trinucleus lævis* of Münster, and that fossil belongs to *Phacops*. But the *Phacops* (*Calymene*) *lævis* of Münster is quite another thing, and typical of another section of the genus; and if the latter were a good species, and not a mere synonym of *P. granulatus*, as I believe it to be, it would be imperative to change the name, and I would then propose the term *P. trinucleus* for this species. At present it had better stand as *P. lævis*.

There is less difficulty about the name of the sub-genus. That bestowed by McCoy is convenient enough, the group being a really good one, distinguished by the soldered head sutures and especially the absence of eyes.* No trace can be seen of these organs in the present species.

Description.—Rarely exceeding an inch and a quarter long, of a broad oblong-oval shape, the head being nearly one-third the whole length, convex, and divided deeply into three tumid lobes, of which the lateral ones or cheeks are not above half the width of the glabella. This is "sub-rhomboidal," or spherical-triangular, convex, smooth, twice as broad in front as behind, where a very narrow pair of basal lobes separates it from the neck-ridge; the upper furrows are quite obsolete. The cheeks are trigonal, the shortest side being the outer or marginal side, very evenly convex, and with no trace of an eye. They are bordered by a very distinct and rather broad smooth margin, which is continuous at the rounded posterior angles of the head, and lost in front, where it abuts against the glabella.

Thorax of 11 segments, with convex narrow axis and rounded pleuræ; the segments of the axis tuberculate at the sides; the pleuræ not much bent back, rounded at the end, the groove narrow and short, the fulcrum placed at less than half way out; the facet rather large.

The tail is short and broad; its length not half its breadth, and both forward and hinder edges being curved, so as to give a lenticular outline. The axis is suddenly narrower than that of the thorax, conical and gently convex, attaining very nearly the border of the tail, blunt at the tip and marked with four or five transverse furrows. The sides have four radiating bent furrows, which are faintly interlined and nearly reach the edge; there is no distinct border to the tail.

The species was first figured in England (from the only English locality I know of, viz., the Knowl Hill, near Newton Bushell,) in the plates executed by Sowerby for the Devonshire Memoir of Professor Sedgwick and Sir R. I. Murchison.† That figure is from

* *Trimerocephalus* has been lately made to include all the species with lobeless or very faintly lobed glabella and soldered sutures and superficial minute eyes, *e.g.*, *Phacops Volborthi*, Barrande, and *P. cryptophthalmus*, Emmrich, which last is figured on our plate for comparison. But it will probably be hereafter restricted to the present species and kindred forms, since the most careful scrutiny fails to detect the least trace of eye or facial suture

† Trans. Geol. Soc., 2nd series, vol. v., 1840.

an uncompressed specimen, but they are mostly distorted, and, as noticed by Mr. Pengelly, the head is generally disjointed from the body and inverted, as if the animal had habitually kept it bent under, and been preserved in the slate in that position. In that posture, and exposed to the accidents of slaty cleavage, it is often difficult to distinguish the parts correctly; and the juxtaposition of two specimens, or the extra elongation along the line of cleavage, have often given rise to a specimen with apparently more than the proper number of body rings, and to all sorts of abnormal proportions of the various parts.

Locality and Geological Position.—Upper Devonian. Knowl Hill, Newton Bushell. It is quoted by Phillips from S. Devon, at Mudstone and Durlstone Bay. I think there is much doubt of these *Lower Devonian* localities, but less doubt about Brushford, N. Devon, in the Marwood or Pilton group.

Explanation of Plate IX.

Fig. 1. *Phacops* (*Trimerocephalus*) *lævis*, Münster. Specimens from Knowl Hill, Newton Bushell. (Mr. Pengelly's cabinet.)

Figs. 2, 3. From the same locality and cabinet. Specimens in which the head has been disjointed from the body and reversed in position. (See also fig. 5.)

Fig. 4. Thoracic ring and tail from Mr. Vicary's cabinet.

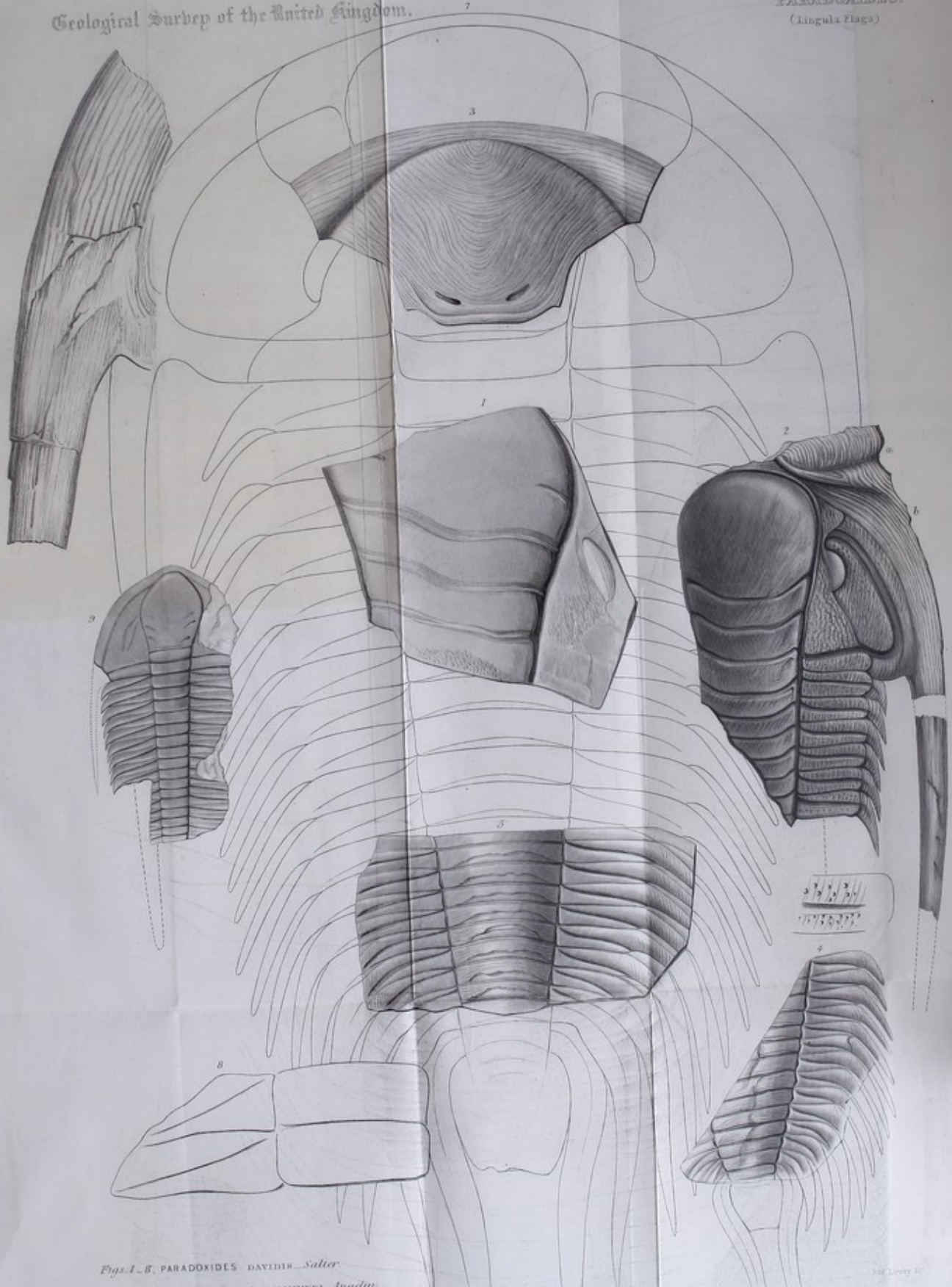
Fig. 5. Original specimen figured by Sowerby in the Geol. Trans., 2nd series, vol. v. (Same locality.)

Fig. 6. *Phacops* (*Trimeroc.?*) *cryptophthalmus*, Emmr., from Nassau. Copy of Sandberger's figure to show the differences of the species. *P. cryptophthalmus* is often confounded with *P. lævis*.

PARADOXIDES.

(Lingula Flags)

Geological Survey of the United Kingdom.



Figs. 1–8. PARADOXIDES DAVIDIS *Salter.*

— 9. —— FORCHAMMERI *Angelin.*

J.W. Salter, direx.

C.R. Rowe del.

BRITISH FOSSILS.

Decade XI. Plate X.

PARADOXIDES DAVIDIS.

[Genus PARADOXIDES. (Sub-kingdom Articulata. Class Crustacea. Order Trilobita. Family Olenidæ.) Elongate, of many segments, with a broad head and spinous head-angles, often greatly extended. Glabella widely clavate, with the lower furrows complete across. Labrum soldered to the hypostome. Body rings flattened, 17 to 20 in number, produced into recurved spines. Tail small, of few segments. Range, primordial zone only.]

Diagnosis. *P. sesquipedalis et ultra, maximus, glabellâ parum clavatâ, genis latiori, sulcis duobus solum perfectis, reliquis obsoletis. Oculi antrorsum positi. Thorax articulis* 19, *axe lato. Pleuræ subrectæ, apicibus recurvis; anticis brevissimis abrupte flexis, ultimis longissimis, fere parallelis. Cauda truncata, axi obscuro* 2–3 *annulato; gladiis lateralibus longissimis.*

Synonyms. *Paradoxides Davidis*, Salter (1863), Quart. Journ. Geol. Soc. (1864), vol. XIX., p. 275, woodcut, and XX., pl. 13, fig. 1–3.

The genus *Paradoxides*, from its bulk, has necessarily attracted attention from the earliest times in which fossils have been observed and collected. Linnæus figured it, from Sweden, and Count Kinsky from Bohemia, in the 18th century, and the *Entomostracites paradoxissimus* was still the name under which Wahlenberg noticed it in his résumé of the Swedish Trilobites in 1821. Brongniart added to the typical form several species afterwards known as *Olenus* by Dalman, who did no more than uselessly change the name of the whole genus. And while the species were distinguished by subsequent observers, the new name *Olenus* seems to have been adopted till Bronn, in 1835, restored that which Brongniart had imposed. Zenker, in 1833, had suggested a division of this large genus, making the great *Paradoxides* the type of *Olenus*, and so reversing the original nomenclature. But Emmrich's essay did not second this idea, and it was left for Goldfuss, in his systematic review of the group (Jahrbuch, vol. v., 1843), to give their correct definition to these two genera, which have since been generally adopted.

The broad club-shaped glabella, large head spines, and numerous

(17 to 20) segments to the body, easily distinguish this group, which comprehends the largest Trilobites known, and yet is the earliest or nearly the earliest type of the whole Trilobite family. *Agnostus* accompanies it in all countries where it has been observed, and it is known to have ranged from N. America to Russia, and from Sweden to Spain and Bohemia. Twenty years ago a single specimen was found in the British slate rocks, and it is only within the last year or two that it has been found in any considerable numbers, in a single locality in South Wales. I had myself the good fortune to discover the new species, which was first figured in the Quarterly Geological Journal for 1863.

Description.—Of the head we have now many specimens, and some of the fragments betoken a fossil not less than 16 or 18 inches long; one or two heads are perfect, and show that it was semi-circular, with very large, thick, cylindrical, and tolerably straight spines. The glabella rather long, reaching and overhanging the front margin, broader but not suddenly so in front, half its length being occupied by the great front lobe.

There are obscure traces in some specimens of short anterior furrows, but I cannot be sure of more than the two complete posterior ones, which bend backwards in the middle, and are equally strong with the neck furrow. The eye is far forward, in advance even of the second or upper glabella-furrow, and is near the glabella,—not half its length distant from it. The cheek is coarsely granular, except toward the outer angle, and abruptly contracted beneath, at the base of the great cylindrical spine.

The labrum is expanded at the base, and has a truncated end, with sub-spinous lateral angles. It is, as usual, separated by scarcely any suture from the hypostome, or rather is connate with

I can, in a fine specimen lately found, count 19 body-rings, and believe this to be the full number. The axis is very wide (in the largest specimen $1\frac{1}{2}$ inch) and convex, fully as wide in front as the pleuræ, spine included, and so for the eight or nine front segments. The apex of the pleuræ in these is abruptly turned back, with a short sharp mucro, and there is no enlargement of the second or third pleura—a character of importance in this genus. All have a deep groove, which is considerably oblique, and reaches the hinder margin just at the base of the spine in all the pleuræ. But from the eighth or ninth segment the pleuræ lengthen, and the axis gradually tapers. The hindermost axial ring is about half the width of the front ones, and scarcely one-fourth as wide as its long pointed pleuræ.

All the middle pleuræ have a strong curve backwards from the fulcral point, but at the same time arch outwards, and gradually, as they approach the tail, close in upon it until the hindermost are parallel with it. These hinder pleuræ are greatly lengthened, and are of two forms in two distinct varieties (possibly sexes?). In one form (fig. 4) the penultimate pleura is developed into a shorter spine than the preceding; and the last is suddenly abbreviated and incurved. This may be by abortion of the segments. In another the increment is regular, but the last spines are not extravagantly developed. In a third variety, the ultimate and penultimate pleuræ are greatly extended (fig. 7), and this is accompanied by a corresponding dilatation and lengthening of the caudal portion next to be described.

The tail in this species is most remarkable, and for some time I was inclined to believe that its outer segment was the ultimate pleura of the body. In fact, the front caudal ring is a very slightly metamorphosed body-joint, and is not very strongly connected with the tail piece; but it nevertheless belongs to it.

Exclusive of the great sabre-shaped lateral spines, which are three or four times its length, the tail is an oblong convex plate, with a short conical broad axis occupying about two-thirds of its length, and annulated by two or three incomplete rings. The extremity of this plate is broad and sharply truncate, contrasting with the parabolic contour of its axis, which is not so long as broad. The sword-shaped appendages are broader as well as longer than the last pleura of the body rings, and at first bend strongly inwards beneath the tail, afterwards diverging again at the tips (fig. 4). In one variety they are, in a moderate sized specimen, four inches long. They are connate with the central plate of the tail, though separated from it by a deep groove, except at the actual base, where the character of a pleura is maintained by the usual pleural groove running out into it.

The nearest approach to this structure is made by the *Paradoxides Bohemicus*. But in that species the enlarged last appendages are true pleuræ, according to Barrande's figure, and the tail itself is destitute of all appendages. Moreover, in that allied species the second pleura of the body is enlarged; so we have an additional character of separation from the present species.

In *P. spinosus*, Boeck, the glabella is shorter and the eye less curved and nearer the glabella. The unfurrowed portion of the pleuræ is shorter, and the hinder pleuræ are only straight, not sinuous,

Paradoxides Davidis nearly equals in dimensions the great *P. Harlani* from Massachusetts, and exceeds the large Newfoundland species described by me under the name of *P. Bennettii.** The three Swedish species are greatly inferior in size.

The above description is chiefly taken from the Quarterly Geol. Journal for the present year. In the plate accompanying that Memoir all the varieties are figured.

Locality and Geological Position.—Lowest Lingula Flags, Porth Rhaw and Solva Harbour, both near St. David's, South Wales. It has been lately detected at the Dolgelly gold mines, close to Pistyl-y-Cain, by Mr. Readwin, and by Mr. Ezekiel Williamson, an excellent observer.

P. FORCHHAMMERI.?

PLATE X. FIG. 9.

SYNONYMS. *Paradoxides Forchhammeri*, ANGELIN, Palæontologia Suecica, t. 2? *Paradox. Forchhammeri*, SALTER, Siluria, 2nd ed. 1859, p. 45; Foss. 5, fig. 2, ib.; Mem. Geol. Surv., vol. iii. ined., pl. 4, fig. 12.

Description.—Our specimen must, when perfect, have been fully 3½ inches long by 1½ broad. Of this length the long head is fully one inch, semi-oval, and with a long clavate glabella, which reaches quite to the front, and is rather broader than the cheeks. Below, the glabella is sub-linear, and not much above half as wide as in front. And it appears to have only the two lower complete transverse furrows; the upper inflated portion, more than twice the length of the lower, being unmarked by any furrows, except a pair of very short ones marking the place of the middle lobes.† The eye is larger and placed further back on the cheek. The border of the head distinct and broad. Spines — ? (the outer angle of the cheek is lost, and we do not know what the spines may be).

Body with a long cylindrical axis tapering very slowly backwards, with straight sides. The axis-rings are not, even in the front part, more than thrice as wide as long, and at the twelfth ring not so much. We have only 15 of the body segments, and the pleuræ are equal and similar for the first eight rings at

* Quart. Journ. Geol. Soc., vol. xv. p. 553.

† Two pairs are marked out in the figure in Siluria above quoted. But there is hardly any warrant for this. The specimen is too imperfect to decide it fully.

least, the second or third not being at all visibly enlarged at the end.*

The pleuræ are wider than the axis by one-fifth, or less, and are but slightly curved, the tip acuminate, short, recurved, but not produced as in *P. Davidis*. We have only eight pleuræ, and cannot therefore determine the shape of the extremities of the hinder ones. But there is no appearance of enlargement in the seventh or eighth. The groove is very oblique, and runs into the short mucro, rather than ends abruptly behind its base. As M. Angelin's *P. Forchhammeri* wants the front body rings, and ours the hinder ones, it is not possible to institute a closer comparison.

Although very incomplete, enough remains to show that the species is distinct from any of the Bohemian ones, unless it may be *P. Bohemicus*, and from either of the three Swedish species described by Angelin, except *P. Forchhammeri*.

But there are several points in which it agrees with the latter pecies and differs from *P. Bohemicus*. The glabella is widely clavate, and the furrows across the base are parallel, or nearly so. The eye appears to be nearly in the right position, but this is obscure. The body rings, of which we have only 16 preserved, have the axis narrower than the pleuræ, and the latter have only short points, and very oblique grooves. The second pleura is not elongated, nor at all wider than the third, another point in which it differs from *P. Bohemicus*, but in which *P. Forchhammeri* does not offer means of comparison. But in the proportionate length to their width, the pleuræ agree much better with the Swedish species, the length being rather more than three times the width, while in *P. Bohemicus* it is rather less.

In both *P. spinosus* and *P. rotundatus* of Bohemia, and *P. Tessini* of Sweden, the two basal glabella furrows, besides the neck furrow, run quite strongly across. Our species does not need, therefore, comparison with them, as it has only one transverse groove above the neck furrow; the rest are very obscurely indicated in this specimen, which has been much compressed in an oblique direction. This will account for the narrow glabella.

Locality and Geological Position.—Lower Lingula Flags, North Wales (exact locality uncertain, probably near Dolgelly). Collected by A. Selwyn, Esq., 20 years back. (Mus. P. Geology.)

* Usually Bohemian species have the second ring enlarged. N. American species the third pleura. In *Anopolenus*, an allied genus, the hindermost 3 or 4 are all enlarged.

Explanation of Plate X.

Figs. 1–6. *Paradoxides Davidis*, Salter, various fragments from the Lower Lingula Flags of St. David's.

Fig. 1. Large glabella, showing two complete furrows, and one incomplete pair (this last is doubtful), and other specimens do not confirm it.

Fig. 2. Tolerably complete head, with the labrum, *a*, turned upward from the lower surface at *b*; the suture between the *labrum* and the *hypostome* is seen to be soldered.

Fig. 3. Labrum of large specimen.

Fig. 4. Hinder body rings showing the gradually lengthening points of the pleuræ, completed from more perfect specimens. (See Quart. Geol. Journ., 1864, vol. XX., pl. 13.) This variety has the last pleura abbreviated.

Fig. 5. Posterior body rings.

Fig. 6. (Not numbered on the plate.) Head spine of the largest specimen known.

All the above, except fig. 2, are in the Mus. Pract. Geology. Fig. 2 is in the cabinet of Mr. J. E. Lee, Caerleon. The ornament of its pleuræ is seen in the magnified figure.

Fig. 7. Outline, restored from the largest fragments, and nearly coinciding with the size of the largest and nearly perfect specimen since found, and placed in the British Museum.

Fig. 8. Body rings of a very large individual. (Mus. Pract. Geology.)

Fig. 9. *Paradoxides Forchhammeri*, Angelin? From the black Lingula flags of N. Wales, Locality unknown, probably Dolgelly. (Mus. Pract. Geology.)

J. W. Salter.

November 1864.