VIII. *The Cambrian Area of Rushton (Shropshire).*

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(*Communicated by* W. W. WATTS, *F.R.S.*)

(Received April 24—Read November 2, 1933.)

[PLATES 38–45.]

CONTENTS.

I. Introduction.

The Cambrian rocks described in this paper lie north of the River Severn between the Wrekin Fault, that runs along the north-west flank of the Wrekin, and the Church Stretton Fault which passes west of Charlton Hill (map, Pl. 38). A few exposures on the south-east side of the Wrekin are also mentioned.

The area is bounded on the north in part by the outcrop of the Rushton Schist and in part by the Uriconian rocks of Charlton Hill to the south of which a small inlier of these older rocks forms the minor elevation of Brom Hill and is entirely surrounded by the Cambrian beds.

The south-eastern part of the area is covered by the Coal Measures of the small coalfield of Dryton, south-east of which we also note the occurrence of an Upper Cambrian (*Ctenopyge*) fauna in Dryton Brook.

The Cambrian rocks thus occupy a wedge-shaped tract of country between two main faults. These converge in a south-westerly direction and, south of the River Severn, form the boundaries of the narrow fault-complex of Coundmoor, which comprises Uriconian and Ordovician rocks and includes a narrow wedge of Shineton Shale in contact with Hoar Edge Grit near Coundmoor Quarry.

The topography of the area is shown on Sheet 42, Shropshire, of the Ordnance Survey Map on the 6-inch scale, and upon Sheet 152 of the 1-inch map, New Series. The geology as interpreted in 1868 is shown on the Geological Survey 1-inch scale map, Sheet 61 N.W. (Old Series), and, as re-surveyed, on the 1-inch map, Sheet 152 (New Series), 1932.

II. Previous Work in the Area.

On the one-inch Geological Survey map (Old Series, edition of 1868), the Rushton area is coloured as altered Caradoc or Bala Rocks with intrusive masses of Greenstone. In a paper published in 1877, Charles Callaway produced a map (Callaway, 1877) on which all this ground was shown as Cambrian quartzite. In the following year (Callaway, 1878) he again referred to the area as consisting of quartzite, and mentioned various exposures of this rock at Rushton and Charlton Hill, and one of "Hollybush Sandstone" in a field south of Brom Hill. Then, in 1879 (Callaway, 1879), he stated that the southern side of Charlton Hill is flanked by quartzite and that this rock can be seen in Charlton Lane, dipping south-south-east at 60°, and also at the southern side of Brom Hill. In a later paper (Callaway, 1884), "On a New Metamorphic Area in Shropshire," he said of the quartzite, "It probably extends continuously from the Wrekin to the village of Rushton, but from this point to Charlton Hill we are on the rock now to be described," *i.e.*, the Rushton Schist.

Blake (1890) gave a section along Charlton Lane, showing Comley Sandstone resting on the quartzite, and a map and section in which the quartzite with overlying Comley Sandstone is represented as extending from the Wrekin to Charlton Hill.

In 1892-3 a few fossils were collected, apparently from the Charlton Hill branch of Dryton Brook, and others from Neves Castle and Cherme's Dingle, by RHODES, under the direction of CHARLES LAPWORTH.

The area of Shineton Shales south-east of the Wrekin Fault has been described recently in an important paper by STUBBLEFIELD and BULMAN (1927), and a brief outline of the preliminary results of the present work in the Rushton area has already been given (POCOCK, 1928).

III. STRATIGRAPHICAL SUCCESSION.

The general stratigraphical succession of the Cambrian and immediately adjacent rocks of the area is as follows :—

Trias.—Pebble Beds.
Lower Mottled Sandstone.

Unconformity :—

Carboniferous.—Keele or Erbistock Beds.
Halesowen or Coed-yr-Allt Beds.

Unconformity :—

Upper Cambrian.—Shineton Shale (Tremadoc).*
Olenidian Beds.
Middle Cambrian.—Paradoxides Beds.
Lower Cambrian.—{ Comley Limestones and Callavia Beds. / Lower Comley Sandstone. / Wrekin Quartzite. }

Unconformity :—

Pre-Cambrian.—
Uriconian { Wrekin Pyroclastics. / Charlton Hill Pyroclastics. / Rushton Schist. }

The positions of the various exposures mentioned in the sequel are, with the exception of 1 and 2, shown on the map, Plate 38, and are listed here for convenient reference.

1. Quarry, north-east end of Hazlehurst Coppice, 550 yards south-east of Forest Glen Pavilion.
2. Quarry, south-west end of Hazlehurst Coppice.
3. Stream section, Charlton Hill branch of Dryton Brook and trench on west side of the stream, 1300 yards north-west of Longwood Smithy.
4. Quarry, 650 yards east of Longwood Smithy.

* In accordance with the practice of most English geologists we class the Tremadoc with the Cambrian because it occurs in the field in close connexion with the Olenidian strata and shares in their tectonics.

5. Neves Castle quarry, 950 yards east of Longwood Smithy.
6. Excavation, east flank of Charlton Hill, 300 yards north-east of the Reservoir.
7. Stream section, Cherme's Dingle, 750 yards east of Longwood Smithy.
8. Excavation 40 to 90 yards north-east of Charlton Hill branch of Dryton Brook, 1200 yards north-west of Longwood Smithy.
9. Stream section, Rushton branch of Dryton Brook, 800 yards north 40° west of Longwood Smithy.
10. Excavation, 1000 yards west 30° north of Longwood Smithy.
11. Excavation, 20 yards east of Charlton Hill branch of Dryton Brook, 1250 yards north-west of Longwood Smithy.
12. Stream, Dryton Brook, 500 yards west 20° north of Ranslett House.
13. Stream section, Dryton Brook, 200 yards west of Longwood Brickworks.

IV. DETAILS OF THE CAMBRIAN ROCKS.

(*a*) Lower Cambrian.

(i) *The Wrekin Quartzite.*—The Cambrian rocks are closely comparable with those of the Comley area some 12 miles to the south-west, fig. 1, which have been described in a series of papers by the senior author (Cobbold, 1910–1927). Here, as there, the basement beds are the quartzites which rest with strong unconformity on the pre-Cambrian rocks. This quartzite group makes a strong feature all along the south-east flank of the Wrekin range and passes round the southern end of Little (Primrose) Hill to the west side where its outcrop is cut off abruptly by the Wrekin Fault.

On the north-west side of the Wrekin Fault the quartzite is present again in faulted contact with the Uriconian rocks of the north-west flank of the Ercall, of Lawrence Hill, and of the Wrekin for half a mile south-westwards from the Forest Glen. Here also it rests unconformably on the Uriconian rocks and dips at a low angle south-eastwards towards the fault.

A small strip of the quartzite has also been observed, caught in along the same fault, 550 yards north of the summit of the Wrekin.

On both flanks of the Wrekin range the lowest beds of the quartzite are crowded with fragments of the underlying pre-Cambrian rocks.

The quartzite has not been seen between the Wrekin Fault and Rushton Quarry, fig. 2, where it rests on an eroded surface of pink felsite which, from its similarity to intrusions in the Wrekin and Charlton Hill, is considered to be of Uriconian age. The basal Cambrian beds here comprise thin alternations of compact, dark, bluish-grey quartzite (*cf.* Cobbold, 1927, p. 559) with dark grey shale and thin, flaggy, red-stained sandstone bands. The quartzite in places fills runnels in the grey shale; a circumstance which suggests deposition on a tidal shore-line where muddy and sandy conditions alternated. The beds have a general southerly dip of about 25°. A minor fault coursing E. 25° S.

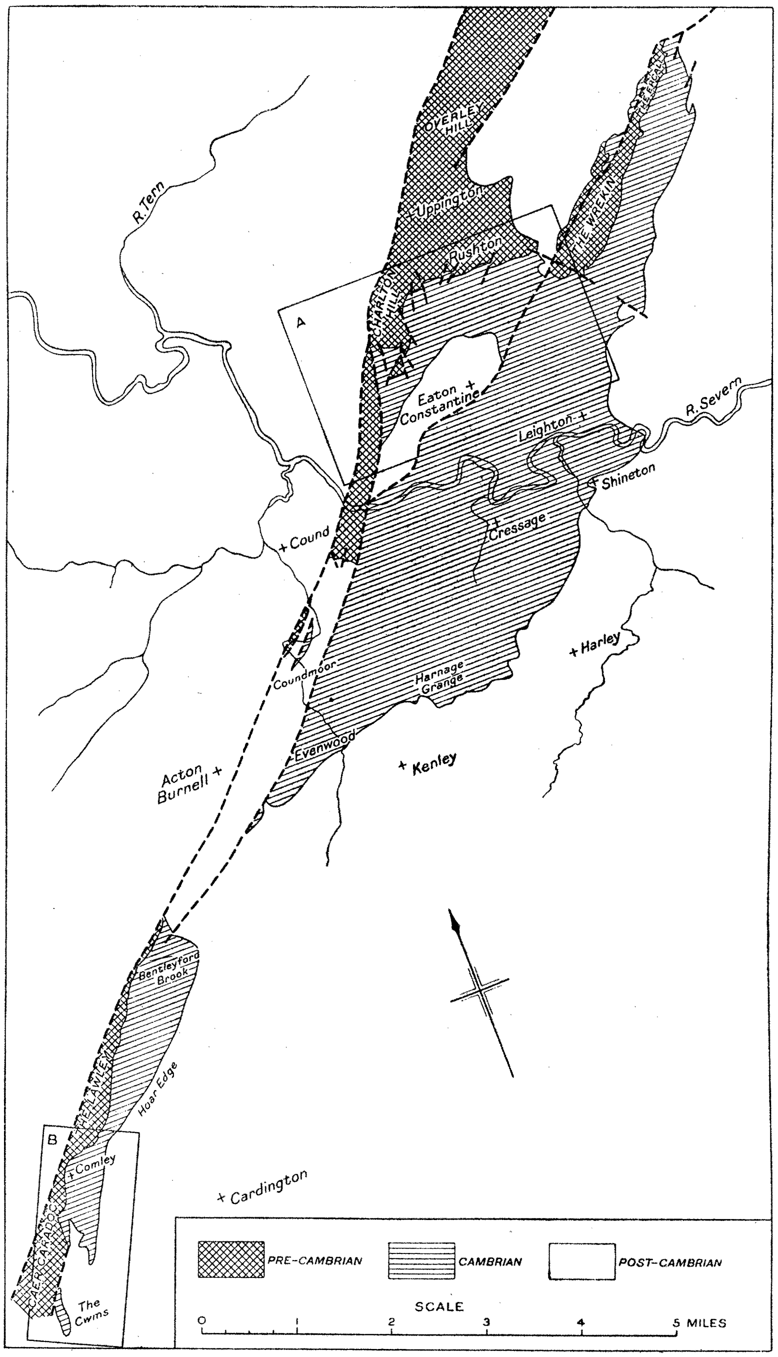

FIG. 1.—Sketch map of the Cambrian Rocks in the Wrekin-Caradoc District. A. Area of large scale map of Rushton Area (Pl. 38). B. Area of large scale map of Comley Area (COBBOLD, 1927, Pl. 43).

crosses the quarry and throws down the quartzite on the north-eastern side against the felsite; the beds on this side of the fault are brecciated, more massive, and of a paler grey colour than those overlying the felsite. The fragments of older rock, so common in the basal beds on the flanks of the Wrekin, are absent at Rushton and no trace of fossils has been found in either the quartzite or the shale.

About 200 yards west of Rushton Quarry massive quartzite is exposed in the bank of a pond south of the lane to Rushton, and its outcrop appears to be shifted slightly towards the north-east by a fault near the crossroads. About 200 yards west of that point, in the lane through the village, its base appears to rest upon the Rushton Schist and exposures occur on both sides of the lane.

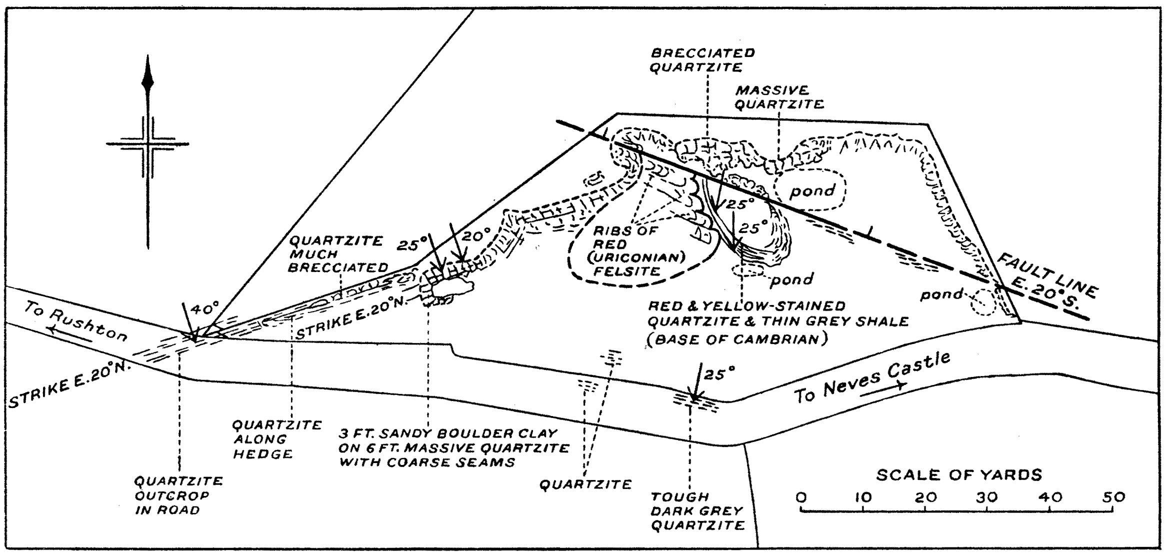

FIG. 2.—Plan of Rushton Quarry.

Between the village and Charlton Hill exposures are scanty, but the quartzite outcrop can be mapped from surface indications, and there is no doubt that the Cambrian beds are underlain by Rushton Schist as far west as the eastern flank of Charlton Hill.

Impure flaggy brown quartzite is seen in a ditch 350 yards a little south of east from a cottage that stands three-quarters of a mile west of Rushton Village. The rock dips south at 30° and is overlain by green glauconitic rock of Comley Sandstone type. West of this exposure the quartzite is displaced to the north across the Rushton–Charlton Hill lane by a minor fault, and then runs south-south-westwards into the Charlton Hill Fault (Map, Pl. 38). The outcrop can be picked up again, 350 yards to the south, trending south-south-westwards as far as Charlton Lane.

In Charlton Lane the unconformable relationship of the Cambrian to the Uriconian rocks is clearly seen. The quartzite, here only about 50 feet thick, dips E. 20° S. at 55°. It rests on a hard silicified Uriconian conglomerate, very similar to the well-known conglomerate bed near the summit of Charlton Hill. The dip of the Uriconian rocks is not clearly measurable at this point, but 60 yards higher up the lane it is about 60° N. 20° W. Here again the quartzite is overlain by green glauconitic sandstone. A yellow clay band containing angular fragments of quartzite marks the junction, which is probably a strike fault, although the thickness of quartzite missing may be small.

A narrow wedge of Cambrian beds is let in between two faults 100 yards west of the Charlton Lane section and the quartzite of this wedge can be seen crossing the lane leading southwards towards Watchoak.

To the west of this faulted wedge two outcrops of the Cambrian beds are present, one resting against the southern end of the Uriconian mass of Charlton Hill, the other south of the small triangular area of Uriconian rocks forming Brom Hill.

The quartzite of the first outcrop strikes east and west along the road at the south side of Charlton Hill and dips to the south at about 45°. The rock is of the usual compact type containing a few small quartz pebbles and its thickness may be estimated at about 60 feet. This outcrop is cut off westwards by a branch from the Church Stretton Fault. Comley Sandstone is present in the field to the south of the lane and Middle Cambrian grits succeed it in a field north-west of Brom Hill.

The Brom Hill triangle of Uriconian rocks is brought up by a north-easterly fault running alongside the lane on the north-west side of the hill. To the south of this hill the second outcrop of Cambrian beds occurs. The quartzite here dips to the south at about 52° and its thickness does not appear to exceed 60 feet.

The presence of quartzite, Comley Sandstone, and Middle Cambrian grits in yet another faulted strip to the west is only evidenced by fragments, but these are sufficient to indicate the position of the outcrops. This faulted block extends southwards to Watchoak and Dryton.

The thickness of the quartzite at Charlton Hill is distinctly less than on the flank of the Wrekin. It is also of a finer grain, and as at Rushton there is an absence of the included fragments of Uriconian rocks so conspicuous a feature of the lowest beds at the Wrekin.

(ii) *The Lower Comley Sandstone.*—Beyond the area under immediate consideration the green glauconitic Comley Sandstone occurs on the flanks of Lilleshall Hill, about 6 miles north-east of the northern end of the Wrekin (CALLAWAY, 1877, p. 662; WHITEHEAD, 1928, p. 15). On the south-east flank of the Wrekin range it rests with apparent conformity on the underlying quartzite, but has not been detected overlying the quartzite on the north-west flank of the hill.

A small quarry in the sandstone by the side of the road to Little Wenlock, at the northern end of Hazlehurst Coppice (loc. 1), has yielded a few specimens of Conchostraca and other fossils (p. 385), and a similar fauna has been obtained from a small quarry at the southern end of the same coppice (loc. 2).

The old quarry (loc. 5, Pl. 38) south of the lane, near the house called Neves Castle at the southern end of the Wrekin, is in typical Comley Sandstone. This is the quarry referred to by CALLAWAY (1877) as yielding *Kutorgina cingulata* in abundance. The sandstone here dips at 50° to the south.

In the adjoining Cherme's Dingle the sandstone extends downstream to a point (loc. 7, Pl. 38) 230 yards W., 17° S. of Neves Castle, where it is apparently overlain by Lower Cambrian Limestones, followed by flaggy beds of Middle Cambrian age (p. 315). This area is much broken by faults and there are indications of the presence of limestones higher up the stream.

Comley Sandstone is exposed in an old quarry (loc. 4) in the field to the west of the dingle and has yielded a small fauna, including Conchostraca (see p. 385).

Westwards of the Wrekin Fault green glauconitic sandstone is present south-west of Rushton Quarry and again in the field south of Rushton village. Many fragments were thrown out of a field drain at the head of the Rushton branch of Dryton Brook, between 300 and 500 yards south-west of the farm at the western end of the village.

Between Rushton and Charlton Hill the outcrop of the sandstone is dissected into blocks by faulting. The limits of these blocks have been determined by shallow diggings and by surface fragments. At some points the rock is actually exposed, as round a large tree-stump 1200 yards north-west of Longwood Smithy, fig. 3, and again 150 yards farther to the west, where a good section, at the upper end of the Charlton Hill branch of Dryton Brook (loc. 3), shows the upper beds of the sandstone passing up into the limestone group.

A small exposure on the east flank of Charlton Hill shows the sandstone dipping east 25°, south at 32°.

South of this locality the Charlton Hill Fault runs for about 200 yards between the steep slope of the hill and the present ploughed land to the east. Close to the fault-line dark shales have been ploughed up, and some small excavations (loc. 6) show that these shales dip at about 35° to the north-west. They have yielded a fauna of about 10 species mainly from very thin sandy layers that alternate with more shaly bands. From the abundance of *Acrothele prima* (MATTHEW), they are referred to as the "*Acrothele prima* Shales" (p. 385).

The Comley Sandstone is seen again in Charlton Lane, but the junction with the quartzite is not clear.

The base of the sandstone was exposed in a temporary excavation in a farmyard 200 yards south-westwards of the trigonometrical station on Charlton Hill, and showed a fine-grained angular conglomerate or pebbly breccia resting on somewhat flaggy greenish-grey quartzite; but no fossils were found here. Similar conglomeratic beds at Comley yield the *Obolella groomi* fauna. Two ponds in the field south of the farm have been dug in the green Comley Sandstone.

The quartzite at the southern side of Brom Hill is also overlain by Comley Sandstone, which can be seen in a small excavation close to the lane to Watchoak. Fragments of the sandstone also occur at the surface in the faulted wedge to the west.

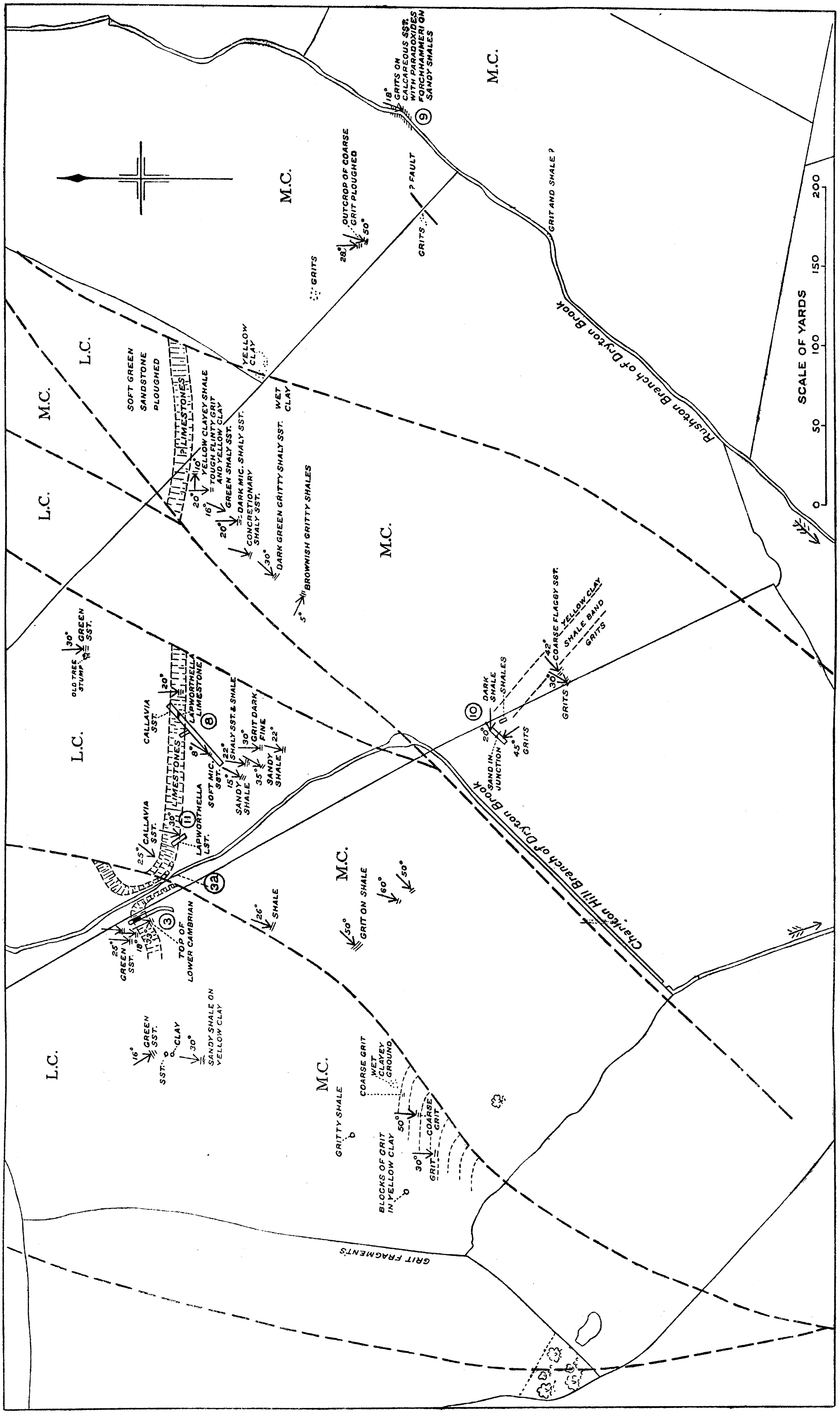

FIG. 3.—Map showing Cambrian localities in and near the Charlton Hill and Rushton branches of Dryton Brook.

The total thickness of the Lower Comley Sandstone in the Rushton area may be estimated at between 500 and 550 feet. Along the south-east flank of the Wrekin the width of its outcrop suggests that practically the full thickness is present there if the sandstone is assumed to have the same high dip as the quartzite.

(iii) *The Comley Limestones.*—The limestone group that succeeds the Lower Comley Sandstone reproduces the succession seen at Comley in all its faunal divisions, but is, where seen, only equally fossiliferous in the *Callavia* and *Lapworthella* Beds. At Rushton the succession in descending order is as follows :—

	Ft.	In.
The *Lapworthella* Limestone	0	6
The *Protolenus* Limestone	0	6
The *Strenuella* Limestone	1	6
The *Eodiscus bellimarginatus* Limestone } The *Callavia* Limestone and Sandstone }	3	8

The *Lapworthella* Limestone occurs in Cherme's Dingle, at a point (loc. 7) 230 yards west, 17° south of Neves Castle, where it is a black nodular calcareous rock precisely matching the type rock from Comley and carrying the same fauna in the same relative proportions. The thickness of the bed is not determinable at this exposure. Associated with it is a pinkish limestone, and 2 yards away, but a little higher in the bank, a flaggy band has yielded fragments of a *Dorypyge.* The rocks at this locality have been so much disturbed and veined with calcite that no sequence has as yet been made out.

The nodules of black material in the limestone have been examined chemically by Mr. E. G. Radley, who reports that manganese is present in fairly large quantity with a small amount of carbon and also a little phosphate.

The right bank of the Charlton Hill branch of Dryton Brook provides a good natural section (loc. 3) of the *Callavia* Sandstone and Limestone. Some shallow trenching higher up the bank proved the presence of the other limestones of the series, but their order and thickness could not be observed owing to the disturbance of the beds at this point.

A trench was opened some 100 yards away in an easterly direction (loc. 8), which, happily, disclosed representatives of all the Comley Limestone horizons in regular order, and, abutting against them, a mass of fossiliferous Middle Cambrian grit was encountered which by its fauna as well as its position could, with certainty, be correlated with the *Paradoxides groomi* Beds of Comley. The mode in which the fossil fragments are aggregated together in a calcareous lenticle among the barren grits is exactly analogous to that seen in the Comley quarry, but there is this difference in the content of the grits ; there are no blocks, small or large, of Lower Cambrian sandstone and limestone such as occur there. The deposit, though coarse, is not so conglomeratic as at Comley.

The faunal evidence is discussed later (pp. 385–394). In both sections and in a small supplementary trench (loc. 11) some 20 yards from the left bank of the brook, the uppermost bed of the Lower Cambrian proved to be the *Lapworthella* Limestone which in such shallow excavations has weathered to a red colour, with *Lapworthella* and other fossils blue-grey or white instead of coal black.

Certain portions of this and other beds have been silicified in part, so far as the matrix is concerned, but the fossils, or at least those that are chitinous or phosphatic, appear to retain the substance of their tests unaltered.

In addition to the fossils the rock contains numerous spheroidal and irregularly shaped nodules showing, when broken, concentric structure. It has been suggested that they have an algal origin, but up to the present this line of research has not been followed further, except for the isolated chemical examination of some nodular bodies from Cherme's Dingle (loc. 7) mentioned above.

The *Protolenus* Limestone, so prolific at Comley, yielded a few of the most characteristic species, but was otherwise disappointing. No cystid ossicles were found, but the collections were made prior to the recognition of these bodies from the Comley rock.

The *Strenuella* Limestone is very poorly represented in the trenches so far as fossils are concerned, but its presence in the area is conclusively proved by several forms from the trench first mentioned (loc. 3), on the right bank of the brook. In the longer trench (loc. 8) its place was occupied by an unfossiliferous band of limestone.

The *Callavia* Beds are replete with fossil fragments and have added a few forms that are new to their fauna.

(*b*) Middle Cambrian.

In Cherme's Dingle on the south-east side of the Wrekin Fault Middle Cambrian, beds have been found in the bank of the brook within one foot or less of the *Lapworthella* Limestone (loc. 7). They consist of micaceous shales with limestone bands which have yielded *Dorypyge* sp. and *Paradoxides*. About 12 yards farther downstream, two species of *Paradoxides*, from a grey flaggy limestone in shales, were figured by Cobbold (1913, Pl. 4, figs. 1–17) as *P. bohemicus*, var. *salopiensis* and *P. hicksi*. The rock specimens in which these forms occur contain a few other fossils (see p. 389).

A species of *Agnostus* said to be from an irregular brecciated bed in crushed shale 4 yards lower downstream than the last has been described and figured (Lake, 1907, p. 29, Pl. 3, figs. 1–3), as *A. incertus* Brögger.

On the south-east flank of the Wrekin, a small faulted strip of Middle Cambrian beds, within the outcrop of the Lower Comley Sandstone, is exposed alongside the track through the woods 400 yards east 10° south of the summit of the Wrekin. The rock is a calcareous sandstone weathering to a brown rottenstone, and contains Paradoxidian fragments and horny brachiopods.

In the ground between Rushton and Charlton Hill Middle Cambrian beds are exposed in the Rushton branch of Dryton Brook. The section (loc. 9) in the left bank of the stream shows the following beds (fig. 4) :—

	Ft.	In.
Sandy shales with glauconitic grit bands	2	0
Hard grit band	0	6
Black rottenstone	0	2
Hard grit band	0	6
Calcareous pebbly grit, with many fossils, in blocks, passing laterally into loose sand	1	0
Dark sandy micaceous shales with fossils	3	0

The shales 2 feet below the calcareous pebbly grit have yielded *Liostracus bruno* and *Paradoxides tessini*, which is found in Scandinavia as far up in the sequence as the *P. davidis* horizon.

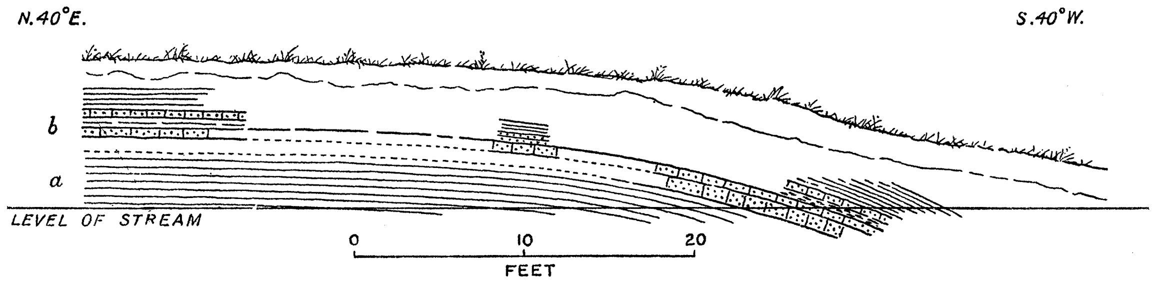

FIG. 4.—Section in the left bank of the Rushton branch of Dryton Brook (Loc. 9). *a* = *Liostracus bruno* Shale. *b* = *Paradoxides forchhammeri* Grit.

The calcareous pebbly grit itself is richly fossiliferous, the extensive fauna indicating the *P. forchhammeri* zone (sensu lato) of Scandinavia (p. 390).

The surface of the field immediately north-west of this section is strewn with blocks of hard glauconitic grit probably from about the same horizon.

Similar hard glauconitic grit, breaking into cuboidal blocks, crops out (loc. 10) 600 yards south of west of the last section, and appears to dip west-south-west at about 40° (see map, fig. 3). This rock is associated with dark shale in which a small trench was cut and a few fossils obtained (see p. 390), two of which are found in the *Agnostus lævigatus* zone of Scandinavia. South of this point the ground is clayey, and it is inferred that it is occupied by Upper Cambrian beds.

As above stated, Middle Cambrian beds have also been proved in the trench (loc. 8) on the east side of the Charlton Hill branch of Dryton Brook, and loose blocks of calcareous grit with a Middle Cambrian fauna have been found in the stream course lying upon ground occupied by *Callavia* Sandstone (loc. 3).

The occurrence of Middle Cambrian rock of the *P. groomi* horizon of Comley at loc. 8 has already been mentioned (p. 314); this is succeeded south-westwards by beds of coarse grit, sandstone, and sandy shale for some 40 yards along the trench.

Middle Cambrian glauconitic grits crop out in the field to the south-west of the stream section, where they give rise to rounded hummocks. Similar Middle Cambrian grits, detected by surface fragments, succeed the Lower Comley Sandstone as above mentioned south of Charlton Hill, south of Brom Hill, and again north of Watchoak in the easternmost faulted strip of the Cambrian.

(c) Upper Cambrian.

The Lingula Flag or Olenus Series (Dolgelly stage) is represented in the Rushton area by loose blocks of black bituminous limestone found in Dryton Brook (Pocock, 1928) at the point (loc. 12) where the brook is crossed by the Wrekin Fault, 500 yards from Ranslett House. The fault here throws the Coal Measures of Dryton Coalfield on the north-west against the Upper Cambrian on the south-east. The limestone blocks appear to have been derived from a wedge of shale caught in along the line of the fault. Five blocks were obtained, all of which are richly fossiliferous and yield a fauna, including *Ctenopyge flagellifera* and *Eurycare angustatum*, indicating the subzones 4 and 5a of Sweden (Westergård, 1922). This fauna is detailed on p. 391. The blocks appear to be the cores of cone-in-cone concretions in shale. Their position in the Shropshire Cambrian sequence has been determined in the Lawley district (Stubblefield, 1930.)

A large part of the Upper Cambrian beds of the Rushton area is concealed by the Coal Measures of the Dryton–Longwood coalfield, which extend north-eastwards as far as Longwood Smithy and south-westwards to the alluvium of the River Severn, near Dryton. On the north-west the junction of the Coal Measures with the Cambrian beds is faulted from near Dryton to a point just north of Longwood Brickworks, from whence their base, apparently resting unconformably on the Upper Cambrian, swings eastwards to Longwood Smithy and then southwards into the Wrekin Fault, about $\frac{1}{4}$ mile south of the smithy. The Wrekin Fault forms the south-eastern boundary of the Coal Measures.

Red-stained shales, highly inclined and much broken, are exposed in Dryton Brook (loc. 13) due west of Longwood Brickworks. They are lithologically very similar to stained Shineton Shales exposed in the same stream south of the Wrekin Fault, but have not yielded any fossils of zonal value.

V. TECTONICS OF THE AREA.

The tectonic structure of the Cambrian and other rocks of the area under consideration may be described as consisting of the broken core of an anticline in Charlton Hill, pitching southward at a high angle, 45° to 55°, and the broken syncline of the Rushton area, pitching southward at a lower angle, say, 25° to 35°.

The Charlton Hill Anticline is bounded on the north-west by the Church Stretton Fault, while the Rushton Syncline is limited on the south-east by the Wrekin Fault, to the east of which the Cambrian rocks have a general south-easterly dip at such comparatively high angles as 50° to 75°.

In the anticlinal area of Charlton Hill the Cambrian quartzite rests on Uriconian tuffs, conglomerates, porphyrite, and felsite, while in the synclinal area of Rushton the underlying rock is the Rushton Schist, which is separated from these igneous and pyroclastic rocks by the Charlton Hill Fault.

It is evident that this fault originated in pre-Cambrian times and that the older rocks had been subjected to great pressure and faulting before denudation reduced them to the approximately level surface upon which the lowest Cambrian beds were laid down.

Subsequently, pressure was renewed and gave rise to the broken folds of Charlton Hill and Rushton, and the upthrust of the Wrekin mass with the steep south-easterly tilt of the Cambrian quartzite on its south-eastern side and the brecciation of the quartzite on its north-western flank close to the Wrekin Fault.

This movement took place at various periods, but its greatest intensity was reached in post-Caradoc, pre-Silurian times; that some of the movement was post-Lower Carboniferous in age is suggested by the high dip of the Carboniferous Limestone of the Little Wenlock area, along its scarp facing the Wrekin.

The existence of a resistant floor of Rushton Schist and Uriconian rocks is probably responsible for the fact that the Cambrian rocks are free from complex folding. This resistant floor has yielded to pressure by breaking into blocks and lenses which have moved relatively to one another in an approximately horizontal direction without much vertical displacement. The lateral displacement of these masses involved the overlying Cambrian beds. That the movement has been in the main horizontal is indicated by the direction of slickensides on fault and joint surfaces at many points in the area; especially in Charlton Hill Quarry.

Assuming horizontal movement along the faults to have taken place, we may dissect the map of the Charlton Hill area and, by aligning the various sections of the Cambrian quartzite, arrive at a plan of the ground as it might have existed before the post-Cambrian faulting took place, fig. 5.

An examination of this plan shows an interesting point in regard to the Uriconian rocks. The disconnected outcrops of the principal Uriconian conglomerate fall into direct alignment. The conglomerate at the north-east corner of the Brom Hill triangle appears to be the same as that at the summit of Charlton Hill, and that again falls into line with the conglomerate in Charlton Lane.

The conglomerate at the south side of Brom Hill may be the same band as that immediately underlying the quartzite in Charlton Lane, though in this case the alignment is not so convincing.

The rocks appear to have been squeezed along a north-west and south-east direction and the effective width of this anticlinal arch, and of the Wrekin arch also, has been reduced, approximately 40 per cent. by lateral shuffling of the fault blocks. A similar reduction in width occurs in the synclinal area of Rushton, as can be seen from the overlapping of the ends of the various segments into which the outcrop of the quartzite has been split by the faults.

Local disturbances in the bedding of the Cambrian rocks occur in the vicinity of the fault lines, as, for instance, on the east slope of Charlton Hill, close to the Charlton Hill Fault, where Lower Cambrian shales dip at about 35° towards the north-west

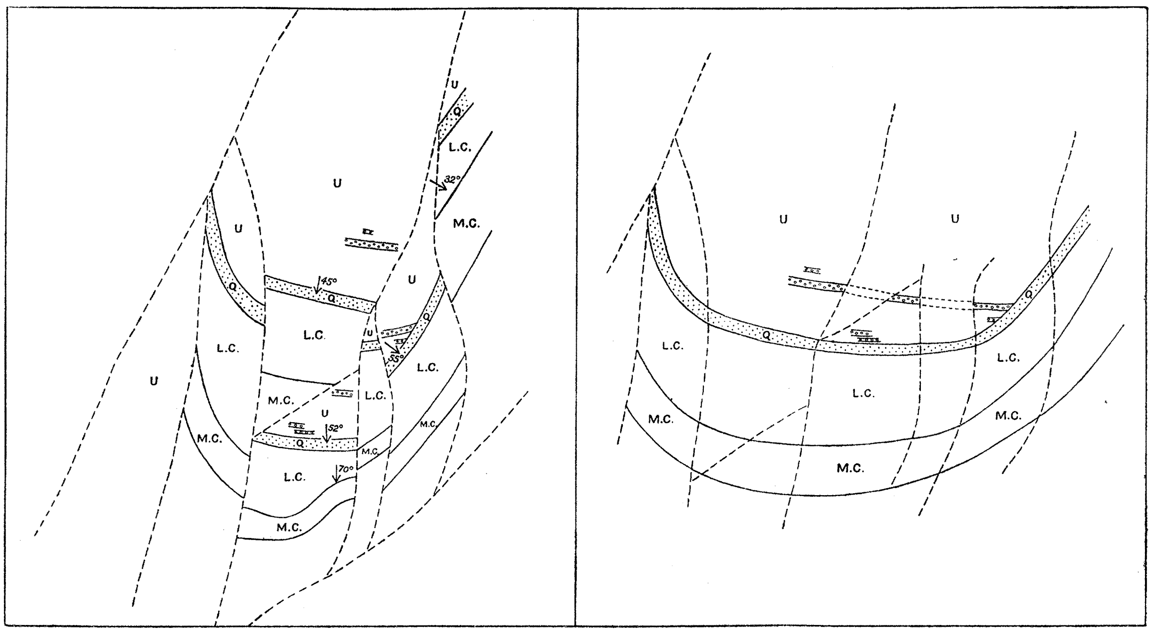

Fig. 5.—Plan showing (*a*) Present distribution of Cambrian and Uriconian Rocks of Charlton Hill; (*b*) supposed distribution of the same rocks prior to displacement along the faults.

or are inverted, while within 100 yards Lower Comley Sandstone dips normally towards the south-east at 65°.

As to the existence of unconformities within the Cambrian rocks, the evidence in this area is not clear. The fact that all the Lower Cambrian limestone horizons, including the *Lapworthella* Limestone at the top, are present, as at Comley, together with the fact that the *Lapworthella* Limestone is succeeded as at Comley by the *Paradoxides groomi* Beds suggests that any unconformity between Lower and Middle Cambrian must be slight or at any rate only developed in certain areas, but the change in character of the deposits and of the faunas indicates a long time interval.

VI. THE FAUNAS OF THE CAMBRIAN AREA OF RUSHTON (SHROPSHIRE).

(*a*) General Remarks.

Almost all the faunal horizons that have been found at Comley are present at Rushton and in the same order. Some species are added and the correspondence with the faunas of Europe and eastern North America are accentuated.

Perhaps the most generally interesting addition to our knowledge is the presence of the *Paradoxides forchhammeri* fauna, but it is equally important to note that the faunas of the Lower Comley Sandstone, the major member of the Shropshire Lower Cambrian, represent very closely, though on a smaller scale, the lower part of Matthew's Etcheminian series of N.E. America. Not only are the faunas the same in character, but the conditions of deposition appear to be identical.

The name Etcheminian was originally suggested by Matthew to indicate a supposed pre-Cambrian sedimentary system (see Walcott, 1900, pp. 331-334); subsequently it was proved that the whole series called by this name was of Cambrian age and in 1903 Matthew fully assented. The name is here used as indicating a local formation only.

(*b*) The Material Studied.

The determination of species is largely based on a number of fragments, or detached portions, almost invariably preserved without distortion and with full natural convexity, in calcareous deposits. In the Lower Cambrian the fossils most frequently occur as casts in decalcified sand-rock, except those with chitinous or phosphatic tests. In the Middle Cambrian decalcification has not penetrated so far and the tests are often in excellent preservation. Much damage occurs in breaking up the rock and still more in the effort to lay bare the still buried portions.

(*c*) Description of Species.

(i) ANNELIDA.

The discovery by Walcott in the Burgess Shale of tubes of the species, which he had previously named *Orthotheca major*, with the animal protruding removes, as he says,* one doubtful form that had been classed with the Pteropoda to the Annelida, and he continues, "with it will probably go *Hyolithellus* and other tube-like shells that have none of the distinctive characters of *Hyolithes* and its allies."

In view of Walcott's remark and of Matthew's previously published opinion that these tubular fossils with thin shells were not Pteropoda but "tubicolous Worms" (1899, *a*, p. 105), the genera *Hyolithellus*, *Torellella*, and other tubular species are here referred to the Annelida.

* Walcott (1911), p. 121, where he redescribes the species as *Selkirkia major*.

HYOLITHELLUS, BILLINGS.

HYOLITHELLUS MICANS, BILLINGS.

Hyolithellus micans, BILLINGS (1872), p. 215.—WALCOTT (1886), p. 142, Pl. 14, figs. 2, 2*a–c*.—COBBOLD (1921), p. 361, Pl. 24, figs. 19-21, where other references are given.

These tubes occur in considerable numbers and at several horizons at Rushton, most typically in the *Lapworthella* Limestone.

Locality and Horizon.—Rushton, locs. 3, 7, and 8, all Lower Cambrian ; and somewhat doubtfully from the *Acrothele prima* Shale (loc. 6). They are of small diameter (0·5 to 1 mm.) from the Lower Comley Sandstone, the *Callavia* Beds and Comley Limestones. Some from the *Lapworthella* Limestone are rather larger (up to 2 mm. in diameter). When recovered from near the surface all tend to be blue instead of black.

The species is distinguished by its glistening surface, with or without transverse marks of growth, by its thin shell, by its circular section, and by its very small rate of taper.

HYOLITHELLUS (?) *CINGULATUS*, sp. nov., fig. 5, Pl. 40,

Holotype.—An elongated tube almost straight and of circular section [51662].*

Description.

Shell nearly straight so far as seen ; apparently circular in section ; tapering very gently about 1 in 15, equivalent to a divergence angle of 4° ; both ends broken away ; shell blue, probably phosphatic, thin (about 0·01 or 0·02 mm. thick), covered, for all the length seen, with somewhat angulated, slightly raised rings, of which 14 may be counted in a length of 1 mm. These are spaced fairly regularly as to distance and are transverse to the axial line ; surface otherwise smooth to the naked eye, but between the rings, granular under high magnification.

Length seen 3·3 mm., diameter at larger end 0·50 mm., total length, if the divergence angle remains at 4° and if the larger end is near the mouth, about 7 or 8 mm.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian, from the *Lapworthella* Limestone.

Remarks.—This specimen was at first taken to be *Hyolithus teretiusculus* LINNARSSON (*H.* (*O.*) *teretiusculus* of HOLM), but that appears to be a larger shell with a divergence angle of 7° to 8°. No operculum of *H.* (*O.*) *teretiusculus* seems to have been known in 1893, and it is possible that LINNARSSON'S species should be transferred from the Pteropoda to the Annelida.

HYOLITHELLUS (?) *TORTUOSUS*, sp. nov., fig. 4, Pl. 40,

Cf. Astrocladia (?) *elegans*, MATTHEW (1890), p. 149, Pl. 7, fig. 7.

This name is proposed for certain sinuous tubes of circular section and small diameter (0·2 to 0·3 mm.), curved in more than one plane, with no sign of taper. They have a

* *Unless otherwise stated the specimens referred to are preserved (under the numbers in square brackets) in H.M. Geological Survey Collection.*

superficial likeness to MATTHEW's figure above quoted. *Astrocladia* ZITTEL, is a genus of the Spongidæ.

Co-types.—Three examples [51661, 51798, 51799].

The ends of the specimens are broken. The lengths and diameters in mm. are:

Specimen.	*A.*	*B.*	*C.*
Approximate length along curve	3·75	2·30	2·75
Diameter	0·15	0·37	0·30

Where not obscured by limonite the surface is black and roughly granular, not shining as are the surfaces of most of the fossils from the same bed. The interior of the tubes is filled with a bright, orange-coloured deposit.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, from the *Acrothele prima* Shale.

LAPWORTHELLA, COBBOLD.

LAPWORTHELLA NIGRA, COBBOLD.

Lapworthella nigra, COBBOLD (1921), p. 360, Pl. 24, figs. 1–6.

This form is very plentiful at Rushton within the horizon named from it. In Cherme's Dingle it is black as at Comley, in the shallow trenches of loc. 8 it is usually weathered to white and the rock itself is purplish or brick-red instead of predominantly black; sometimes the shells are blue-grey and occasionally, when weathering has not reached them, they are black. They are, possibly, phosphatic.

Locality and Horizon.—Rushton, locs. 3, 7, and 8; from the *Lapworthella, Protolenus,* and *Strenuella* Limestones.

HELENIA, WALCOTT.

HELENIA CANCELLATA, COBBOLD.

Helenia cancellata, COBBOLD (1921), p. 363, Pl. 24, figs. 7–10.

This species is represented by two quite typical examples [He. 3400, 52854].

The shells weather to a blue colour and sometimes to white; they are believed to be phosphatic.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian, from the *E. bellimarginatus* and *Protolenus* Limestones.

TORELLELLA, HOLM.

TORELLELLA (?) *INORNATA*, sp. nov., fig. 2, Pl. 40.

This species is based on the Holotype only [51659].

Other fragments probably belong, but are short and unsatisfactory.

Description.

A curved tube about 10 mm. long, with oval section, the diameters being in the proportion of 4 to 3, the tube is straight for about half its length, at which distance its upper side is broken away disclosing an oblique view of the section; from this point the external impression only is seen; the tube curves away more and more strongly to the, presumed, proximal end. The tube is set edgeways in the rock and the curvature is towards one of the flatter sides of the oval section. At the mid-length the external diameter is 0·90 mm. and the internal 0·75, giving a thickness of test of about 0·07 on each side. Both ends are broken and the distal end is a little crushed. It is consequently impossible to decide if the tube is at all tapered.

The test is thick by comparison with that of *Hyolithellus* and has weathered to the usual blue shade that is associated with phosphatic shells; the interior is filled with sandy matrix of the same grade as that outside.

No striæ of growth or other surface marks have been detected.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian from the *Callavia* Beds near their summit.

The oval section, its very slight taper and its presumed phosphatic constitution are characters in common with *T. lævigata* (LINNARSSON), from which it differs in being definitely curved instead of only slightly sinuous and in the proportions of the elliptical cross-section.

TORELLELLA (?) *SCABRA*, sp. nov., fig. 3, Pl. 40.

Some apparently phosphatic tubes, collected in 1892 by RHODES, from the Old Quarry at Neves Castle associated with *Kutorgina* and *Hyolithellus micans*, are readily distinguished from the latter by their scabrous surface and dull grey colour, instead of the smooth glistening black of *H. micans* as preserved in the same rock.

Co-types Nos. [51660, 52855, 52856, 52857].

Description.

Shell nearly straight for the short length seen, circular or oval in section, tapering slowly, divergence angle about 5°; test relatively thick, probably phosphatic, surface dark grey, finely granular with angular matter possibly due to partial decomposition.

Dimensions.—Lengths of fragments from 5 to 10 mm., diameters ranging from 0·5 to 0·8 mm.

Some show signs of crushing in places indicating that the tubes were less resistant than those of *H. micans*, a short and typical fragment of which is preserved in [52858] the same rock.

Locality and Horizon.—Rushton, loc. 5.—Lower Cambrian, the Lower Comley Sandstone.

RUSHTONIA, gen. nov.

This genus is proposed to include some tapering bent tubes of phosphatic material, regularly curved in one plane and with a clear but varying angle of divergence.

Genotype.—*Rushtonia lata* gen. et sp. nov.

Stratigraphical position.—Lower Cambrian, *Callavia* and *Protolenus* Beds.

Geographical range.—Only known from Shropshire, England.

Diagnosis.

Tube, small, phosphatic, initial end not observed. Section elliptical, compressed, no distinction between ventral and dorsal faces. Longitudinally curved in one plane towards one of the flat faces. Curvature gradually decreasing to be nearly straight at the oral aperture. Divergence angle changing gradually. Oral aperture straight, transverse, in one plane which is at right angles to the axial line of the tube. Sculpture of many minute, impressed growth-striæ.

The genus is allied to *Torellella*, HOLM, in (i) the elliptical section ; (ii) the phosphatic shell ; (iii) the transverse and simple oral aperture and growth-striæ. It differs in the wider divergence angle, the regular curvature and, in the genotype, in the relative thickness of the shell.

A second species *Hyolithus* (*Orthotheca*) *compressus*, COBBOLD (1921, p. 357, Pl. 24, figs. 17*a*, *b*) is now removed to this genus. It differs from the genotype in that the divergence angle increases instead of decreases in the oral direction and the shell is described as thin.

RUSHTONIA LATA, Gen. et sp. nov., figs. 1 *a–c*, Pl. 40.

This is a presumed phosphatic tube with relatively thick shell and oval section.

Holotype [51658].

When first found only the slightly convex upper surface projected from the rock ; during preparation the proximal end was uncovered and the sides cleared of matrix ; then the greater part of the shell came away in fragments (some of which are preserved as portions of the holotype), this disclosed the sectional view and the impression of the underside.

Description.

A rather flat tube, slightly curved distally and strongly bent down proximally, length measured along the curve, 9 mm., width at mouth 2·4 mm., depth about 0·9, section oval, with axes in the proportion of 10 to 4, divergence angle about 14°. Test very fragile in its present state, colour sky blue all through, thickness considerable 0·10 to 0·12 mm. at the exposed section, probably thinner towards the small end ; surface smooth with very faint lines of growth transverse to the axis of the tube ; mouth also transverse, of the same shape as the section, with a slight trace of a thickened margin; proximal end very small, but rounded not absolutely sharp.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian, from the *Protolenus* Limestone.

"MINUTE RODS."

Under this term certain small tubes, that cannot be placed zoologically, are recorded as present in both Middle and Lower Cambrian.

When complete they appear to be circular in section, with diameters about 0·5 mm., and tapering at an angle of about 3° to 4° to a blunt point. The lengths when fairly exposed are from 2 to 4 mm. In colour they are usually the same as that of the containing limestone, but sometimes they are a darker grey.

It seems probable that more than one species is represented ; they recall MATTHEW's figures of the initial parts of *Urotheca* and other annelids, but their position in classification is extremely doubtful.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. bohemicus salopiensis* Limestone and the *P. groomi* Grits ; also Lower Cambrian, from the *Lapworthella* and *Protolenus* Limestones.

(ii) POLYZOA.

Gen. et Spp. indet., figs. 7 and 8, Pl. 39, and fig. 26, Pl. 44.

Certain undetermined fragments referred to this Class occur in the Lower Cambrian of Rushton at three horizons ; the *Lapworthella* Limestone, locs. 7 and 11, the *Callavia* Beds, loc. 8 ; and the *Acrothele prima* Shale, loc. 6. The specimens are too few and fragile to warrant making thin sections.

The first [51664], fig. 7, Pl. 40, is a somewhat convex body, much like that from Comley figured by COBBOLD (1931 *a*, Pl. 12, fig. 15). It appears to be a thin lamina upon the gently convex surface of some solid body.

The second [51665], fig. 8, Pl. 40, is a lamina with a rather different habit of growth, as though it had expanded on a flat muddy surface. Both specimens came from the *Lapworthella* Limestone.

The third [51761] is decidedly different from either in the characters of the œcial apertures, these are very regularly arranged and have practically the same diameters, the separating walls are somewhat thick, but not so wide as those of the two previous specimens. The lamina covers an irregular surface.

The fourth specimen [51685], fig. 26, Pl. 44, has a very irregular surface, as though the lamina had spread over several rounded objects, consequently no satisfactory photograph has been secured. The surface is covered by round or oval projections with perforated tops, arranged in groups and separated from one another by deep and distinct grooves. Each group is separated from its neighbours by deeper and wider furrows.

The diameters of the perforate projections may vary from 0·25 to 0·75 mm., that of a group may be 1 to 2 mm. and the whole object measures about 2 to 3 mm. across, but has no clear cut boundaries. It appears to have grown on the surfaces of small nodules of slightly greater solidity than the rest of the deposit.

(iii) BRACHIOPODA.

MICROMITRA, MEEK.

MICROMITRA PUSILLA (LINNARSSON) (?)

Kutorgina cingulata pusilla, LINNARSSON (1876), p. 25, Pl. 4, figs. 53, 54. —— MATLEY (1902), p. 147, figs. 19–20. —— GRÖNWALL (1902), p. 40. —— *Micromitra pusilla* (LINNARSSON), WALCOTT (1912), p. 339, Pl. 2, figs. 2, 2*a–c*.——cf. *Micromitra* indet., COBBOLD (1921), p. 328, Pl. 21, figs. 18, 19.

Two specimens [Pe 2347d and He 3457d] are referred to this species, but with reserve, as they do not show the radiating ridges spoken of by WALCOTT, which, however, are missing in LINNARSSON'S fig. 53, but present in his fig. 54 of a " somewhat exfoliated " specimen. The Rushton specimens are small (lengths 1·00 and 1·40 mm.).

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Sub-genus *PATERINA*, BEECHER.

MICROMITRA (PATERINA) LABRADORICA (BILLINGS).

Obolus labradoricus, BILLINGS (1861), p. 6, fig. 6.——*Micromitra* (*Paterina*) *labradorica* (BILLINGS), WALCOTT (1912), p. 347, Pl. 2, figs. 2, 2*a–f* —— COBBOLD (1921), p. 332, Pl. 21, figs. 10*a*–13.

A good many fragments with the characteristic sculpture and one partially exfoliated ventral valve (with its counterpart) numbered [He 3381] indicate this species.

Locality and Horizon.—Rushton, locs. 3 and 8.—Lower Cambrian, from the *Callavia* Beds, and the *E. bellimarginatus* Limestone.

MICROMITRA (PATERINA) cf. *MINOR*, COBBOLD.

Micromitra (*Paterina*) *minor*, COBBOLD (1921), p. 333, Pl. 21, figs. 14–16.——cf. *M.* (*P*) *minor gibbosa*, COBBOLD (1921), p. 334, Pl. 21, fig. 17.

It is not quite certain that specimens [D 205 and He 3288] are of this species, the matrix is so intractable that the shells cannot be completely cleared.

It is possible that they may belong to the variety *gibbosa.*

Locality and Horizon.—Rushton, loc. 3.—Lower Cambrian, the *Callavia* Beds, and the *Strenuella* Limestone, loc. 12.

OBOLIDÆ.

OBOLUS, EICHWALD.

OBOLUS PARVULUS, COBBOLD.

Obolus parvulus, COBBOLD (1921), p. 338, Pl. 22, figs. 13–19.

This species, which is very characteristic of the *E. bellimarginatus* Horizon at Comley and occurs both above and below it, is found at Rushton in similar positions.

Locality and Horizon.—Rushton, loc. 3 and 8. Lower Cambrian, from the *Callavia* Sandstone and the *E. bellimarginatus* and *Strenuella* Limestones. It is also doubtfully identified from a pink limestone associated with the *Lapworthella* Limestone of loc. 7 (Cherme's Dingle), where the sequence has not been determined.

OBOLUS, sp. indet., fig. 10, Pl. 40.

The internal impression of a fragment of a dorsal valve [51667] has suggested a reference to *Obolus* (*Leptobolus*) *bretonensis* (MATTHEW), WALCOTT (1912), p. 426, Pl. 32, figs. 5, *5a–e*.

The evidence is too scanty to warrant a description and the size is much smaller than any of the specimens figured by either MATTHEW or WALCOTT.

Locality and Horizon.—Rushton, loc. 3—Lower Cambrian from a phosphatic bed between the *Strenuella* Limestone and the *Protolenus* Limestone associated with *Obolella atlantica*, and many fragments of other Brachiopoda, Hyolothidæ, and Annelida.

LINGULELLA, SALTER.

LINGULELLA, cf. *CONCINNA*, MATTHEW, fig. 9, Pl. 40.

Lingulella concinna, MATTHEW (1901), p. 273, Pl. 5, figs, *2a*, *b*——WALCOTT, 1912, p. 486, Pl. 23, figs. 2, *2a–h*, and Pl. 24, figs. 1, *1a–r*.

There seems very little doubt that the form now referred to [51666] is the same as that from the *Dictyonema* Shale of Fögelsång, Skane, Sweden, which is referred by WALCOTT to MATTHEW's species.

Locality and Horizon.—Rushton, loc. 12.—Upper Cambrian, fairly plentiful in one of the loose blocks of bituminous limestone, associated with *Leptoplastus raphidophorus* ANGELIN and species of *Ctenopyge* and *Eurycare*.

LINGULELLA, cf. *FERRUGINEA*, SALTER.

Lingulella ferruginea, SALTER (1867), p. 340, fig. 1.——*Lingulella* cf. *ferruginea*, SALTER, MATLEY (1911), p. 300, Pl. 26, figs. 5, *6a* and *b*.—*Lingulella ferruginea*, SALTER, WALCOTT (1912), p. 496, Pl. 29, figs. 1, *1a–w*; Pl. 30, fig. 1; Pl. 31, figs. 3, *3a–c*; Pl. 35, figs. 4, *4a–b*.

Forms referred to this species are found at Rushton, loc. 3, in the *P. bohemicus salopiensis* gritty limestone and loc. 9 in the *P. forchhammeri* Grit; both Middle Cambrian.

WALCOTT quotes this species from (1) Upper Cambrian (Canada, and Œland Island, Sweden); (2) Middle Cambrian, from highest to lowest horizons (Canada, Newfoundland, Scandinavia, and Wales); (3) " Middle " [= Lower] Cambrian " *Protolenus* Zone " (Hanford Brook, New Brunswick).

LINGULELLA VIRIDIS, COBBOLD.

Lingulella viridis, COBBOLD (1921), p. 341, Pl. 22, figs. 10–12.

Of this species but one dorsal valve has been recognized in the collection. At Comley it occurs fairly plentifully in the *Strenuella* Limestone and not in any other horizon.

At Rushton it occurs in a bed referred, by its other fossils, to the *E. bellimarginatus* Limestone which is the next horizon below.

Locality and Horizon.—Rushton, loc. 3.—Lower Cambrian, from the *E. bellimarginatus* Limestone.

KUTORGINA, BILLINGS.

KUTORGINA (?) *ANGLICA*, sp. nov., figs. 13–15 and (?) 11 and 12, Pl. 40.

Kutorgina cingulata, BILLINGS, CALLAWAY (1877), p. 662.—Cf. *Kutorgina cingulata* (BILLINGS), WALCOTT (1912), p. 580, Pl. 5, figs. 1, 1*a–s*, where 13 earlier references are given and among them *Obolella* (*Kutorgina*) *cingulata*, BILLINGS (1861), p. 8, figs. 8 and 10.—Cf. also *Kutorgina perugata*, WALCOTT (1912), p. 583, Pl. 5, figs. 3, 3*a–c*.

There is but one difficulty in adopting CALLAWAY's specific identification for the shells found at the Neves Castle Quarry, loc. 5 of this paper. This is, that these shells are phosphatic, and *K. cingulata* is calcareous.

In his " observations " immediately after his generic diagnosis, WALCOTT specifically mentions (p. 580) that the shells of *Kutorgina* are distinguished from those of *Micromitra* by being calcareous.

The shells now under discussion are very fragmentary, some are pressed flat, others appear to have full natural convexity, not one, however, gives a complete idea of the exterior aspect.

Holotype.—A small dorsal valve [51669].

Paratypes.—Ventral valves [51668A, 51670]. Dorsal valve [51671].

Description.

Dorsal valve : nearly circular, well rounded in front, widest in advance of the mid-length, behind which the sides are less convex and converge to the rounded postero-lateral angles, posterior border passing in a gentle curve behind the umbo. Convexity moderate, highest at the umbo which is separated from the posterior margin by, approximately, one-tenth of the length. Usually there are indications of a well-marked sinus along the centre line, beginning at about one-quarter of the length from the umbo. It is possible that this may be due to lateral compression for no trace of sinus is seen in a valve that has been much flattened. Area rudimentary (see fig. 12), extent doubtful.

Ventral valve : wider than long, posterior border (hinge line) straight, overhung by the apex ; front and sides well rounded, widest at about the mid-length, whence the sides converge to the rounded cardinal angles ; convexity moderate, highest at about one-quarter of the length from the apex ; area unknown.

Shell of both valves thick, of many laminæ with rugose edges, inner layers marked by radiating striæ, substance phosphatic ; as preserved, reduced to a somewhat incoherent state and readily pulverized. Outer layer black, grey when much weathered.

Sculpture, concentric striæ of growth with four or more rather deep concentric furrows marking stages of growth, between which the surface is swollen. When pressed flat these concentric swellings are modified into strong ridges with hollow interspaces (see fig. 15) as though the annular convexities were heaped up towards their outer boundaries.

Localities and Horizon.—Rushton, locs. 5 and 2.—Lower Cambrian, from the Lower Comley Sandstone.

Almost all the features seen may be matched with some of the figures given by WALCOTT for *K. cingulata* and *K. perrugata*,* but no instances occur in this collection of the extravagantly incurved apex of the ventral valve, seen in aged valves of the former.

Figs. 11 and 12 are inserted in Pl. 40 as examples of young ventral and dorsal shells.

OBOLELLA, BILLINGS.

OBOLELLA ATLANTICA, WALCOTT.

Obolella atlantica, WALCOTT (1890), vol. 12, p. 36; —— and (1891), p. 611, Pl. 71, figs. 1, 1*a*–*c* (where eight other references are given).

Among the forms referred to the Comley variations noticed below, there are three or four specimens that must be referred to WALCOTT's type. They are not nearly so transverse as *transversa*, with which they are associated, and less convex than *comleyensis*.

OBOLELLA ATLANTICA COMLEYENSIS, COBBOLD.

Obolella atlantica var. *comleyensis*, COBBOLD (1921), p. 342, Pl. 22, figs. 6–9 and text-fig. 1.

This form is well represented in the *Callavia* Beds at Rushton locs. 3 and 8, and, as at Comley, is also found in the *E. bellimarginatus* Limestone.

OBOLELLA ATLANTICA TRANSVERSA, COBBOLD.

Obolella atlantica var. *transversa*, COBBOLD (1921), p. 344, Pl. 22, figs 1–3 and text-fig. 2.

This variety, accompanied by some instances that appear to grade into the var. *comleyensis*, is prevalent in the *Strenuella* Limestone at the same localities (locs. 3 and 8).

ACROTRETIDÆ, SCHUCHERT.

ACROTHELINÆ, WALCOTT and SCHUCHERT.

ACROTHELE, LINNARSSON.

ACROTHELE INTERMEDIA, LINNARSSON, fig. 20, Pl. 40.

Acrothele intermedia, LINNARSSON (1879), p. 25, Pl. 3, figs. 38–44. —— GRÖNWALL, 1902, p. 39. —— WALCOTT (1912), p. 646, Pl. 56, figs. 3, 3*a*–*d*.

Four good specimens of this species occurred in the RHODES Collection of 1892, and are now missing. Drawings were made in 1912, a copy of one of these is inserted on Pl. 40.

* *Perugata* of WALCOTT's monograph (1912).

The species is quoted by LINNARSSON from the *Exsulans* Limestone at Andrarum, Sweden, and by GRÖNWALL from the same horizon at Borregaard, Bornholm.

Locality and Horizon.—Rushton, loc. 7, Cherme's Dingle, associated with *P. hicksi*, and with *Agn. incertus* occurring just above the *P. hicksi* Fauna.

ACROTHELE PRIMA (MATTHEW), fig. 19, Pl. 40.

Acrothele matthewi prima, MATTHEW (1886), p. 41, Pl. 5, figs. 16 and 16*a*. —— HALL and CLARKE (1892), Pl. 3, fig. 27. —— *Acrothele prima* (MATTHEW), WALCOTT (1912), p. 653, Pl. 61, figs. 6, 6*a*–*b*, and Pl. 62, fig. 2. (Under this reference WALCOTT cites several others.)

In the lower part of the Lower Comley Sandstone at Rushton a number of shells referable to this species are found in shale.

The surface characters are very much the same as those of *A. coriacea*, but the position of the apex, almost over the posterior border, is quite distinctive. The material is very fragmentary, but almost always exhibits the sculpture.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, The *Acrothele prima* Shale, about 100 feet above the Wrekin Quartzite.

Sub-genus *REDLICHELLA*, WALCOTT.

ACROTHELE (*REDLICHELLA*) *GRANULATA* (LINNARSSON).

Acrothele granulata, LINNARSSON (1876), p. 24, Pl. 4, figs. 51 (and 52 ?). —— (1877), p. 22, Pl. 2, fig. 11.

Acrothele (*Redlichella*) *granulata* (LINNARSSON), WALCOTT (1912), p. 663, Pl. 56, figs. 2, 2*a*–*n*. —— STRAND (1929), p. 341.

As with *Acrotreta socialis*, this species appears to be confined to the basal division of the Middle Cambrian at both Rushton and Comley, and it appears to be the same in Scandinavia, where it is not confidently recorded from beds higher than the *Conocoryphe exsulans* Zone.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, the *P. groomi* Grits.

ACROTRETINAE, MATTHEW.

ACROTRETA, KUTORGA.

ACROTRETA GEMMULA, MATTHEW, fig. 17, Pl. 40.

Acrotreta gemmula, MATTHEW (1894), p. 87, Pl. 14, figs. 2*a*–*d*. —— (1895), p. 126, Pl. 5, fig. 5*a*–*d*. —— (1903), p. 97, Pl. 3, fig. 4*a*–*d*. —— WALCOTT (1912), p. 686, Pl. 66, figs. 3, 3*a*–*c*, and Pl. 67, figs. 5, 5*a*–*i*.

This species occurs in the shale, in groups of several valves, and exhibits most of the features shown or described by Walcott very clearly.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian from the *Acrothele prima* Shale.

WALCOTT places this species in the Middle Cambrian, but the type horizon and locality are MATTHEW's division 1 *b* 2 of the Cambrian of Hanford Brook, near St. Johns, New Brunswick, now regarded by most geologists as Lower Cambrian. It is also quoted from the Etcheminian.

ACROTRETA PARVULA (WALLERIUS).

Obolella parvula, WALLERIUS (1895), p. 65, figs. 9*a–d*.
Acrotreta parvula (WALLERIUS), WALCOTT (1912), p. 699, Pl. 77, figs. 4, 4*a*.

Specimen [52859] answers well to WALCOTT's figures and description of this species. It occurs with a number of very minute valves of, possibly, the same species and one of a ventral valve referred to *Acrotreta sagittalis* (SALTER).

Locality and Horizon.—Rushton, loc. 10.—Middle Cambrian, from shale at the summit of the Middle Cambrian quartzose Grits, referred to the *Agn. lævigatus* Zone of Scandinavia.

Remarks.—This species was described from the *Agnostus lævigatus* Zone of Djüpdalen, Sweden, and has been identified from the same horizon at other places in that country.

ACROTRETA SAGITTALIS (SALTER).

Obolella sagittalis, SALTER (1866), p. 286.

Acrotreta sagittalis (SALTER), WALCOTT (1912), p. 704, Pl. 71, figs. 2, 2*a–h*, 3, 3*a–j*.

Numerous other references are given in WALCOTT's monograph.

The species appears to range from summit to base of the *Paradoxides* Beds, and is quoted by WALCOTT (p. 705) from the *Protolenus* Zone.

Locality and Horizon.—Rushton, loc. 3, the *P. groomi* Grit—loc. 9 the *P. forchhammeri* Grit—loc. 10, the (?) *Agnostus lævigatus* horizon. All Middle Cambrian.

ACROTRETA SOCIALIS, von SEEBACH.

Acrotreta socialis, von SEEBACH (1865), p. 341, Pl. 8*a*, figs. 1–4. —— Non. *Acrotreta socialis*, von SEEBACH, LINNARSSON (1876), p. 16, Pl. 3, figs. 32–35. —— *Acrotreta socialis*, von SEEBACH, LINNARSSON (1877), p. 374. —— WALCOTT (1902), p. 599. —— (1912), p. 711, Pl. 73, figs. 3, 3*a–c*, and 4, 4*a–c*. —— (?) COBBOLD (1921), p. 347, Pl. 22, fig. 35.

The same form that was found at Comley and referred to von SEEBACH's species occurs at Rushton in the *P. groomi* Grit.

It appears that before *A. schmalenseei* WALCOTT, was separated off as a distinct species, many references to *A. socialis* have been made from higher horizons. So far as information goes, these references were made on insufficient evidence, and it is probable that *A. socialis* is confined to the lower part of the Middle Cambrian and is not present in the *P. forchhammeri* Zone.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian from the *P. groomi* Grit.

ACROTHYRA, MATTHEW.

ACROTHYRA COMLEYENSIS, COBBOLD.

Acrothyra comleyensis, COBBOLD (1921), p. 348, Pl. 33, figs. 1–8, and text-fig. 3, p. 349.

Three or four specimens agreeing well with the original figures of this species (the only one of the genus at present known from the British-Middle Cambrian) occur in association with the *P. groomi* Fauna at Rushton.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian from the *P. groomi* Grit.

ACROTHYRA SERA (MATTHEW).

Acrothyra signata sera, MATTHEW (1902 *b*), p. 383, Pl. 13, figs. 3*a–e*.——*Acrothyra sera* (MATTHEW), WALCOTT (1912), p. 718, Pl. 80, figs. 4–8, where a full synonymy is given.——*Acrothyra* cf. *sera*, MATTHEW, COBBOLD (1921), p. 350, Pl. 23, figs. 9–18.

As at Comley this species occurs very plentifully in the highest horizon of the Lower Cambrian at present recognized. Associated in considerable numbers, a variety, or possibly sub-species, appears with it which has the front and side slopes concentrically corrugated. Owing to the nature of the matrix, it has been impossible to ascertain further details of the shell, and it must remain undescribed.

Locality and Horizon.—Rushton, locs. 7, 8, 9 (Cherme's Dingle).—Lower Cambrian from the *Lapworthella* Limestone.

BILLINGSELLIDÆ

BILLINGSELLINÆ

BILLINGSELLA, HALL and CLARKE.

BILLINGSELLA EXPORRECTA (LINNARSSON) ?

Orthis exporrecta, LINNARSSON (1876), p. 12, Pl. 2, figs. 13–19, and Pl. 3, figs. 20, 21.——WALLERIUS (1895), p. 66.——*Billingsella exporrecta* (LINNARSSON), WALCOTT (1912), p. 754, Pl. 88, figs. 1, 1*a–l*.

Some 8 or 10 fragments are referred to this species, which WALCOTT says is a very variable one. So far as they go they agree with the figures and descriptions, but they do not give any detailed information as to the interiors.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

(iv) GASTROPODA.

CAPULIDÆ, Cuvier.

HELCIONELLA, Grabau and Shimer.

HELCIONELLA OBLONGA, Cobbold.

Helcionella oblonga, Cobbold (1921), p. 365, Pl. 24, figs. 38 and 39.

This form appears to be as plentiful as it is at Comley in the same horizon. It shows some variation in the shape of the mouth, which is a more elongated oval, and the shell is consequently narrower; another form occurs which has the mouth expanded horizontally as a flange.

The sculpture remains the same and it does not seem advisable to separate these forms from the type.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. groomi* Grit.

HELCIONELLA RUGOSA COMLEYENSIS, Cobbold.

Helcionella rugosa, Hall, var. *comleyensis*, Cobbold (1921), p. 365, Pl. 24, fig. 10.

One fragment of an external impression showing sculpture clearly indicates this Comley form.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian, *Càllavia* Beds.

(v) HYOLITHIDÆ.

HYOLITHUS, Eichwald.

HYOLITHUS ŒLANDICUS, Holm. figs. 21, 22, Pl. 40.

Hyolithus œlandicus, Holm (1893), p. 70, Pl. 5, figs. 44–47.

Two specimens referred to this species occur [51677, 51782]. One is a dorsal face, moderately convex, with raised, rounded striæ of growth fairly regularly arranged and convex distally. The other, a ventral face, more convex, with no visible striæ on the damaged surface, but with transverse, raised lines on the impression of the interior representing stages of growth. Apical angle, about 13°. Apex, gently curved toward the dorsal side.

In 1893 the species was, apparently, only known to Holm from shales of the *P. œlandicus* zone of Œland.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose blocks containing the *P. bohemicus salopiensis* Fauna.

HYOLITHUS TENUISTRIATUS, Linnarsson. Fig. 26. Pl. 40,

Hyolithus tenuistriatus, Linnarsson (1873), p. 792, Pl. 1, figs. 82–85.——Brögger (1879), p. 60, Pl. 4, figs. 18, 18*a*–*b* and 14.——Holm (1893), p. 72, Pl. 1, figs. 82–93. ——Grönwall (1902), p. 45.——Strand (1929), p. 343.

This species is very plentiful at Rushton, but when not well exposed there is a possibility of confusing it with *H. obscurus* and *H. operosus* (see pp. 334, 335), which occur in association in the same rock fragments.

The normal sculpture is shown in the figure.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

HYOLITHUS, sp. indet. "Fin support." Fig. 28, Pl. 39.

Two specimens occur which seem to be fin supports and may belong to *H. tenuistriatus* or to *H. operosus*, with which they are associated.

One [51683] is curved almost semicircularly, has a length (along the curve) of 5·5 mm., the proximal width being 0·60 mm., the distal width 0·45 mm., the section appears to be an oval, with length double the width. Substance, black, apparently chitinous, but too much damaged to show any surface character.

The second specimen [52864] is curved proximally for a short distance and then proceeds in a nearly straight line; length 7 mm. It is seen edgeways, and is of the same oval section.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

HYOLITHUS OBSCURUS, HOLM, var. *ANGLICUS*, nov., fig. 29, Pl. 39.

Hyolithus obscurus, HOLM (1893), p. 76, Pl. 5, figs. 29–31 and (?) 32, 33.——*Hyolithus obscurus*, HOLM, GRÖNWALL (1902), p. 45.

The species was described by HOLM as a small species; the English variety appears to be about 50% larger than his figured specimen and compares very favourably as to width with *H. tenuistriatus*. He also observed two impressed lines on the dorsal face, close to each of the side angles; in the present form there is but one in the same position, and that is sometimes obscure or even absent.

Holotype for the variety [51684]. It is an internal impression showing the dorsal face and some portion of the ventral, with the counterpart of the former.

Paratype [51721 E], an exterior of the dorsal face, showing also the section.

Description.

Pyramidal shell:—A flattened sub-triangular pyramid with apical angle varying from 18° to 23°, lateral angles fairly sharp, ventral angle obtuse and rounded, ratio of dorso-ventral to transverse diameter varying from 2 : 3 to 1 : 2. Dorsal face:—nearly flat, rounded at the angles and, on the internal impression, marked parallel with the border by a line impressed sideways, making a little marginal terrace. This is not visible in the paratype, except where the shell is exfoliated. Ventral face:—composed of two sub-circular arcs joining at a blunt angle. Aperture:—ventral margin transverse, dorsal margin standing up at an angle of between 80° and 90° with the plane of the ventral margin, the two ventral faces connected by a sharp curve. Sculpture:—of fine striæ of growth varying in thickness, crowded together in places, strongly curved on the dorsal, and very slightly so on each of the ventral faces. The sculpture is very like that of *H. tenuistriatus* but rather finer.

In a note appended to his description, HOLM mentions a number of specimens agreeing with his form, except that they have only one marginal line at the borders of the dorsal side. With these is an operculum, which he describes as belonging to his species.

A somewhat damaged operculum, wanting almost all the ventral portion, is found on the slab holding the counterpart of the holotype, its diameter agrees with that of the pyramidal shell, to which it almost certainly belongs, and it has, so far as it goes, the characters mentioned in HOLM's description.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian from the *P. forchhammeri* Grit.

HYOLITHUS OPEROSUS, sp. nov., figs. 1–5, Pl. 41.

Not *Hyolithus socialis*, LINNARSSON (1873), p. 295, pl. 16, figs. 10–12, and HOLM (1893), p. 78, Pl. 1, figs. 72–77, and (?), Pl. 6, figs. 16, 17.

Holotype [51686.]

Paratypes (A) [51688], (B) [51689], (C) [51703].

The material consists of some 12 or more fragments of the pyramidal shell, which were at first thought to be *H. tenuistriatus* LINNARSSON, and subsequently were referred to *H. socialis* LINNARSSON, but were found on further study to be different from either.

Description.

Shell, rather large, tapering slowly at about 10°, decidedly curved towards the ventral side, section biconvex, ratio of dorso-ventral to transverse diameter about 2 : 3, side angles sharply rounded, especially internally ; dorsal side decidedly convex, ventral side strongly convex, with the curvature more strongly marked at the rounded ventral angle ; sculpture of fine and coarse, raised growth lines, irregularly grouped as in *H. tenuistriatus*, but stronger, especially in the older shells ; the lines are directly transverse ventrally, and on the dorsal side they curve strongly mouth-wards with a slight flattening across the centre line.

Dimensions.—The widest mouth seen is 6·7 mm. across, indicating a total length of about 40 mm. for the complete shell.

Remarks.—The troublesome work of separating specimens of this species from those of *H. tenuistriatus* has suggested the specific name.

All occur in a hard pebbly and calcareous grit with no distortion or damage from crushing, but they are very difficult to lay bare. Lengths vary from 25 mm. downwards, all showing the longitudinal curvature, but few the complete section ; in two cases a septum is seen near the apex (see fig. 3), distant about 6 mm. from the, supposed, pointed end. Special attention is called to paratype B (fig. 5), which seems to show a temporary malformation of the dorsal lip which occurred suddenly when about half full grown. At about 7 mm. from the broken apical end—that is, 20 mm. from the probable position of the apex—the curve of the growth lines is changed from an elliptical to a deeply emarginate form which, in a further length of about 10 mm., had gradually recovered its proper shape and continued so to the distal end of the specimen.

The species seems nearest to *H. socialis* with which it agrees in the longitudinal curvature and apical angle. While the general form of the cross sections are similar, the Rushton species is considerably deeper, the section more rounded, the sculpture much coarser; the complete length when full grown is probably greater by 50 per cent.

H. operosus vies with *H. tenuistriatus* in length and frequency, but differs radically in cross section and in the apical angle; in sculpture the difference lies in the relative coarseness of the Shropshire form.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

HYOLITHUS ARANEUS, HOLM, var. *ANGUSTUS*, nov., fig. 27, Pl. 40.

Hyolithus araneus, HOLM (1893), p. 80, Pl. 5, fig. 78.

Holotype.—[51682.]

HOLM's description of his species is substantially as follows:—

Shell small, straight ventrally, triangular in section; ventral faces flat and meeting at an indistinctly rounded angle of about 90°, dorsal side gently convex, lateral angles acute, divergence angle 25°—30°; oral orifice weakly projecting at each ventral face and more strongly at the dorsal. Sculpture of sharp, but fine, closely-set raised lines of growth, curving weakly on each ventral face, convex in oral direction, and curving more strongly on the dorsal side. In addition the ventral side has a few fine, raised, longitudinal lines, standing apart, three on each face and one or two near the mid-line.

Some 10 or 12 specimens occur in the Rushton Collection which agree with the above description, except that the longitudinal lines are more plentiful, as many as 20—25 having been counted on one ventral face. Some have a few stronger lines, with weaker ones between them.

Only occasionally can the spider-web pattern spoken of by HOLM be detected. The angle of divergence is 15° to 16°; in HOLM's species it is 25° to 30°.

The holotype for the variety is [51682], the distal part of a small shell which was probably not longer than 7 mm. when complete; another minute but typical specimen is [51802].

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

HYOLITHUS PENNATULOIDES, sp. nov., figs. 24, 25, Pl. 40.

A form originally assigned to *H.* (*O.*) *cor* HOLM proves on preparation to be an undescribed species allied to *H. pennatulus* HOLM and others of his group Carinati. The two faces of the ventral side are channelled much like the dorsal face of *H.* (*O.*) *cor*, and when only one face is visible, especially in the form of an external impression, the two species may easily be confused.

Holotype [51679] with counterpart.

Paratype [51680] with counterpart.

Description.

Shell almost straight, bent at apex towards the ventral side. General section widely triangular with strong, rounded projections at the angles. Divergence angle 28° to 29° ; Dorsal side gently convex with lip projecting ; ventral side with a strongly raised rib at the ventral angle, one-third as wide as the shell, well rounded and too strong to be called a keel ; on either side is a very slightly convex space, inclined downwards to the marginal rib, which is less wide than the central rib, but, relatively, equally convex. Sculpture of rounded raised growth lines, spaced evenly at about 30 to the mm. in the distal part of the holotype, and running in straight lines at right angles to the axial line, continuous across the ribs and interspaces. On reaching the margin they pass round in a sigmoidal curve to the dorsal side and cross it in a curve, convex distally.

Dimensions.—Holotype ; length seen 2·4, width of larger end, 1·5—total length of shell probably in excess of 3 mm. Paratype : length 4·8, incomplete distally.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—In preparing the holotype the right side was too much damaged for figuring, and is shown in restored outline in fig. 24. The paratype is seen edgewise, and has been cleared down the dorsal side sufficiently to show its convexity ; the ventral side exhibits traces of the side-space, and a small fragment of the central rib has also escaped damage.

This species differs from *H. pennatulus* in the relative width of the central rib, in the gentle convexity of the side spaces, in the rounded side ribs and in the transverse growth lines being straight across the side spaces, not curved so as to suggest, with the smooth, rounded, narrow keel, the appearance of feathers.

H. (*O.*) *cor* has an almost smooth surface with very faint sculpture, and its divergence angle (15° or 16°) is much larger than that of a single ventral face of *H. pennatuloides*. *H.* (*O.*) *lineatulus* has fine growth striæ crossed by very fine longitudinal lines, its apical angle is about the same as that of a single ventral face of our species. *H.* (*O.*) *cor* is found in the *P. forchhammeri* Zone of Sweden and at Bornholm in the same zone ; also as far up as the *Orusia lenticularis* Zone.

ORTHOTHECA, Novák, 1886.

This term is used as a convenient group designation for those species of *Hyolithus* that have the oral orifice nearly in one plane. The limits of *Orthotheca*, as a distinct genus, not being defined.

HYOLITHUS (*O.*) *COR*, Holm, fig. 23, Pl. 40.

Hyolithus (*Orthotheca*) *cor*, Holm (1893), p. 58, Pl. 2, figs. 60–63, and Pl. 6, fig. 10.

This is a well-marked species, easily identified when the heart-shaped cross-section can be observed. If the dorsal face only is in view it may be confused with *H. pennatuloides*, from which it differs in having a larger apical angle as well as in cross-section. It is fairly plentiful in the collection.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

INCERTÆ SEDIS.

HYOLITHUS (*O.* ?) *ORNATUS*, sp. nov., fig. 6, Pl. 40.

Holotype.—A nearly complete shell showing the dorsal face only [51663].

Description.

Shell straight in the dorsal view, tapering evenly to the apex, divergence angle about 7° ; curved in a side view concave towards the ventral side. Section only known for the dorsal half. Ventral face convex, otherwise unknown. Dorso-ventral diameter, exceeding half the transverse. Dorsal face, with rounded swellings continuous along each side, having a well-marked channel between them which occupies rather more than half of the width. Side angles rounded. Sculpture (of dorsal face) consisting of well-marked, transverse, incised lines, regularly arranged but not equally spaced, 6 or 7 of these may be counted in a length of two millimetres near the mouth ; between these, numerous striæ of growth, also of incised character, are seen ; crossing these transverse lines a series of longitudinal, raised lines occur, only to be seen in appropriate lighting and magnification. Surface black, very finely granular, not polished. Oral orifice apparently at right angles with the axial line ; lip incurved.

Dimensions in mm. : length, along the curve, 6·30, width at larger end 2·00, width of channel 1·10, depth of same below swellings 0·20.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—Unfortunately no second specimen has been identified. The species seems to be near to *H.* (*O.*) *lineatulus*, Holm, but has a smaller divergence angle, 7° as against 14° ; a more pronounced channel on the dorsal side ; and relatively deep, transverse growth lines, which seem to imply that the oral margin was incurved. It is consequently described here as a new species.

It also appears doubtful if it is really a *Hyolithus* or an annelid.

HYOLITHUS (*O.* ?) *BAYONET* (Matthew).

Orthotheca bayonet, Matthew (1899 *a*), p. 193, Pl. 3, figs. 1*a–c*. —— (1899 *b*), p. 114, Pl. 7, figs. 1*a–c*. *Hyolithus* (*Orthotheca*) *bayonet*, Matthew, Cobbold (1921), p. 357. Pl. 24, figs. 12–16.

At Comley this is the most characteristic species of the so-called Pteropoda of the *Protolenus* Limestone. Two specimens from the same horizon at Rushton were secured in the small amount of material collected from the narrow trench. There are doubts whether it should be placed under *Orthotheca*, and it is consequently placed here under *incertæ sedis*.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian from, the *Protolenus* Limestone.

(vi) TRILOBITA.

Secondary Thickening of the Tests of Trilobites.

Raw (1931, pp. 502–506) calls attention to the preservation of very thin tests of trilobites, retaining their natural convexity owing to their having acquired, probably before entombment, a coating, on one or both sides of the tests, of carbonate of lime in which hardly any grains of the sand of the matrix are to be seen.

Many instances of this occur in the collection from Rushton, and they are not confined to one stratum nor to all the fossils in one hand specimen, but occur very sporadically here and there; and often in different thicknesses on the same fossil.

This thickening does not appear to be anything like the deposit of carbonate so often found filling cavities between two shells or between pebbles in the matrix, for it has a smooth outer surface of granular texture looking exactly as if it were the outer surface of the test.

If a simile may be allowed, it is as though they had been painted over very inefficiently, the " colour " being thick in one place, thin, or even absent, in another.

The result, as to the fossil, is, first the obliteration of the finer details of sculpture, then the filling up of the smaller furrows and, gradually, the smoothing over of the whole test so that, while its general form is still there, it appears to be a different species. The varying obliteration of detail is perhaps best seen in those trilobites that have a pitted surface of test, like the *Liostraci*.

To mention one instance among several; in the holotype of *Liostracus bruno* sp. nov. the pitting is seen quite clearly in some parts, indistinctly or not at all in others; this is not due to wear, for the more distinct sculpture is seen upon the prominent parts.

Perhaps the most convincing is that of a small specimen referred to *Agraulos robustus*, sp. nov., see figs. 7 and 8 (a photograph), Pl. 43, in which one-half of the outer thickening has come away leaving the other half intact. One can see, with a lens, the thickening and thinning and the consequent obliteration. It has not been possible to observe whether the actual test has come away with the secondary thickening or is left on the internal cast. In *Liostracus* and *Agraulos* the test seems to be always thin (about 0·01 mm.) and this specimen is a small one of the species.

There is another manifestation of what appears to be the same process, arrested perhaps in an early stage. Certain trilobites when examined under strong magnification have a test that looks as if it were covered with a fine sharp dust, possibly crystalline, but on too minute a scale to be definitely recognized as such.

This secondary thickening seems to be prevalent only in sandy or gritty deposits in which the coarser terrigenous material has accumulated intermittently, with long intervals.

AGNOSTIDÆ, McCoy.

AGNOSTUS, Brongniart.

AGNOSTUS FISSUS, Lundgren, var. MANCUS. nov., figs. 9–12, Pl. 44.

Synonymy for *Agnostus fissus* is as follows:—

Agnostus fissus, Lundgren, MS., Linnarsson (1879), p. 23, Pl. 2, fig. 34.——Tullberg (1880), p. 16, Pl. 1, fig. 3 *a–d*.——Matthew (1896), p. 230.——Grönwall (1902), p. 50.——Lake (1906), p. 3, Pl. 1, figs. 1–3.——Illing (1916), p. 406, Pl. 28, figs. 6–8.——Nicholas (1916), p. 452.

Three cephala, associated with the *P. bohemicus salopiensis* Fauna, are doubtfully referred to this species, with which they are in agreement in shape, form of glabella and convexity, but differ in that the cleft in the anterior lobe of the glabella is either entirely wanting or only represented by a little depression at the front, and there are signs that this may be accidental. A study of the published figures of the species shows considerable variation in the length of the cleft.

Co-types for the variety [51743–51746].

Description.

Cephalon.—General form:—subquadrate, rounded anteriorly, with narrow margin of even width, gently convex. Glabella:—convex, posteriorly higher than cheeks, anteriorly rather lower, divided by a cross-furrow which is not quite straight, anterior lobe quadrate with rounded front, about one-third of the total length of the glabella, in some specimens without cleft, in others a short cleft is seen, but it is uncertain if it be original or a result of accident, posterior lobe pinched in at two places on each side (simulating the second and third side furrows in other trilobites) dividing off three pairs of incomplete side-lobes; between these the surface rises backwards from the anterior cross-furrow to the mid-length of the lobe and then falls again to the posterior margin; basal lobes not well seen, apparently small and triangular, connected behind the glabella by a fairly obvious but narrow band. Cheeks:—evenly convex and of approximately the same width all round, separated in front of the glabella by a weakly impressed or obsolescent line, surface smooth or wrinkled with irregular, impressed radiating lines. Lateral angles rounded. Test smooth.

Length and width approximately equal (3·75 mm.).

Pygidium:—One mutilated specimen only. General form:—sub-quadrate, length and width apparently equal, posteriorly it is more rounded than the front of the cephalon, than which it is also more convex. Axial lobe:—about 0·75 of the total length, convex, standing well above the pleural lobes, tripartite by two faint cross-furrows, anterior division too much damaged to be described, median division narrower than the other two, rising to a tubercle which appears to project on to the posterior division; this is lance-shaped, strongly outlined by the dorsal furrow, highest and widest at one-quarter of its own length from in front, with one little round convex spot showing on the left of the axial line (? accidental, the right side is damaged at the corresponding point).

Pleural lobes :—each a little narrower in the dorsal view than the axial lobe, rising slightly from the dorsal furrow and then descending boldly to the border, which is not well seen, but appears to be narrow.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose block with the *P. bohemicus salopiensis* fauna.

Remarks.—One of the cephala is quite a good *fissus*, except for the suspicion that the cleft may be adventitious. The associated pygidium is very like that of *Agn. gibbus*, LINNARSSON, with the exception that the pleural lobes are not divided posteriorly, a feature which is wanting also in the Bornholm specimen of BRÖGGER's variety *hybrida* (GRÖNWALL (1902) p. 49).

AGNOSTUS GIBBUS, LINNARSSON. Figs. 3, 4, Pl. 44.

Agnostus gibbus, LINNARSSON (1869), p. 81, Pl. 2, figs. 52, 53.——BRÖGGER (1878), p. 62, Pl. 6, fig. 11.——LINNARSSON (1879), p. 32, Pl. 2, figs. 31 and 32.——TULLBERG (1880), p. 15, Pl. 1, fig. 2.——*Cf.* also *Agnostus gibbus*, var. *hybrida*, BRÖGGER (1878), p. 62.

Two specimens, [51737, 51738] that were at first thought to be *Agn. atavus*, TULLBERG, are now found to be more akin to LINNARSSON's species.

Description.

Cephalon :—moderately convex, broadly rounded in front, with a narrow border all round. Glabella :—rather narrow, almost parallel sided, depressed in front nearly to the level of the cheeks, divided into two lobes by a transverse furrow, anterior lobe triangular, with rounded sides and sharp apex, about one-third of the total length of the glabella and about the same width—posterior lobe slightly narrowed at about one-third of its length by a pair of side impressions, rising to a summit at about two-thirds of its length whence it descends to the back border in a convex curve. Basal lobes :—not preserved, apparently small. Dorsal furrow :—strong and deep. Pleural lobes :—convex, separated in front by a strong furrow, widening gradually backwards, crossed by a few, well-marked, radiating furrows at irregular distances apart (? adventitious), otherwise smooth.

Pygidium :—the same shape as the cephalon and rather more strongly convex, with a narrow border. Axial lobe :—convex, tripartite, anterior division damaged, apparently, as wide as the posterior : median division, narrower and with a well-marked spinose projection at the back ; posterior division, lanceolate.

Dimensions in mm. :—

Length of cephalon, 2·50 ; width, 3·00 [51737]
pygidium, 2·30 ; ,, 2·50 [51738]

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose block with the *Paradoxides bohemicus salopiensis* Fauna.

AGNOSTUS LENS, GRÖNWALL. Figs. 5—8, Pl. 44.

Agnostus lens, GRÖNWALL (1902), p. 65, Pl. 1, figs. 8 and 9. —— ILLING (1916), p. 414, Pl. 31, figs. 3–7.

Six specimens [51739, 51740, 51741, 51742, and He 3460 B and C] are confidently referred to this species. The cephala agree well with GRÖNWALL's description and figures, and, when viewed from behind, show the band connecting the basal lobes of the glabella. The pygidia also agree, except that the interior shows a fairly distinct ridge between the ends of the pleural lobes, and the exterior, though damaged at the same spot, gives indications that they were separated by a slight hollow, if not by a distinct furrow. Indications of the same can be detected in GRÖNWALL's fig. 9 and possibly in ILLING's fig. 7, though it is not mentioned in the descriptions.

Dimensions in mm. :—

Cephalon :—Length, 2·5 ; width 2·6 ; height, 0·7.

Pygidium :—Length, 2·6 ; width, 2·7 ; height, 0·6.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

AGNOSTUS LUNDGRENI, TULLBERG. Figs. 20 and ? 21. Pl. 44.

Agnostus lundgreni, TULLBERG (1880), p. 20, Pl. 2, fig. 8. —— GRÖNWALL (1902), p. 51. —— STRAND (1929), p. 345. —— *Agnostus atavus*, TULLBERG, STRAND (1929), p. 344, Pl. 1, fig. 20.

The cephalon figured agrees very closely with those shown in STRAND's figure and referred by him to *Ag. atavus*, though he himself expresses a doubt whether his *A. atavus* may not be a synonym of *A. lundgreni*.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—TULLBERG's types for *Agnostus atavus* were found by him and NATHORST in a loose block of " orsten " lying upon the lowest division of the alum shales at Andrarum, which shales contain blocks of orsten *in situ* and it was concluded that the *atavus* block came from that horizon, which became known as the " *Agn. atavus* Zone." MOBERG later on (1910, p. 59) doubted the validity of this zone set up on such slender evidence.

Dr. A. H. WESTERGÅRD in response to an enquiry kindly replied that there is no doubt now that the block came from the zone of *Agn. intermedius*, TULLBERG, and that, consequently, the name " *Agn. atavus* Zone " must drop. The *Agn. intermedius* Zone lies above the " *Exsulans* kalk " and *Agn. atavus* does not indicate so low an horizon as was supposed, possibly it is a synonym for another species.

AGNOSTUS STENORRHACHIS, GRÖNWALL. Fig. 22, Pl. 44.

Agnostus stenorrhachis, GRÖNWALL (1902), p. 76, Pl. 1, fig. 16. —— ILLING (1916), p. 411.—NICHOLAS (1916), p. 454. (Where comparison is made with *A. longifrons*, NICHOLAS, and the question is raised whether the two species are not identical.)

Two pygidia, agreeing with GRÖNWALL's description and figure, retaining the test, occur in the collection.

GRÖNWALL's specimens came from the *P. davidis* Zone of Borregaard and Læsaa in Bornholm associated with *Agn. nathorsti* and *Agn. planicauda.* The Rushton specimens are from the loose block with the *P. bohemicus salopiensis* Fauna. A wide range seems to be indicated.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose block with the *P. bohemicus salopiensis* Fauna.

AGNOSTUS ROTUNDUS, GRÖNWALL. Figs. 1, 2. Pl. 44.

Agnostus rotundus, GRÖNWALL (1902), p. 78, Pl. 1, fig. 19. —— LAKE (1906), p. 14, Pl. 2, figs. 3 and 4. —— ILLING (1916), p. 416, Pl. 31, fig. 11.

One fragment of a pygidium, numbered [51735], estimated to exceed 5 mm. in length, shows characters that indicate GRÖNWALL's species.

There are no signs of compression, but the convexity is low though preserved in calcareous rock in which other fossils retain their natural form. The dorsal furrow is wide and shallow. The axial lobe is well defined, without transverse divisions, and apparently parallel-sided for about three-quarters of its length after which it tapers rather rapidly to a blunt point, very like the form shown in LAKE's fig. 4. The specimen was fractured (probably before fossilization) behind the anterior margin, which is consequently missing; the axial lobe appears to be widening out forwards; the side lobes retain their width for the greater part of their length, then narrow rapidly to meet and coalesce behind the axial lobe, with no sign of any separating depression.

The border is very narrow anteriorly and widens all the way to the posterior margin, the groove and convex rim at any point being of about equal breadth.

Locality and Horizon.—Rushton, loc. 9. Middle Cambrian, from the *P. forchhammeri* Grits.

Since the above was written a complete but much weathered and smaller pygidium [51736] has been found, which appears to belong to this species (fig. 2, Pl. 44). The pleural lobes narrow posteriorly and are a little flattened where they meet. If compressed in shale this would probably produce the effect seen in both LAKE's and ILLING's figures of a dividing space or line, which is not noted by GRÖNWALL.

AGNOSTUS PARVIFRONS, LINNARSSON. Figs. 13–19, Pl. 44.

Agnostus parvifrons, LINNARSSON (1869), p. 82, Pl. 2, figs. 56 and 57. —— BRÖGGER (1878), p. 71, and vars. *nepos* and *mammillatus, idem*, pp. 71–74, Pl. 5, figs. 3*a–d*, and Pl. 6, fig. 2. —— TULLBERG (1880), p. 34, Pl. 2, figs. 26–28. —— MATTHEW (1896), p. 220. —— GRÖNWALL (1902), p. 74. —— ILLING (1916), p. 422, Pl. 33, fig. 10. —— STRAND (1929), p. 347, Pl. 1, fig. 14, and var. *mammillatus*, p. 347, Pl. 1, figs. 15 and 19.

Cephala and pygidia of the species occur in considerable numbers and in varying forms in the *Paradoxides forchhammeri* Grit of Rushton.

The cephala are oval in shape, truncated posteriorly, strongly convex and surrounded by a narrow border, some have length and width equal, in others the length is much in excess of the width. The height (convexity) is usually one-third of the length.

The glabellas vary from being very nearly circular to elongated ellipses, frequently only one-third the length of the shield, but often reaching about half-way and occasionally nearly three-fifths of the length. Usually a small raised node occurs in advance of the mid-length of the glabella. The small basal lobes are well seen and sometimes in the posterior view the connecting band between them.

The pygidia are also very variable, the larger number would probably come under BRÖGGER's var. *mammillatus,* but more as well as less extravagantly formed shields occur, some spatulate in shape, with an expanded and swollen posterior margin.

Locality and Horizon.—Rushton, loc. 9. Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—The elongated cephala with elliptical glabellas are suggestive of *Agn. brevifrons*, ANGELIN, but these differ from TULLBERG's figure and description of that species in having the front margin expanded and none of the associated pygidia have the pleural lobes confluent behind. The cephala are more in accord with TULLBERG's fig. 28, the original of which came from " one foot below the Andrarumskalk."

Figs. 13 and 14, Pl. 44, illustrate the rounded cephala with very short glabellas; figs. 15 and 16 show the most elongated forms in the collection, and have the elliptical glabella; elongate forms with short rounded glabellas also occur.

EODISCIDÆ, MATTHEW.

EODISCUS, MATTHEW.

EODISCUS LOBATUS, (HALL.)

Agnostus lobatus, HALL (1847), p. 258, Pl. 67, figs. 5*a–f*.

Microdiscus lobatus, HALL, WALCOTT (1886), p. 156, Pl. 16, figs. 1, 1*a*, 1*b*.——SHALER and FOERSTE (1888), p. 36, Pl. 2, fig. 13.—WALCOTT (1891), p. 632, Pl. 71, figs. 4, 4*a*, 4*b*.—LAKE (1907), p. 32, Pl. 3, figs. 4–6.——COBBOLD (1910), p. 22, Pl. 3, figs. 17, 18.—*Goniodiscus lobatus* (HALL), RAYMOND (1913), pp. 104, 105, fig. 11.

Two examples of this species are present from Rushton, both from the *Protolenus* Limestone of loc. 8. The reasons for not adopting RAYMOND's generic reference are given by COBBOLD (1931, p. 460).

EODISCUS SPECIOSUS, (FORD). Figs. 23–24, Pl. 44.

Microdiscus speciosus, FORD (1873), p. 137, figs. 2*a*, 2*b*, and 1877, p. 141.——WALCOTT (1886), p. 154, Pl. 16, figs. 3, 3*a–c*, and (1890), p. 632, Pl. 81, figs. 5, 5*a–c*.——MATTHEW (1896), p. 236, Pl. 17, fig. 6.——LAKE (1907), p. 33, Pl. 3, fig. 7.——COBBOLD (1910), p. 23.

Two pygidia occur from the same horizon as *E. lobatus* at Rushton, loc. 8, in the *Protolenus* Limestone of the Lower Cambrian.

PAGETIA, WALCOTT.

PAGETIA ATTLEBORENSIS (SHALER and FOERSTE).

Ptychoparia attleborensis, SHALER and FOERSTE (1888), p. 39, Pl. 2. fig. 14——*Pagetia attleborensis* (SHALER and FOERSTE), COBBOLD (1931), p. 462, Pl. 38, figs. 1–5 and (?) 6 (with long synonymy).

The species is very plentiful at Rushton, locs. 3 and 8, in the *Callavia* Beds of the Lower Cambrian.

PAGETIA ANNIO (COBBOLD).

Ptychoparia (?) *annio*, COBBOLD (1910), p. 24, Pl. 3, figs. 5–8 and 14.——*Pagetia annio* (COBBOLD), COBBOLD (1931), p. 465, Pl. 38, figs. 7–10.

This species, though less plentiful than *P. attleborensis*, is better represented in numbers than it is at Comley ; both cranidia and pygidia are found.

Localities and Horizon.—Rushton, locs. 3 and 8. Lower Cambrian from the *Callavia* Beds.

CONOCORYPHIDÆ, CORDA.

CONOCORYPHE, CORDA.

CONOCORYPHE EMARGINATA LONGIFRONS, COBBOLD. Fig. 22, Pl. 41.

Conocoryphe emarginata, LINNARSSON, var. *longifrons*, COBBOLD (1911), p. 286, Pl. 24, figs. 8–13.

From the number of fragments of cranidia referred to this species, it seems to have been as plentiful at Rushton as the associated *Dorypyge lakei.*

One [51705] of two nearly perfect cranidia is figured, as giving a rather better representation of the species than the fragments figured in 1911 (quoted above). This gives the proportion of length to width in the dorsal view more accurately than was then possible.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. groomi* Grit.

MESONACIDÆ, WALCOTT.

CALLAVIA, MATTHEW.

This genus is well represented at Rushton in the Calcareous Beds near the summit of the Lower Cambrian, but always, as elsewhere in Shropshire, by fragments of detached parts of the shields, usually very friable. Among these there are probably two or more species awaiting description.

CALLAVIA CALLAVEI (LAPWORTH).

Olenellus callavei, LAPWORTH (1888), p. 484.——*Olenellus* (*Holmia*) *callavei*, LAPWORTH (1891), pp. 530–536, Pls. 14 and 15.——*Callavia callavei* (LAPWORTH), MATTHEW (1897), p. 397 (footnote).——WALCOTT (1910), p. 282, Pl. 13, figs. 1 and 2.——(?) *Callavia crosbyi*, WALCOTT (1910), p. 284, Pl. 28, figs. 1–8.

Further references to the occurrence of this species are included in WALCOTT (1910), and it is listed in COBBOLD (1921), pp. 370, 371, 379.

Dr. FRANK RAW has not completed his studies of this and cognate species, but has expressed the opinion that there is no difference between *C. crosbyi* and *C. callavei.* The writer is fully in agreement with this opinion, though we have only detached fragments to deal with.

Among the fragments from Rushton the more noticeable are, a glabella, three cheeks, a pygidium, and some of the innumerable portions of thoracic segments.

The cheeks exhibit the intergenal spine, the intra-marginal ridge and its connection with the edge of the doublure, and also, the line curving backwards from the anterior end of the eye towards the genal angle, recognized by KIÆR (1916, p. 70) in his species *Kjerulfia lata* and regarded by him as the trace of the anterior branch of the facial suture in symphysis.

The pygidium is of the same general type as others found at Comley, but can only be referred to this species with doubt.

Locality and Horizon.—Rushton, locs. 3 and 8.—Lower Cambrian, the *Callavia* Beds.

PARADOXIDÆ, EMMRICH.

PARADOXIDES, BRONGNIART.

PARADOXIDES BOHEMICUS SALOPIENSIS, COBBOLD. Figs. 1–3, Pl. 42.

Paradoxides bohemicus, var. *salopiensis*, COBBOLD (1913), p. 47, Pl. 4, figs. 9–17.

This variety was described in 1913 from fragments collected in 1892 from a calcareous band in shale near to loc. 7 in Cherme's Dingle. This band has not yet been identified.

In the collection from loose blocks (at loc. 3) a good cranidium [51710] and numerous other detached portions occur, and are here referred to the same species and variety. These permit of a few additions to the original description.

Cranidium :—

(i) In certain lighting two additional pairs of very short glabellar furrows are just discernible on the front lobe of the glabella. (ii) The anterior border is only slightly convex and in older individuals may be completely overlapped by the glabella. (iii) Facial suture : the anterior branch diverges from the eye as far as the interior limit of the marginal rim, which it cuts in a curved line directed more forwards ; the posterior branch is sigmoidal and short, cutting the margin a little farther out than the palpebral lobe. (iv) Apart from the raised lines on the margin of the cephalon and doublure the surface of the test appears quite smooth, but with strong magnification all the parts seen are covered with very low tubercles which appear also as depressions on the interior. (v) The relative length and width of the palpebral lobe does not seem to diminish with growth ; it is clearly larger than in the Bohemian form.

The dimensions in millimetres and relative proportions of the cranidium are :—

		Proportion relative to total length.
Lengths.		
Cranidium	26	1·00
Chord of palpebral lobe	11	0·42
Occipital ring	4	0·15
Widths.		
Across anterior sutures	36	1·38
,, posterior sutures	40	1·55
,, palpebral lobes	36	1·38
Of anterior glabellar lobe	20	0·77
Of occipital ring	13	0·50

Hypostoma [51710] fig. 2, Pl. 42. Some half-dozen fragmentary hypostomas are found in the various portions of the same loose block which provided the cranidium figured and are quite in accord with the Bohemian specimens.

Thorax. Numerous pleuræ with smooth surfaces are found in association, some almost certainly belong to this species, others are referred with reserve to *P. œlandicus* or *P. groomi*.

Pygidium. Fig. 3, Pl. 42. The specimen [51711] is an exfoliated exterior with a very thin test (0·025 mm.) and in general form obviously like that figured by Barrande (1852, Pl. 10, fig. 22) for *P. bohemicus*, Boeck.

The axial lobe is obscurely divided into six rudimentary segmental rings (apart from the articulating facet). The first of these is clearly marked, the others are only indicated by incipient furrows impressed at the sides of the lobe. All these rings bear two weak depressions, one on each side of the axial line, analogous to the "scars" shown by Matthew (1884, p. 101, fig. 5) and hypothetically referred by him to "points of attachment of limbs." The pleural lobes are very flat, have a strongly marked pleural furrow anteriorly and only weak indications of the posterior segments.

Surface.—Minutely tubercular.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from a loose block of calcareous grit.

PARADOXIDES FORCHHAMMERI, Angelin. Figs. 7, 8, Pl. 42.

Paradoxides forchhammeri, Angelin (1854), p. 2, Pl. 2.——Brögger (1878), p. 37, Pl. 1, and Pl. 2, figs. 7–10.——Grönwall, 1902, p. 112.

As with other species of the genus, the presence of *P. forchhammeri* is determined from fragmentary material, belonging to many portions of the dorsal shield.

The sculpture on the fragments has the same characters as those shown in Brögger's figure on his Pl. 1.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

PARADOXIDES cf. *GROOMI*, LAPWORTH.

Paradoxides groomi, LAPWORTH (1891), p. 532 (footnote).——(COBBOLD), 1911, p. 283, Pl. 23.

P. groomi was described from detached fragments, associated together in the calcareous portions of a conglomeratic grit. A few fragments have been found in similar material at Rushton in association with many others referred to *Dorypyge*, *Conocoryphe*, etc., and in the same method of agglomeration.

The fragments indicate a large species of *Paradoxides* with a very smooth test and terrace lines on the doublure like those figured for *P. groomi* (COBBOLD, 1911, Pl. 23, figs. 5 and 7), but until further evidence is forthcoming it can only be said that the species is probably present.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, the *P. groomi* Grit.

PARADOXIDES HICKSI, SALTER.

Paradoxides hicksi, SALTER (1866), p. 285.——SALTER AND HICKS (1869), p. 55, Pl. 3, figs. 1–10.——LINNARSSON (1883), p. 14, Pl. 3, figs. 1–5.——COBBOLD (1913), p. 47, Pl. 4, figs. 1–5.——ILLING (1916), p. 428, Pl. 36, figs. 1–7.

No further specimens of this species have come to light in Shropshire since 1913, when those now noted were fully described.

Locality and Horizon.—Rushton, loc. 7.—Middle Cambrian, from the *P. hicksi* Limestone in Cherme's Dingle.

PARADOXIDES cf. *ŒLANDICUS*, SJÖGREN. Figs. 4–6, Pl. 42.

Paradoxides œlandicus, SJÖGREN (1872), p. 72, Pl. 5, fig. 1.——LINNARSSON (1877), p. 3, Pl. 1, figs. 1–6.——STRAND (1929), p. 350.——Cf. also *Paradoxides pinus* HOLM *in museo*, STRAND (1929), p. 350.

The evidence for the presence of this species in the Rushton area is cumulative and depends upon a number of fragments of detached portions of the dorsal shield, with characters both of shape and surface in complete agreement with LINNARSSON's figures and descriptions. The reference to SJÖGREN's species cannot, however, be regarded as certain, owing to the fact that *P. pinus*, HOLM MS., and *P. œlandicus* are very much alike, only differing at all clearly in the number of thoracic segments and in the shapes of the pygidia. The two species are found in the same horizon at Borgholm, in the Isle of Œland, Sweden, and also at Roykensie, in Norway (Mjösen district).

Dr. WESTERGÅRD was kind enough to send photographs of the two species, and also specimens of *P. œlandicus* from the type locality. The latter are now deposited in the British Museum (Nat. Hist.) at South Kensington (Nos. In 28393–28398).

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose block containing the *P. bohemicus salopiensis* Fauna, and loc. 8, from the *P. groomi* Grit.

PARADOXIDES TESSINI, BRONGNIART. Fig. 11, Pl. 42.

Paradoxides tessini, BRONGNIART (1822), p. 31, Pl. 4, fig. 1.——ANGELIN (1854), p. 1, Pl. 1, figs. 1–3.——BRÖGGER (1879), p. 43, Pl. 2, fig. 6, and Pl. 4, fig. 9.——LINNARSSON (1879), p. 5, Pl. 1, figs. 1–4, and (1882), p. 10, Pl. 1, figs. 1–13.——GRÖNWALL (1902), p. 103, Pl. 4, fig. 26.——STRAND (1929), p. 349, Pl. 2, figs. 1–4.

The internal impression of a nearly complete cranidium [51787] from sandy shales is the sole evidence from Rushton for this species. Fragments of pleuræ occur in association, but they are too poorly preserved to be of any use.

The shale occurs at loc. 9, immediately under the *P. forchhammeri* Grit; *Liostracus bruno*, sp. nov. occurs plentifully in association with the *Paradoxides*.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *Liostracus bruno* Shale.

PARADOXIDES sp. indet. A. Fig. 9, Pl. 42.

Cf. *Paradoxides*, sp. indet. No. 2, GRÖNWALL (1902), p. 121, Pl. 2, fig. 9.

The two pygidia [51786 and 51788] used in drawing fig. 9 seem to indicate an undescribed species. They have a general resemblance to one from Comley figured in COBBOLD (1911), Pl. 24, fig. 18 (not fig. 17), and there referred (p. 285) to *P. davidis*, SALTER as possibly belonging to a young individual.

Description.

A semi-elliptical shield nearly as wide as long, maximum width near the anterior end and with a deep notch in the posterior border. Axial lobe:—gently convex, parabolic, rather more than half the length of the shield, divided into two portions and the articulating facet, anterior portion a definite axial ring, posterior portion elongate, sub-triangular, of gentle convexity and having a somewhat flattened, triangular space anteriorly. Pleural lobe:—nearly flat, with edges turned down, but without any indication of a pleural rib along the anterior and side borders, elongated backwards into two cusps between which the border is deeply emarginate. Test smooth, very finely granular and very thin, thickness about 0·01 mm., (?) young.

Compared with *P. davidis* adult, these pygidia are wider anteriorly and the notch is far deeper. They differ from the figured specimen from Comley in the absence of any pleural rib, in being widest anteriorly and in other relative proportions. In general shape they are more like the pygidium of *P. rugulosus* CORDA, which, however, is constricted in width anteriorly, is much less deeply notched, and has the end of the axial lobe resting on a cushion-like swelling of the pleural lobes.

Dimensions in mm.	[51786].	[51788].	The Comley specimen.
Length of shield	5·7	4·8	7·0
,, axial lobe	3·4	2·2	3·4
,, notch	1·8	1·7	1·5
Width, maximum	5·3	4·0	6·0

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. forchhammeri* Grit.

Since fig. 9 was drawn, the specimen has been much damaged posteriorly.

There is some similarity to GRÖNWALL'S *Paradoxides* sp. indet No. 2, from the *P. forchhammeri* Zone at Borregaard, in Bornholm; our form, however, is narrower anteriorly.

PARADOXIDES sp. indet. B. Fig. 10, Pl. 42.

Two examples of a free cheek, which cannot be identified specifically, occur in the material from the *P. forchhammeri* Grit.

It is at first sight exceedingly like that figured in 1913 for *P. bohemicus salopiensis,* and the doubt arose whether the species ranged through from the *P. œlandicus* to the *P. forchhammeri* Zone.

Description.

The figured specimen [51716] shows both branches of the facial suture, the whole of the curve of the eye and the postero-lateral border, but the genal angle is missing.

The cheek is very flat, with a narrow convex lateral border separated by a hollow from an intra-marginal ridge, and has a very low, flat and narrow posterior margin, only visible in certain lighting. The curve of the eye is approximately a quadrant of a circle, and the chord of the arc is a very little greater than half the length of the cheek measured between the two ends of the facial suture. The anterior branch passes outwards in a sinuous curve from the eye to the lateral margin, the posterior branch takes a similar course and cuts the posterior border at an angle of less than 45°. Test :—The surface under an ordinary hand lens appears uniformly and finely granular, under a microscope it is seen to be very delicately shagreened with a sort of broken down network of raised lines. Thickness, approximately 0·04 mm.

The principal differences, so far as seen, between this cheek and that of *P. bohemicus salopiensis* are found in the relatively narrower marginal fold, the surface character of the test, which in *salopiensis* is covered with low tubercles, and possibly, in the curvature of the eye.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *Paradoxides forchhammeri* Grit.

OLENIDÆ, BURMEISTER.

Very many detached cranidia, free cheeks, thoracic segments and occasional pygidia were found in the loose blocks of black bituminous limestone from Dryton Brook, loc. 12. The writer desires to acknowledge with much gratitude the very great help he received from Dr. C. J. STUBBLEFIELD in his examination of this material, which was very difficult, owing to the mixture of species present and the nature of the rock.

LEPTOPLASTUS, ANGELIN.

LEPTOPLASTUS RAPHIDOPHORUS, ANGELIN. Fig. 18, Pl. 45.

Leptoplastus raphidophorus, ANGELIN (1854), p. 47, Pl. 26, fig. 2.——WESTERGÅRD (1922), p. 143, Pl. 8, figs. 13–17, Pl. 10, figs. 2 and 3.

This species is well represented in Block " D " by many cranidia and free cheeks in good preservation, one fairly good thoracic segment and two damaged pygidia. Two very indifferent free-cheeks are recognized from Block " A."

EURYCARE, ANGELIN.

EURYCARE ANGUSTATUM, ANGELIN. Figs. 7, 8, Pl. 45.

Eurycare angustatum, ANGELIN (1854), p. 48, Pl. 26, fig. 5.——(?) BRÖGGER (1882), p. 149, Pl. 12, fig. 3.——PERSSON (1904), p. 517, Pl. 9, figs. 9–13.——WESTERGÅRD (1922), p. 150, Pl. 10, figs. 4–7.——POULSEN (1923), p. 31, Pl. 1, figs. 9 and 10.——STRAND (1929), p. 358.——STUBBLEFIELD (1930), p. 58.

Many specimens referred to this species occurred in Blocks " A," " C," and " D."

As will be seen if the figures are compared, the cranidia are very like those of *Ct. flagellifera angusta* and unless well exposed it is difficult to make certain of identification.

CTENOPYGE, LINNARSSON.

CTENOPYGE FLAGELLIFERA (ANGELIN). Figs. 16, 17, and 15*b* (?). Pl. 45.

Sphærophthalmus flagellifer, ANGELIN (1854), p. 49, Pl. 26, fig. 7.——LINNARSSON (1880), p. 142, Pl. 5, figs. 14–17.——*Ctenopyge flagellifera* (ANGELIN), WESTERGÅRD (1922), p. 152, Pl. 10, figs. 19–23, and Pl. 11, fig. 1.——POULSEN (1923), p. 38, Pl. 1, figs. 12 and 13.——STUBBLEFIELD (1930), p. 58.

This form of *Ctenopyge* is not so abundant in the collection as the variety *angusta*.

It is characterized by its relatively narrow glabella and wide fixed cheeks. The free cheeks have the genal spine projecting at, approximately, right angles to the margin, and in advance of a transverse line drawn through the eye.

Var. *ANGUSTA*, WESTERGÅRD. Figs. 14, 15*c* and *d* (?). Pl. 45.

Ctenopyge flagellifera angusta, WESTERGÅRD (1922), p. 153, Pl. 11, figs. 2–8.——POULSEN (1923), p. 39.——STUBBLEFIELD (1930), p. 58.

This variety is more abundant in the loose blocks than any of the other forms. The cranidia are principally distinguished by the relative wideness of the glabella and narrowness of the fixed cheeks.

In the many detached free cheeks the difference lies in the position at which the long curved spine springs from the margin. In ANGELIN'S form it is much farther forward than it is in *angusta* ; also the posterior branch of the facial suture cuts the margin in ANGELIN'S form farther away from the eye than it does in *angusta*, giving it a more sinuous course.

CTENOPYGE DRYTONENSIS, sp. nov. Figs. 9, 15*a*, 19. Pl. 45.

At first this form was taken to be another variety of *Ct. flagellifera* (ANGELIN), but on closer study it seems necessary to give it a different specific name.

Holotype, a well-preserved cranidium, No. [51776].

Paratypes, cranidia [51773, Pe 2473 A, B, C, Pe 2441 A, Pe 2426 A].

This species is closely related to ANGELIN'S, but differs in having a relatively longer glabella, a more expanded front and a generally flatter extent of fixed cheek. Only cranidia are known.

Description.

Cranidium. General form :—trapezoidal with emarginate sides, front border transverse (sometimes a little emarginate), with rounded lateral angles, moderately convex.

Glabella :—convex transversely and longitudinally, tapering decidedly to its rounded extremity, sides approximately straight, three pairs of furrows, anterior pair very short, median pair extending transversely on each side to one-fifth of the glabellar width, the posterior pair oblique and extending to about one-third of the same width, all deeper at their inner ends. Occipital furrow :—rather wide, deep at the sides, shallow across the axial line. Occipital ring :—rather wider than the glabella, of fairly uniform breadth, curved backwards in the dorsal view, centrally provided with the narrow elongated base of a delicate spine (usually broken) which projects nearly horizontally backwards. Dorsal furrow :—neither deep nor wide but clearly marked at sides and front of the glabella, tangential to the side of the intra-marginal furrow, but not actually merging with it. Front :—considerably arched up in the middle, no preglabellar field, intra-marginal furrow straight and transverse in the dorsal view, curved concave forwards when the cranidium is tilted forwards, making a fairly sharp line at the bottom ; marginal rim transverse, high in the middle, forming the anterior slope of the furrow and sharply folded over, almost angular at the edge. In the holotype it is seen (at a fracture) to descend into the rock to as low a point as the bottom of the furrow. Fixed cheek :—flat opposite the palpebral lobe, rising a little towards its outer limit and falling again into the palpebral furrow ; anteriorly falling in a gentle slope from the palpebral ridge to the intra-marginal furrow but becoming a little more convex towards its lateral curved margin ; posteriorly convex and descending with increasing curvature to the posterior border ; spreading out behind the eye into a sub-triangular lateral projection. Palpebral lobe, ridge, and furrow :—lobe—rarely preserved, crescentic, raised at the edge, rather small, situated a little behind the mid-length of the cranidium (length about 0·7 of the shield) ; ridge—taking a straight course obliquely backwards, very obvious and having a triangular cross-section, it is not a flat band ; furrow distinct but narrow. Posterior border :—of small breadth proximally, distally expanding, set a little obliquely to the line of the occipital furrow, extending out to a distance a little greater than the width of the glabella, with a very small, low, but convex rim ; furrow shallow.

Facial suture :—anterior branch convex outwards from the eye to the intra-marginal furrow and then cutting the rim very obliquely ; posterior branch diverging outwards from the eye in a gently sinuous course to the posterior angle.

Test :—Very thin, less than 0·01 mm., smooth as seen under a lens, but under high power, microscopically granular, the granules having an angular appearance, like sharp dust.

Approximate Dimensions in mm.	Holotype [51776]	Paratypes.	
		[Pe 2473].	[Pe 2441].
Length of cranidium excluding spine	3·80	2·50	3·75
Length of glabella	2·00	1·90	2·50
,, front	1·00	0·40	0·80
,, occipital ring, excluding spine	0·80	0·25 (?)	0·50
Width of glabella, at base	2·25	1·40	2·50
,, opposite eyes	2·00	1·25	2·25
Width of cheek, opposite eye	1·25	0·80	1·25
Width across posterior angles	6·50	4·00	7·00 (?)

Remarks.—The holotype appears to represent Barrande's *forme longue,* the two measured paratypes, his *forme large.*

On comparing this species with WESTERGÅRD's figures and descriptions, it appears that almost every point mentioned is found in one or other of the Swedish species, but not together.

SPHÆROPHTHALMUS, ANGELIN (?)

SPHÆROPHTHALMUS (?) *PARABOLA* sp. nov. Figs. 11–13, Pl. 45.

This species cannot be definitely placed under ANGELIN's or any other genus, but is described specifically, for it is very prevalent in the fauna from the loose blocks in Dryton Brook. Only cranidia are known with certainty, and they vary somewhat in minor details.

Holotype.—Cranidium [51778].

Paratypes A [51779] ; B [51780].

Description.

Cranidium.—General form :—trapezoidal, front transverse and of little breadth, sides emarginate behind the palpebral lobe, otherwise convergent forwards, posterior margin transverse, convexity strong especially in the glabella. Glabella :—tapering gently forwards, sometimes with almost straight sides to the rounded end, more frequently they make a parabolic curve, especially noticeable when the anterior end is partly covered with matrix ; very convex both transversely and longitudinally, apex reaching down to touch, or almost touch, the intra-marginal furrow, from which it is seen, in both side and front views, to rise almost vertically. Two pairs of furrows, the posterior pair oblique, weak at the dorsal furrow and deepening to an irregularly oval pit at about two-fifths of the glabella width, and connected across the centre line by a very shallow extension, not to be detected in every specimen, and due to the dragging down of the side slopes of the pits; the anterior pair very short, weak, and sometimes absent, penetrating the glabella on each side for not more than one-fifth of its width and ending in a similar pit more or less distinct. Occipital furrow :—well marked all across, but shallow at the dorsal furrow and across the middle, sinking on either side to an elongated irregular hollow which is situated, approximately, on the same straight line with that joining the pits in the glabellar furrows. Occipital ring :—as wide as the base of the glabella, convex backwards, the margin appearing in the dorsal view more convex than the furrow, having a tubercle-like prominence on its posterior half sometimes showing beyond the margin as a very short spine. Dorsal furrow :—narrow but distinct round the sides and end of the glabella, where it almost touches the bottom of the intra-marginal furrow. Front :—preglabellar field practically absent :—intra-marginal furrow shallow :—marginal rim distinctly raised above the furrow, but to a very small height; in the front view it is considerably arched from side to side over a distance about equal to the width of the glabella, and it is continued right and left to half the width of the cheeks. Fixed cheek :—convex, especially so anteriorly where, like the glabella, it falls steeply into the marginal furrow, about half as wide as the glabella opposite the eye, widening out behind it to equal the full glabellar width, highest near the palpebral lobe. Palpebral parts :—lobe,—situate a little in advance of the mid-length of the cranidium, relatively rather large, prominent; ridge,—curving obliquely backwards from low down near the apex of the glabella, over the cheek to the palpebral lobe, often obsolescent;—palpebral furrow,—clearly marked, more or less parallel with the axial line. Posterior border :—commencing at the dorsal furrow opposite to the half-length of the ring, and running out transversely with a slight curve to the facial suture, furrow narrow, rim slightly raised and narrow. Facial suture :—anterior branch taking a nearly circular line from the eye to the intra-marginal furrow beyond which the same curve is continued cutting the rim obliquely; posterior branch, taking a sinuous, divergent course from the eye to the lateral angle which is distant from the dorsal furrow by about the glabellar width.

Test:—very thin, probably under 0·01 mm., only showing a fine microscopic granulation.

Dimensions in mm.	Holotype	Paratypes.	
		[51779]. A	[51780]. B
Total length	2·75	2·40	4·25
Length of glabella	1·75	1·75	2·50
,, front	0·40 (?)	0·15 (?)	0·75
,, occipital ring	0·60	0·50	1·00
Width of glabella at base	2·00	1·60	2·50
,, opposite eyes	1·90	1·50	2·40
,, cranidium across posterior angles (about)	6·00	5·20	7·00

The wide form appears to be represented by the holotype and paratype B; the narrow form by paratype A.

Locality and Horizon.—Rushton, Dryton Brook; loc. 12—Upper Cambrian, from loose blocks in the stream.

Remarks.—The distinctive features of these cranidia are (i) the strong curvature downwards of the front of the cheeks and glabella, making in the dorsal view three parallel and sub-equal rotundities; (ii) the posterior glabellar furrows with their enlargements and the tendency they show to being weakly connected across; (iii) the parabolic outline of the glabella, which is so apparent when partially covered with matrix, even in those specimens which, after preparation, have the sides approaching parallelism; (iv) the short length occupied by the front margin.

Most of these are features seen in *Sphærophthalmus*. On the other hand, the eyes are too far forward for this genus, and the posterior border of too wide an extent.

There is some resemblance to *Leptoplastus*, as Dr. STUBBLEFIELD kindly suggested, in the wide convex glabella, the more anterior position of the eyes, the slightly raised marginal rim and its width, but *Leptoplastus* is generally less convex and has fixed cheeks which are narrow opposite the eyes.

Ctenopyge flagellifera and its varieties with which it is so intimately associated are also flatter forms, with a wider posterior border and a more elevated front margin.

Before the front margin was cleared up this species seemed to be a link between both the above-mentioned genera and the later one *Bœckia*, chiefly because of the apparent absence of an upturned margin. The large glabella and supposed extension of the suture to the mid-line had raised this suggestion.

Whether *S.* (?) *parabola* should be allowed to remain under *Sphærophthalmus* is an open question. There is no pygidium in the collection suggestive of that genus, and only a few doubtful free cheeks.

FREE CHEEKS. Figs. 7, 14, 16, and 10. Pl. 45.

EURYCARE, CTENOPYGE, SPHÆROPHTHALMUS (?)

Owing to the number and mixture of species in the loose blocks it has been impossible to identify the free cheeks satisfactorily. They are beautifully preserved, but very fragmentary and most difficult to prepare.

Specimen [51781] (fig. 14) is probably an example of *Ct. flagellifera angusta* WESTERGÅRD. The spine is curved in two planes; it rises a little at first and then turns gently down till the broken end is well below the plane of the margin. Specimen [51770] (fig. 16) is referred to *Ct. flagellifera* (ANGELIN).

Specimen [51774] (fig. 7) is probably an example of *Eurycare angustatum*, ANGELIN.

Specimen [51777] (fig. 10) is the nearest approach we have to *Sphærophthalmus*. It is somewhat like WESTERGÅRD's figure (1922, Pl. 13, fig. 12) of the cheek of *Sph. major* LAKE, but it is not that species, for the eye is too far advanced.

LIOSTRACUS, Angelin.

In dealing with a number of detached and often fragmentary cranidia, the writer has found the following criteria useful in the discrimination of those that should be referred to this genus.

(i) A prominent glabella, with sides more or less parallel.
(ii) Cheeks which are decidedly convex and descend all the way from the edge of the dorsal furrow.
(iii) Facial sutures more or less parallel with the axial line anteriorly and diverging moderately posteriorly.
(iv) A very thin test, appearing smooth to the unaided eye, but seen under strong magnification to be thickly strewn with minute pits even in the furrows.
(v) The aspect in a side view, mentioned by Lake (1931, p. 145) of the glabella appearing to rest upon the cheeks, not sunken between them.

LIOSTRACUS BRUNO, sp. nov. Figs. 10, 11, and (?) 12, 13. Pl. 42.

This name is proposed for some very well-preserved cranidia from the calcareous bed of the *P. forchhammeri* Grit at Rushton.

Holotype [51794].	Cranidium	from	limestone.
Paratype A [51728].	,,	,,	,,
Paratype B [51729A].	,,	,,	shale,
Paratype C [51729B].	,,	,,	,,

Description.

Only Cranidia are known.

Cranidium.—General form :—trapezoidal with well-rounded front, converging sides, and base emarginate on either side of the occipital ring ; moderately convex, greatest height at about one-quarter of the length of the glabella from its base. Glabella :—also trapezoidal, rather more than half the total length of the cranidium, width at base less than the length, sides nearly straight and tapering distinctly, the anterior width about three-quarters of that at the base ; apex bluntly rounded, with three pairs of oblique, obsolescent furrows, not always visible, surface declining longitudinally from the highest point in a gentle curve to the depressed apex and posteriorly to the occipital furrow, evenly and gently curved laterally from furrow to furrow. Occipital furrow :— of fairly even width and depth, straight and transverse, steep-sided towards the glabella less so towards the occipital ring. Occipital ring :—length one-quarter of its width, posterior border evenly convex backwards, surface rather convex in both directions with an obsolescent raised node at the centre. Dorsal furrow :—wide, not deep, continuous round the apex of the glabella, where it forms a little horizontal shelf or terrace. Front :—divided into two subequal parts by the line of change of curvature which represents the intra-marginal furrow, posterior portion gently convex downwards with no trace of division along the axial line, anterior portion gently concave up to its slightly raised edge, which becomes a little convex in the exterior of the shield, but appears quite sharp between the dorsal shield and the doublure in the interior; laterally cut off obliquely by the facial suture. Fixed cheeks:—gently convex, descending evenly from the dorsal furrow all round, coalescent in front of the glabella. Palpebral ridge, lobe, and furrow:—ridge, nearly straight, oblique, not always seen:—furrow, only marked by the change of curvature:—lobe, about one-third of the length of the glabella, projecting more or less at right angles to the surface of the cheek, with raised edge, situate a little behind the mid-length of the cranidium and distant from the glabella by about half the width thereof. Postero-lateral border:—extension outwards from the dorsal furrow about equal to or a little less than the width of the glabella, furrow narrow at first, but gradually widening laterally, margin a narrow, raised, rounded ridge taking a gently sigmoidal course, fairly evenly curved downwards to the end with no geniculation. Facial suture:—anterior branch straight forwards parallel with the axial line from the eye to meet the change of curvature and continuing in a bold curve obliquely across the flat or concave portion of the front, cutting the anterior edge at a point distant from the axial line by the half-width of the glabella at its base.

Test.—Thin (0·02 mm. or less), closely and regularly pitted in all parts visible, generally of a nut-brown colour. In the holotype there are signs of a very thin and partial secondary coating, blurring the impressed lines and sculpture.

Shale specimens.—A number of cranidia, referred here to this species, occur in a flattened and somewhat distorted condition in coarse sandy shale, one or two feet lower in the sequence than the limestone-preserved types. They are some 50% larger in linear dimensions, have a more tapering glabella and the anterior branch of the facial suture is somewhat divergent forwards. At first they were taken to represent a different species, but the divergencies in form may well be attributed to the flattening and, on comparison of the measurements given below, no material differences in the proportions of the parts were detected.

Dimensions in mm.	Holotype.	Paratypes.		
		A.	B.	C.
Length of cranidium	6·00	6·40	10·00	10·20
,, front	2·00	2·00	3·00	3·50
,, glabella	3·30	3·00	5·60	5·25
,, occipital ring	0·60	0·70	1·50	1·50
Width across anterior sutures	6·00	5·00	8·00	7·50
,, at posterior angles	8·00	7·70	?	?
,, of glabella at base	2·60	3·00	5·00	4·00

The holotype and paratype A are from limestone, the paratypes B and C from shale.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, typically from the *P. forchhammeri* Grit, also from shale immediately below.

LIOSTRACUS COMLEYENSIS, RUD. RICHTER.

Ptychoparia (*Liostracus*) *lata*, COBBOLD (1913), p. 38, Pl. 2, figs. 16*a*–17*c*.——*Liostracus comleyensis*, RUD. RICHTER (1919), p. 226.——LAKE (1931), p. 147, Pl. 18, figs. 11 and 12.

Three specimens [He 3294 (22), 3294 (43), 3294 (44)] with lengths of about 5·5, 4, and 1·2 mm. from the loose block yielding *P. bohemicus salopiensis*, are referred to this species, though they are more or less imperfect.

The test is not well preserved, under high magnification the two smaller specimens appear to be covered with a crystalline deposit. The largest appears to have had a secondary coating outside varying in thickness from place to place and with a smooth outer surface.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from loose block with the *P. bohemicus salopiensis* Fauna.

LIOSTRACUS DUBIUS (COBBOLD). Fig. 14, Pl. 43.

Ptychoparia (*Liostracus*) *dubius*, COBBOLD, 1911, p. 295, Pl. 25, figs. 19–21, and COBBOLD, 1913 *a*, p. 39, Pl. 3, figs. 19*a* and *b*.——*Liostracus dubius* (COBBOLD), LAKE, 1931, p. 148, Pl. 18, figs. 13 and 14.

This little species is found at Rushton with lengths from 1·3 to 5·5 mm., the second nearly twice as long as the largest from Comley. They retain the characteristics given in the description, and so far as this goes, it indicates that it is a good species. LAKE, in his notice of the species, remarks that it is not unlikely that this is the immature form of some other species and that it resembles *Liostracus comleyensis* R. RICHTER, rather than *L. pulchella* (COBBOLD), with which last the type specimens were associated.

The present specimens [51731] [Pe 2373 I] agree closely with the type and allow of one addition to the description. The test is preserved and is minutely pitted in specimens of all sizes.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

LIOSTRACUS (?) sp. indet, PYGIDIA. Figs. 15–17, Pl. 43.

Four pygidia that may belong to one or other of the species of *Liostracus* above mentioned are figured.

They appear to have about six pleural ribs weakly developed, the length is about half the width, the axial lobe is about two-fifths of the same width, the pleural furrows do not reach the margin, which is entire and turned down into the rock.

Fig. 17 [51734] is, apparently, a transitory pygidium of a meraspid stage.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian from the *P. forchhammeri* Grit.

AGASO, sub-genus of *LIOSTRACUS* Nov.

(Latin, *Agaso*, a jockey; in allusion to the shape in side view like a jockey's cap.)

Genotype.—*L.* (*Agaso*) *rushtonensis*, sp. nov.

Generic range and distribution.—Only known from the Middle Cambrian of Rushton, Shropshire (*Paradoxides forchhammeri* Grit).

Diagnosis.

(Only cranidia are known with certainty.)

Cranidium.—Trapezoidal, with rounded front, margined by a flat rim, from which the convex surface rises abruptly and sweeps in one unbroken curve to the occipital ring. Transversely, the surface takes a similarly continuous curve from side to side, only broken by the slight projection of the palpebral lobe, and, posteriorly, by a slight additional rise over the glabella. Dorsal and occipital furrows :—obsolescent externally, internally outlining the glabella more or less clearly. Fixed cheek :—about half as wide as the glabella. Facial sutures :—divergent from the eyes both backwards and forwards. Test :—pitted in all parts.

Remarks.—*Agaso* seems to stand in the same relation to *Liostracus* as that of the sub-genus *Blainia*, WALCOTT (1916 *b*), p. 393, to *Asaphiscus*.

The pits on the surface are similar to those seen in *Liostracus*, but less minute.

The study of these forms has suggested that they might be referable to either *Agraulos s.l.* or to *Asaphiscus*, or more closely to WALCOTT's sub-genus of the last-named *Blainia*, but with the exception of the extreme depression of the glabella, they agree best with *Liostracus*, especially with the species *L. bruno*, sp. nov., from the same calcareous bed.

LIOSTRACUS (*AGASO*) *RUSHTONENSIS* sp. nov. Figs. 2*a–d*, Pl. 45.

Holotype. An almost complete cranidium much exfoliated, numbered [51763].

Description.

(Cranidia only known.)

General form :—Trapezoidal with well-rounded front, rather strongly convex, with curvature almost continuous. Glabella :—semi-elliptical, sides practically parallel at base, curving forwards gently to the bluntly rounded end, boundary smoothed over on exterior, distinct internally, without furrows or central keel. Occipital furrow :—wide and shallow internally, barely visible externally. Occipital ring :—rather short continuing the curvature of the glabella, posterior border a semi-ellipse. Dorsal furrow :—barely visible externally, clearly marked on the interior, wide and shallow, continuous round the end of the glabella. Front :—pre-glabellar field convex downwards in continuation of the fixed cheeks :—intra-marginal furrow, none, only represented by change of curvature, which approaches 90°,—marginal rim a flat expansion with almost sharp edge gently arched from side to side in the view from the front. Fixed cheek :—convex, continuing the curve of the surface of the glabella, continuous round the end of the glabella, descending and extending out behind the eye to the posterior angle.

Palpebral lobe :—small, length about one-tenth of that of the cranidium, crescentic, depressed at the edge, situated low down on the cranidium and behind its mid-length. Postero-lateral border; with weak furrow and a relatively wide, low rim, expanding in breadth laterally, termination not seen, probably rounded. Facial suture :—anterior branch divergent and nearly straight to the rim which it crosses on an inwardly directed curve; posterior branch, curved convex outwards, cutting the margin at a distance from the dorsal furrow about equal to the width of the glabella.

Test :—thick, macroscopically smooth, under a strong lens the surface shows shallow pits at fairly regular intervals; these are best seen on the occipital ring and furrow of the holotype.

Dimensions of holotype in mm. :—

Total length	9·5
Width over anterior angles	12·5
,, palpebral lobes	10·0
,, posterior angles	12·5
Length of glabella	5·2
Width of glabella at base	5·0

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

LIOSTRACUS (*AGASO*) *POCOCKI* sp. nov. Figs. 3*a–d*. Pl. 45.

Holotype.—A well-preserved cranidium (damaged since the photograph was made) numbered [51764].

Description.

(Only cranidia are known.)

Cranidium.—General form :—trapezoidal, somewhat intermediate between *rushtonensis* and *pringlei*, with rounded front, possibly always smaller than either.

The glabella is parabolic rather than elliptical or tapering, and even more depressed than in the other two species; in the dorsal view the furrow can only be traced where a portion of the shell has come away; the margin of the occipital ring is more rounded, and it has a more distinct central node.

The test is pitted, the pits being smaller and more closely packed than in the other species; it is also less thick (0·02 to 0·04 mm).

Dimensions of the holotype in mm. :—

Total length	8·5
Width across anterior angles	9·0
,, over palpebral lobes	9·0
,, across posterior angles	12·0
Length of glabella	3·5
Width of glabella at base	3·5
Length of palpebral lobe, about	2·0

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

LIOSTRACUS (*AGASO*) *PRINGLEI*, sp. nov. Figs. 1*a–d*, Pl. 45.

(Named in honour of Dr. JOHN PRINGLE, who collected a large part of the fossils from the exposure.)

Holotype.—An exfoliated cranidium somewhat damaged at the sides [51762].

Paratypes.—Cranidia numbered [Pe 2326 E, Pe 2326 F].

Description.

(Cranidia only known.)

Cranidium.—In this species the glabella is more tapering than in the genotype, and its side-slopes meet at a rounded angle making a faint line, almost a keel, along the centre. In certain lighting two pairs of oblique glabellar furrows are just visible on the internal impression, in side view the angle at which the longitudinal curve rises from the marginal rim is quite obtuse, the palpebral lobes are situated more nearly at the mid-length; the postero-lateral borders are oblique to the transverse line of the occipital furrow; and the facial sutures seem to converge forwards more rapidly.

The test is not well preserved on the holotype, the paratypes show the pitting much more clearly.

Dimensions of holotype in mm.:—

Total length of the cranidium, about	12
Width at anterior angles (estimated)	11
,, over palpebral lobes	14
,, at posterior angles (estimated)	16
Length of glabella	7
Width of glabella at base	7
Length of palpebral lobe, about	3

Locality and Horizon.—Rushton loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

PYGIDIA (?). Figs. 4, 5, 6, Pl. 45.

There are three fragmentary pygidia [51763 and 51766] associated with the three forms of *L.* (*Agaso*), and also with the many species of *Solenopleura* and *Liostracus*, but they do not agree with the published figures and description of the pygidia of the last-named genera. They are therefore assigned with some confidence to *Agaso*, but, naturally, with reserve.

Two of these pygidia [51763] were lying one partly over the other and neither showed the full contour or number of ribs; by removing one it was possible to expose a complete half of the other and to gain a fairly clear idea of the axial lobe. From this a reconstruction of the whole pygidium has been prepared.

Description.

Pygidium.—General outline :—lenticular, twice as wide as long, anterior margin gently curved, posterior and side margins forming a segment of a circle, gently convex. Axial lobe :—convex, sides tapering slowly backwards to the blunt and slightly raised end at about one-fifth of the total length of the shield from the posterior border, divided into five convex rings including the terminal portion, by well-marked furrows (fig. 5). Pleural lobe :—divided by four well-marked and one weak pleural furrows into four rounded ribs and a half-rib at the anterior margin ; the furrows follow the curve of the margin, but with an increasing backward direction ; between the last two furrows there is a flat web-like connection, which is raised a little as it crosses the axial line. Margin turned down into the rock.

The pygidia vary somewhat in details and may represent different species.

All three specimens appear to be interiors or internal casts and consequently show no surface characters.

Dimensions.—Length 7, width 14, width of axial lobe about 2 mm.

These pygidia if they really belong to the cranidia (and no other species is found in the same rock to which they can reasonably be referred) introduce a new element into our English Middle Cambrian faunas. The tail being almost as large as the head is somewhat reminiscent of *Asaphiscus* of the North American Middle and Upper Cambrian.

SOLENOPLEURIDÆ, Angelin.

SOLENOPLEURA, Angelin.

SOLENOPLEURA ACADICA, Whiteaves, MS., var. *ELONGATA*, Matthew. Fig. 17, Pl. 42.

Cf. *Solenopleura acadica*, Whiteaves, Matthew (1887), p. 157 and Pl. 2, figs. 5*a* and 5*b*.——Var. *elongata*, Matthew (1887), p. 158, Pl. 2, fig. 6.——Grönwall (1902), p. 156, and Pl. 4, fig. 19.

In the collection from the loose blocks of *Paradoxides* bearing material (loc. 3), a cranidium and many fragments occur, which cannot be distinctly separated from that described by Grönwall from the Andrarum shales of Borregaard in Bornholm. They agree more closely with his description and figure than with those given by Matthew. In our specimen the glabella is one and a quarter times as long as it is wide at its base, instead of one and a half, as given by Matthew, in whose figure it is also more decidedly tapering.

In one point the specimen differs from Grönwall's description ; there is a very decided tubercle on the occipital ring rising almost as high as the glabella. Grönwall says the ring is " bred og flad uden nogen Tuberkel eller Pig," though in the reproduced photograph (his fig. 19) there is a dark spot in the middle (seen only with a lens) just where a tubercle would come. Matthew says of *S. acadica* that the ring is strongly elevated, and has a " small tubercle in the middle pointing upwards." Both authors speak of the cheeks as sloping down to the marginal rim and nearly meeting in front of the glabella, where, GRÖNWALL says, they are separated by a flat or weakly concave space. This is seen in our specimen.

The test in the Rushton specimen is thickly covered with rounded tubercle-like granulations which are smaller and distinctly separated on the glabella, but larger on the cheeks encroaching more on the interspaces, leaving pit-like hollows in the unoccupied corners; thus they are in agreement with MATTHEW'S description (cheeks "with strongly-pitted surfaces").

On a transverse section through the palpebral lobes, the glabella is a little narrowed and its width is almost exactly that of the cheek (including the palpebral lobe). Also at this section the cheeks attain their greatest height which is, however, much lower than that of the glabella.

In fig. 17 the anterior marginal rim and furrow have been restored, in outline, from the counterpart [51796].

Dimensions in mm. :—

Length of cranidium, about	7
Width, across anterior facial sutures, about	8
,, ,, palpebral lobes	9
,, ,, posterior sutures	11
Length of glabella	4·5
Width of glabella at base	3·6
Height of glabella above postero-lateral angles	3·0
Thickness of test	0·05

Beneath this on the interior there is a secondary coating of calcareous material of varying thickness from 0·25 mm. and upwards. No secondary coat has been detected on the exterior.

Locality and Horizon.—Rushton (loc. 3).—Middle Cambrian, from a loose block containing the *P. bohemicus salopiensis* Fauna.

SOLENOPLEURA (?) *ANGUSTIORA* sp. nov. Fig. 4, Pl. 43.

Holotype.—A well-preserved cranidium [51792]. It has some characters in common with *Solenopleura*, others seem to indicate another generic reference.

Paratype.—A less well-preserved cranidium [52865].

Description.

Cranidium.—General form :—quadrilateral rather than trapezoidal, with strongly-rounded front and two wing-like projections at the basal angles, convexity strong, features in good relief. Glabella :—moderately convex, tapering to its rounded extremity, highest at about one-third of its length from the base, declining forwards on a regular curve, having 3 pairs of furrows, with vague indications of a fourth pair close to the apex. Occipital furrow :—wide and deep. Occipital ring :—convex, margin elliptical, with low central node. Dorsal furrow :—wide, of moderate depth, continuous round the front of the glabella. Front :—a quadrant of a circle, one-third as long as the glabella ; pre-glabellar field :—approaching flatness with a trace of a dividing impressed line, intra-marginal furrow,—a wide rounded hollow without definite boundaries,—marginal rim extending at full breadth to a point opposite the half-width of the cheek, where it begins to be cut off very obliquely by the facial suture, convex, raised at the outer edge, and (as seen at the fracture) turned down into the matrix. Fixed cheek :—convex, strongly so towards the palpebral lobe, where it rises to a summit a little lower than the glabella but well above the dorsal furrow, falling anteriorly from the summit with a gentle declivity traceable to the preglabellar field, falling laterally with increasing declivity to the palpebral furrow and facial suture, and again with increasing steepness to the posterior border and to the wing-like extension behind the eye. Palpebral lobe, ridge, and furrow :—lobe,—very prominent with edge raised as high or higher than the summit of the cheek, length about a quarter of that of the glabella, situated behind the mid-length of the cranidium ; ridge,—only feebly indicated ; furrow,—exceedingly well marked. Postero-lateral border :—extending from the dorsal furrow a distance approximately equal to the width of the glabella, increasing in breadth to its rounded end, traversed by a broad open furrow and having a slightly-raised rim along its edge ; horizontal for a quarter of its extent, then curving down strongly, not angularly geniculated. Facial suture :—anterior branch slightly divergent as far as the marginal rim which it cuts very obliquely on a curve converging strongly, posterior branch very divergent from the eye, not well preserved.

Test :—thick, approximately 0·05 mm., surface closely pitted all over, even in the furrows ; the pits are of very irregular shape not rounded, the interspaces form an irregular, raised net-work, there are no tubercles.

Dimensions in mm. :—

Length	5·7
Maximum width across anterior sutures	5·6
,, ,, over palpebral lobes	5·5
,, ,, across posterior angles, about	8·3
Length of glabella	3·3
Width of glabella at base	3·0

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—This species is at once separated from others of the genus *Solenopleura* by the large front, by the backward position of the eyes, by the character of its sculpture and by the relatively great width of the postero-lateral border with its accompanying extension of the fixed cheek. Comparison may be made with *S. arenosa,* BILLINGS, and MATTHEW's variety *angilimbata* (1897), pp. 182 and 183, Pl. 4, fig. 10, and Pl. 3, fig. 13. MATTHEW's descriptions of these forms are not so clear in detail as usual ; his figures, however, so far as they go, indicate a species with a more transverse anterior margin, greater relative width of the fixed cheek and less width of posterior margin. Another species, *S. communis*, BILLINGS, as figured by MATTHEW, p. 155, figs. 4*a–e*, is narrow across the eyes and has the wing-like posterior extension of the fixed cheek very broad behind the eyes (as well as occupying a greater relative width of cranidium) due to the advanced position of the eyes, to which BILLINGS (1861, vol. 2, p. 72), calls attention in his description; in this he also describes the sculpture as consisting of "a few scattered tubercles just visible to the naked eye" with finer "numerous minute tubercles" between them.

Whether these species (and others) with close-set eyes should remain under ANGELIN'S genus cannot be determined without more information as to the whole dorsal shields.

SOLENOPLEURA APPLANATA (SALTER). Fig. 1, Pl. 43.

Conocoryphe applanata, SALTER (1865), p. 285.——SALTER and HICKS (1869), p. 53, Pl. 2, figs. 1, 2, 4, 5, 6.——*Solenopleura applanata*, SALTER, ILLING (1916), p. 432, Pl. 37, figs. 8 and 9.——NICHOLAS (1916), p. 463, Pl. 39, figs. 8 and 9.——LAKE (1931), p. 130, Pl. 17, figs. 2–12.

The writer submitted the Rushton specimen to Mr. PHILIP LAKE, who very kindly examined it critically, and identified it as *S. applanata*, to which species it is now confidently referred.

Hitherto *S. applanata* has only been known to the writer from shale, the present specimen is from a calcareous grit, and exhibits its full natural convexity.

The dimensions of the cranidium [51722] in mm. are :—

Length	5·7
Width across anterior sutures	5·5
,, at posterior angles . . . ca.	9·0
Length of glabella	3·3
Width of glabella at base	3·0

The test appears to be 0·05 to 0·06 thick.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

SOLENOPLEURA BRACHYMETOPA (ANGELIN), and var. *NUNTIA*, GRÖNWALL. Fig. 2, Pl. 43.

Aulacopleura brachymetopa, ANGELIN (1854), p. 27, Pl. 19, fig. 1. —— *Solenopleura brachymetopa*, ANGELIN var. *alutacea*, BRÖGGER (1879), p. 51, Pl. 3, fig. 8. ——*Solenopleura brachymetopa*, ANGELIN. GRÖNWALL (1902), p. 153, Pl. 4, figs. 14 and 15. —— var. *nuntia*, GRÖNWALL, *id.*, p. 154, Pl. 4, figs. 14 and 14*a*. ——STRAND (1929), p. 352.

Several cranidia referable to this varying species have been found in the *P. forchhammeri* Grit, excellently preserved as to test and convexity, but too fragmentary to identify with certainty. GRÖNWALL'S var. *nuntia* is probably present as well as the type form. The specimen figured is very convex, has small palpebral lobes, a rather long glabella, and contrasts well with *S. applanata* figured on the same plate.

The thickness of the test is about 0·10 mm.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

SOLENOPLEURA cf. *BUCCULENTA*, GRÖNWALL. Figs. 18*a* and *b*, Pl. 42.

Solenopleura bucculenta, GRÖNWALL (1902), p. 152, Pl. 4, fig. 18.

Two specimens, which are counterparts [51720, 51721], are found in the collection, both are defective in the marginal rim and elsewhere. Notwithstanding the defects they agree with GRÖNWALL's description, except that no larger grains have been detected on the test, the whole surface appears to have a microscopic granulation, well seen on the cheeks and neck ring of the external impression. In the exterior (fig. 18*a*) the glabella shows the sculpture well, notwithstanding its polished aspect to the naked eye. The marginal rim rises steeply from the intra-marginal furrow, but is not seen to turn down into the rock. If it does so, the doublure must be almost in contact with the rim and the edge quite sharp. The thickness of the test is about 0·05 mm.

Approximate dimensions in mm. :—

Length about	6·00
Width across anterior facial sutures	5·00 (?)
,, over palpebral furrows	6·00
,, at posterior border	8·00
Length of glabella	3·80
Width of same at base	3·80
Length of front	1·20

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

GRÖNWALL says his species stands very near to *S. brachymetopa*, but has a longer and narrower glabella.

SOLENOPLEURA RUSHTONENSIS sp. nov. Figs. 12–14 and (?) 15–16, Pl. 42.

The material consists of many detached cranidia preserved in limestone; three pygidia and a free check are referred, with reserve, to the species.

Holotype.—Cranidium [51717]. Paratypes.—[51789, 51718].

Description.

Cranidium.—General form :—trapezoidal, nearly twice as wide as long, sides inclined to the base at an angle of about 60°; convexity strong, glabella and cheeks very prominent. Glabella :—width of base and length equal, each about half the length of the cranidium, anterior width about half that of the base, sides nearly straight, apex rounded, greatest height at about one-quarter of the length from the base, surface sloping down on either side and joined along the axial line by a curve of short radius, three pairs of weak furrows, with sometimes the trace of a fourth quite near the apex, all are oblique and do not meet at the centre line, the ends of the most posterior pair are separated by about one-fifth of the glabellar width. Occipital furrow :—straight, transverse, well defined, deep at the sides. Occipital ring :—with circularly curved margin, convex, with a strong tubercle rising as high as the glabella, a little behind the mid-length. Dorsal furrow :—well impressed, continuous round the front of the glabella and lying in the bottom of the deep valley at the sides. Front :—wide, very slightly convex forwards, consisting of the marginal rim, which is rather narrow and slightly raised ; intra-marginal furrow, also narrow ; and the pre-glabellar field which descends from the glabella in a gently convex slope. Fixed cheek :—strongly convex, highest opposite the anterior end of the palpebral lobe, where it is nearly as high as the glabella on the same transverse line, falling rapidly to the palpebral furrow, less rapidly towards the glabella ; gently towards the intra-marginal furrow and the posterior border ; expanding out behind the eye to the suture, and anteriorly inwards to meet in the pre-glabellar field. Palpebral lobe, ridge, and furrow :—lobe,—rather large for the genus (one-fifth of the length of the glabella), very prominent and set almost at right angles to the slope of the cheek, so that its outer edge is about level with the contiguous summit of the cheek ; ridge,—very weak, oblique ; furrow,—very distinct. Postero-lateral border :—margined with a narrow convex rim, horizontal for about half its length, whence it falls at a fairly even slope to the end ; furrow, almost on the same transverse line as the occipital furrow, widening gradually to be almost flat at the rounded end. Facial suture :—anterior branch diverging a little from the eye in a gentle curve convex outwards to meet the intra-marginal furrow, it then turns inwards to cut the rim obliquely and reaches the margin at a point distant from the axial line by about half the maximum width of the glabella ; posterior branch sigmoidal, diverging far outwards.

Test :—very thick, varying from 0·06 to 0·10 mm. Surface :—very finely granular, rough, very adhesive to the matrix ; internal impression also appearing granular.

Dimension in mm.	Holotype. No. 51717.	Paratypes.	
		No. 51789.	No. 51718.
Length of cranidium	13·50	13·50	10·80
,, front	c^a 4·00	c^a 3·50	2·50
,, occipital ring	c^a 2·50	c^a 3·00	2·80
,, glabella	7·50	7·50	6·50
Width of glabella, at base	7·20	7·00	5·90
,, front at furrow	12·40	?	9·50
,, front at extreme margin	7·00	?	5·20
Width between palpebral furrows	12·50	12·00	11·80
,, at posterior border	24·00	23·50	16·80
Length of palpebral lobe	3·00	2·70	3·00

Free cheek (?), figs. 15*a* and *b*.

This free cheek seems to fit either of the specimens represented in figs. 13 or 14 very well and was found in the same block of calcareous grit. In fig. 15*a* it is photographed as it lies in the rock; that is, obliquely to a dorsal view of the complete cranidium. In fig. 15*b* it has been tilted on its margin until that appeared to be level, giving approximately the dorsal aspect when in place.

The test is of the same character as that of the cranidia.

Thorax unknown.

PYGIDIUM (?). Fig. 16, Pl. 42.

The pygidium figured occurs about 1 inch from the cranidium (fig. 14 of the same plate) and in the same bedding plane, this association, in a part of the rock not crowded with fossils, makes it very probable that it belongs to the same individual and the characters of the test are in agreement.

Two or three other examples of the same pygidium from the same rock occur in the collection.

Description.

Pygidium.—General form:—transverse, more than twice as wide as long, somewhat convex. Axial lobe:—convex, occupying one-third of the width, tapering slowly backwards to its bluntly rounded end which does not quite reach the posterior margin, having about six divisions (excluding the articulating surface) clearly marked anteriorly, less distinct posteriorly. Pleural lobes:—about as wide as the axial lobe, with four well-marked ribs and two or three more weakly indicated posteriorly; these all follow the curvature of the anterior marginal rib, which is transverse for about one-third of its length, then curved backwards and (distally) downwards. Margin:—entire, without a rim, its edge forming a sub-circular arc.

Dimensions:—Length, 4·1 mm.; width, 10·0; length of axis (articulating facet excluded), 3·0; width of axis, 3·1 mm.

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from a loose block yielding the *P. bohemicus salopiensis* Fauna.

Remarks.—The cranidia are easily recognized by the convexity of the cheeks, by the sub-triangular form of the glabella, and by the way in which the test adheres to the matrix.

When compared with other described species, it is difficult to determine to which it is nearest.

Possibly its closest relation is *S. acadica,* WHITEAVES, but, looking at MATTHEW'S earliest figure (1885, p. 71, Pl. 7, fig. 15), the glabella of our form seems much too triangular, the eyes too large, and too far back, and the marginal rim has no pronounced increase in breadth in front of the glabella.

In 1887 MATTHEW published (Pl. 2, fig. 5), further figures of WHITEAVES' species; in these the glabella is rather more triangular, the eyes too far out to agree with

S. rushtonensis, and he shows no additional breadth in the middle of the marginal rim. Turning to the accompanying description, which is given in some detail, there are many points in which it might have been written for our form. The only feature in disagreement being " eye lobe short " ; but the relative width of fixed cheek at the eye is not stated nor is any reference made to the presence or absence of a backward thickening in the middle of the marginal rim.

Our form is also near to *S. holometopa*, ANGELIN (see GRÖNWALL (1902), p. 155, Pl. 4, figs. 20, 21), from which it apparently differs considerably in the glabella, in the width at the posterior margin, in the position and size of the eyes, and (for what it is worth) in the absence of the scattered larger tubercles on the test.

The Rushton species seems to be a well-marked and distinct form—its more important features being the shape of the glabella, the position and size of the eyes, the prominence of the fixed cheeks and the relative width across the posterior angles.

There seems little doubt but that this species is a *Solenopleura*, but if the free-cheek figured really belongs to the same species, it would seem to be one that is somewhat intermediate between that genus and *Ptychoparia*. LAKE (1931, p. 136) calls attention to MATTHEW'S observation of the little spines springing from the rounded genal angles of *Solenopleura* and looks upon this feature as one of the more useful distinctions between this genus and *Ptychoparia*, which has a strong spine springing from a non-rounded genal angle and its border " continuous with " that of the cheek.

In our specimen the spine is in continuation with the rim of the cheek, but is produced obliquely outwards, and the specimen shows (in suitable lighting) a slight rise of the cheek, which makes an approach to a continuous rounded border at the genal angle—as though the cheek were beginning to take on a spineless form.

The pygidium figured is too short and transverse to agree with that of *Ptychoparia*.

The horizon in which *S. rushtonensis* is found seems to be near the base of the *Tessini* Zone of Scandinavia.

SOLENOPLEURA, sp. indet. **Fig. 3, Pl. 43.**

A small cranidium, wanting the occipital ring, right cheek and both palpebral lobes [51724], seems worth description, if only because it shows the posterior glabellar furrows connected across the axial line and the next anterior pair also exhibiting, in certain good lighting, a trace of the same feature.

Description.

This is a small form about 4·3 mm. long (including a moderate allowance for the missing occipital ring), strongly convex, general outline trapezoidal, approaching to a wide rectangle, sides deeply emarginate. Glabella :—about two-thirds of the assumed total length, tapering strongly forwards to the truncate apex, with two pairs of oblique furrows, the posterior pair connected across the axial line by a weak depression, the next anterior pair also connected by a line in the sculpture that does not appear to be depressed and is probably due to an absence of some of the granulations. Occipital furrow :—only partly preserved, apparently it was deep and transverse. Dorsal furrow : —relatively wide and deep, and traceable round the glabellar apex. Front :—rather transverse, rim strongly convex and well marked, widening a little in the middle, tapering laterally and suggesting that the facial suture cuts it at a very acute angle and that the free cheek would have a very long anterior, spine-like process ; furrow—well marked. Pre-glabellar field :—only represented by a depressal line separating the two anterior projections of the fixed cheeks. Fixed cheek :—convex, not so high as the glabella, descending forwards and produced inwards to a point near the axial line. Palpebral parts :—lobe missing, situated at about the mid-length of the cranidium and high up upon it ; furrow—well marked and indicating the length of the lobe ; ridge—slightly elevated and running in a straight line towards the end of the glabella. Postero-lateral border :—with well-marked rounded hollow and marginal rim, both widening outwards to the rounded termination. Facial suture :—anterior branch—convex outwards, descending very steeply from the eye and apparently cutting the anterior marginal rim at a very acute angle ; posterior branch—taking a long sigmoidal curve from the eye to the postero-lateral angle, which is distant from the dorsal furrow by nearly the basal width of the glabella.

Test :—apparently thin, not exceeding 0·01 mm., covered very thickly with an irregular granulation, the interspaces sometimes giving the appearance of punctæ.

Length of glabella	2·70
,, ,, front	1·00
Width of glabella at base	2·75
Width across posterior angles	6·50
Width between anterior sutures	5·20

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Some features of this specimen suggest that it is young and only half-grown. The convexity, the connection of the glabellar furrows across the axial line, the thinness of the test, and, perhaps, the very oblique course taken by the suture when it reaches the marginal rim, may be due to immaturity. The general aspect, however, is one of full growth. Of the associated forms it seems nearest to *S. applanata* (fig. 1 on the same plate, which has been drawn to the same scale of enlargement). The differences are apparent. It is just conceivable that it might be the young of that species at the beginning of the holaspid stage.

CORYNEXOCHIDÆ, Angelin.

CORYNEXOCHUS, Angelin.

CORYNEXOCHUS PUSILLUS, Illing. Fig. 21, Pl. 41.

Corynexochus pusillus, Illing (1916), p. 431, Pl. 36, figs. 1 and 2.

The specimen figured [51784] is very minute, about 1 mm. long and 1·5 wide posteriorly.

It is in accord with ILLING's description with certain reservations, due doubtless to the imperfection of the shale specimens. In his description he traces the facial suture from the eye up to the side of the glabella and round its swollen anterior lobe. The Rushton specimen exhibits (on the right side) an extension of the front in advance of the fixed cheek, which brings the course of the suture more into accord with that of other species of the genus, at the same time the length of the palpebral lobe, which unfortunately is not clearly seen in our specimen, is shortened. The anterior branch may therefore be described as slightly convergent forwards from the eye, to meet the margin a short distance from the glabella.

The course for the posterior branch is, in our specimen, almost straight to the postero-lateral angles, presumably it is fractured in the specimen from the Stockingford shales (ILLING's fig. 2).

It is of course not impossible that the Rushton specimen is an immature form, but, except in size there is no evidence of this.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. groomi* Grit.

CORYNEXOCHUS ILLINGI, sp. nov. Figs. 19, 20, Pl. 41.

Cf. *Karlia minor*, WALCOTT (1889), p. 441.——(1916 *a*), p. 224, Pl. 36, figs. 7 and 7*a*, and *Corynexochus minor* (WALCOTT), WALCOTT (1916 *b*), p. 319, Pl. 55, figs. 6–6*d*.

Cf. *Karlia stephenensis*, WALCOTT (1916 *a*), p. 224, Pl. 36, fig. 8, and *Corynexochus stephenensis* WALCOTT (1916 *b*), p. 324, Pl. 55, figs. 5, 5*a*–*c*.

Holotype—a cranidium, numbered [51703].

Paratype—a partial cranidium, numbered [51704].

Description.

Cranidium.—General form :—trapezoidal, length about two-thirds of the greatest width, with very convex glabella, and much flatter side lobes. Glabella :—prominent, anteriorly expanded both laterally and vertically, narrowing posteriorly to two-thirds of its maximum width, broadly rounded anteriorly and almost covering the marginal rim, sides practically straight (appearing slightly convex or concave according to orientation), highest at about one-quarter to one-third of its length from the front margin and sloping down posteriorly to about half this height, with three pairs of almost obsolete, short furrows scarcely discernible on the exterior. Occipital furrow :—straight, deep, and wide. Occipital ring :—sub-triangular, with a relatively strong spine projecting upwards and backwards. Dorsal furrow :—weakly impressed, not always discernible on the exterior, but quite distinct interiorly. Front :—marginal rim, very narrow opposite the glabella, widening outwards and extending from the glabella a distance equal to about one-sixth of the maximum width ; between the rim and the rise of the cheek on either side there is a small, obliquely quadrangular area, sloping down forwards. Fixed cheeks :—triangular, somewhat tumid, appearing more so posteriorly by reason of the greater depression of the lateral angles, descending from the dorsal furrow. Palpebral parts :—lobe,—situated very low down, narrow, elongate, opposite the mid-length of the cranidium; ridge,—not seen; furrow,—only represented by an incised line. Posterior border :—widening outwards, very slightly raised at the edge, horizontal for about half its width, then geniculated and curving rather steeply down at the ends. Facial suture :—anterior branch,—convergent, nearly straight, posterior branch divergent with a slightly convex curve, cutting the posterior margin at a distance from the centre line rather less than the length of the glabella.

Test :—thin, granular, the granules being rounded, fairly regularly arranged and placed touching one another. They are, relatively to the size of the cranidia, rather large and best seen in the paratype.

Approximate dimensions in mm.	Holotype.	Paratype.
Length	2·50	1·75
Width at posterior angles	3·25	2·20
Maximum width of glabella	1·50	1·10
Minimum width of glabella	0·90	0·60

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. groomi* Grit.

Remarks.—This species seems nearest to *C. stephenensis* (WALCOTT) in the general shape of the cranidium, in that species, however, the maximum width of the glabella is at the front border, the eyes are situated farther back, the geniculation of the posterior border seems farther out, the test is described as "covered with fine, irregular raised lines," the course of the posterior branch of the facial suture is shorter and more convex, the posterior border is concave backwards, and in point of size *C. stephenensis* is about twice as long as *C. illingi.*

In this latter respect our species is nearer to *C. minor*, but this differs in the shape of the glabella, which is much more like that of *C. pusilla.* As with our species, the posterior border of *C. minor* is convex backwards in all WALCOTT's figures, but the dorsal furrow is described as "wide and deep."

The two Rushton species are readily separated by the shapes of the glabellas. When first seen and before the margins of the cranidia are exposed, there is a possibility of mistaking a young *Dorypyge* for a *Corynexochus.*

The specific name is given in honour of Professor V. C. ILLING, who was the first to recognize the genus from British deposits, followed in the same year (1916) by Mr. T. C. NICHOLAS.

ORYCTOCEPHALIDÆ, Beecher.

DORYPYGE, Dames.

DORYPYGE LAKEI, Cobbold.

Dorypyge lakei, Cobbold (1911), p. 287, Pl. 25, figs. 1–2.

Very numerous fragments of this species are found at the base of the Middle Cambrian of Rushton.

The minute cranidia of young forms when only partially uncovered may be mistaken for *Corynexochus*.

Locality and Horizon.—Rushton, loc. 8.—Middle Cambrian, from the *P. groomi* Grit.

The absence of this species from the *P. bohemicus salopiensis* Fauna, though present in the *P. groomi* Grit is remarkable. It is found at loc. 7 in Cherme's Dingle a foot or so above the *Lapworthella* Limestone where the sequence is practically undecipherable. At Comley it is recorded from an horizon estimated to be 300 feet above the *P. groomi* Grit in which it first appears.

DORYPYGE RUSHTONENSIS, sp. nov. Fig. 23, Pl. 41.

Compare *Dorypyge danica*, Grönwall (1902), p. 134, Pl. 3, figs. 7–12.

Holotype.—One-half of a pygidium and its counterpart, numbered [51706].

Paratypes.—A. A damaged pygidium [51707]. B. A small pygidium, wanting the spines [51708]. C. A fragment of a larger pygidium, [51800].

About 12 specimens of pygidia indicate a species near to Grönwall's from his *Conocoryphe æqualis* Zone which is just below his *P. davidis* Zone at Bornholm.

Description.

Pygidium.—General form excluding the spines a wide triangle, length about half the width, convex, with five spines projecting in the horizontal plane on each side. Axial lobe :—strongly convex, with five transverse furrows, dividing off the articulating facet (or half-ring), four convex rings of about equal length and one terminal portion rather longer, without spines or nodes and retaining its convexity to the well-rounded end. Dorsal furrow :—not impressed, but distinctly marked by the abrupt change of curvature.

Pleural lobe :—convex, of the same width as the axial lobe, or a little greater, traversed by four wide pleural furrows separating off an anterior half-rib, three more rather flat-topped ribs, and a small triangular portion between the last furrow and the axial furrow. Border :—continuous all round the posterior end, connecting the bases of five straight, strong, spines of oval section projecting horizontally on each side ; the first four are of approximately equal length and diameter, the fifth is perhaps double this length, but very little greater in diameter.

Test :—thick (0·025 in a shield 3·5 long, and 0·05 in one $7\frac{1}{2}$ mm. long), surface roughly granulate, with a scattered, larger granulation on the axial lobe.

Dimensions in mm. (approximate).

—	Holotype.	Paratypes. A.	B.	C.
Length excluding spines	5·00	3·00	3·50	7·50
Width excluding spines	8·00	5·00	4·20	?
Width of axial lobe	2·50–3·00	1·25	1·20	?

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian. The *P. forchhammeri* Grit.

Comparison of *D. rushtonensis* with other European species.

Horizons (Scandinavian nomenclature).	*P. forchhammeri* Zone.	Zone of *Cono. æqualis.*	*P. tessini* Zone.	*C. exsulans,* Zone.	*P. œlandicus* Zone.
Species.	*D. rushtonensis,* sp. nov.	*D. danica,* GRÖNWALL.	*D. reticulata,* COBBOLD.	*D. oriens,* GRÖNWALL.	*D. lakei,* COBBOLD.
Maximum length known, in mm. excluding spines	7·5 +	26	15	10	7+
Axial rings (number of) excluding anterior facet	5	5	6	6	6
Axial spines (number of)	None	None	None	5	5
Pairs of marginal spines (number of)	5	5	6	6	6
Pairs elongated (number of)	1	2	None	1	None

One other British species is known from fragments too incomplete for detailed comparison (*D.* cf. *richthofeni,* DAMES, NICHOLAS, 1916, p. 465, Pl. 3, figs. 10 and 11) from the calcareous grit at the top of the Caered mudstones of St. Tudwal's peninsula, North Wales.

ELLIPSOCEPHALIDÆ.

A note on the Shropshire members of this family is inserted in COBBOLD (1931 *a*), p. 477.

ELLIPSOCEPHALUS, ZENKER.

ELLIPSOCEPHALUS NORDENSKJÖLDI, LINNARSSON. Fig. 25, Pl. 44.

Ellipsocephalus nordenskjöldi, LINNARSSON (1882), p. 20, Pl. 4, figs. 1 and 2.

Though not very well preserved and rather smaller than the type, there seems no doubt but that a single cranidium in the collection should be referred to LINNARSSON'S well-known species. It is an internal impression in sandstone [51760] about 10 mm. long and a little less than 15 wide at the posterior angles. The glabella is parallel-sided with rounded end reaching to the not quite distinct front border. One pair of glabellar furrows is clearly seen and another is just traceable; perhaps the most marked feature of the specimen is the strong palpebral furrow. The anterior branch of the facial suture is slightly divergent forwards and on meeting the marginal rim it crosses it obliquely inwards.

Locality and Horizon.—Rushton, loc. 3.—Lower Cambrian, from the *Callavia* Beds.

It is a pleasure to record this species which is so characteristic of the upper part of the Lower Cambrian of Scandinavia; it affords another link between our *Callavia* Horizon and the *Holmia* Beds of Sweden and Norway.

PROTOLENUS, MATTHEW.

PROTOLENUS PUSTULATUS (COBBOLD).

Anomocare (?) *pustulatum*, COBBOLD (1910 *a*), p. 40, Pl. 6, figs. 1–3.——*Strenuella pustulata*, COBBOLD (1921), p. 379 (listed).——*Protolenus pustulatus*, COBBOLD (1931 *a*), p. 488, Pl. 39, figs. 16–18.*——*Strenuella pustulata* (COBBOLD), LAKE (1932), p. 196, Pl. 21, figs. 16–18.

Fragments of this species are plentiful in a band of limestone lying immediately above the *Callavia* Beds; a stratigraphical position identical with that at the type locality at Comley, and it has not been found outside this limestone band.

Locality and Horizon.—Rushton, loc. 3.—Lower Cambrian; the *E. bellimarginatus* Limestone.

Since this notice was written, we have had the advantage of seeing LAKE'S part vii of his Monograph (see reference above), in which he gives reasons for referring this species to *Strenuella.* He does not, however, notice the fact that the anterior branch of the facial suture is very short and diverges from the palpebral lobe to the marginal rim, which it cuts on a short forward curve, not on a long one, as is suggested by his fig. 16 of Pl. 21, and also by that of COBBOLD (1910 *a*, Pl. 6, fig. 1); the marginal rim in those figured specimens had not been entirely cleared of matrix. In the two specimens of the same species figured by COBBOLD (1931 *a*, Pl. 39, fig. 10) it has been cleared almost to the end and the course of the suture is closely indicated. On the same plate, fig. 19, of a cranidium of *Protolenus latouchei*, COBBOLD, shows a rim not cleared, while fig. 20 represents a cranidium of *P. paradoxoides*, MATTHEW, in which the rim has been almost entirely cleared.

P. pustulatus has the eye and suture of *Protolenus* and a front which is characteristic of *Strenuella.*

* By some inadvertence COBBOLD'S fig. 17 (1931 *a*) of a supposed pygidium has been reproduced upside down.

AGRAULOS, Corda

AGRAULOS ROBUSTUS, sp. nov. Figs. 6 and (?) 7, 8, 9, Pl. 43.

The material consists of some half-dozen, more or less incomplete, cranidia, which when partly covered by matrix simulate those of *Liostracus dubius* (Cobbold) in the concentric arrangement between the apex of the glabella, the coalescing fixed cheeks, the convex marginal rim, and the punctate test.

Holotype.—A nearly complete cranidium [51725,] and its counterpart.

Paratype.—An incomplete cranidium numbered [52866] in the same collection.

Description.

Cranidium.—General form :—trapezoidal with sides converging forwards very slowly and but little emarginate near the eyes, front semicircular, convexity moderate. Glabella :—tapering very slowly to the rounded apex, with three pairs of obsolescent furrows rarely seen on the exterior, but just discernible in the paratype, strongly convex, highest at about a quarter of its length from the base, in transverse section the sides curve upwards and meet at an obtuse angle which catches the light, giving the impression of a very low keel. Occipital furrow :—transverse, straight, uniformly wide and deep. Occipital ring :—rising steeply from the furrow almost to the height of the glabella, and forming the base of a strong spine projecting horizontally over some considerable part of the thorax. Dorsal furrow :—wide and deep, continuing round the glabellar apex with a raised outer edge sometimes minutely crenulate. Front : —semicircular, divided into two concentric, convex bands by the rapid change of curvature which marks the inner boundary of the slightly flattened marginal rim ; preglabellar field absent ; the rim appears to be cut off very obliquely by the facial sutures. Fixed cheeks :—narrow, convex, descending all round from the margin of the dorsal furrow, and sometimes slightly marked by short, radiating raised lines in continuation of the crenulation above mentioned, confluent in front of the glabella and surrounding it with a convex band of almost uniform width, extending a very little distance out behind the eye. Palpebral parts :—lobe,—convex downwards, not raised at the edge, but nearly horizontal, moderate in size and situated opposite the mid-length of the glabella ; ridge,—slightly raised on the exterior, curving obliquely forwards from the palpebral lobe over the cheek to the outer raised edge of the dorsal furrow at a point a little behind the curved apex of the glabella ; furrow,—not existent. Posterior lateral border : —furrow transverse and nearly in line with the occipital furrow, rather narrow and margined by a narrow raised rim, in the back view descending in a uniform curve to the lateral angles, extent about equal to the glabellar base. Facial suture :—converging gently forwards from the eye and cutting the marginal rim very acutely, behind the eye almost straight, divergent to the posterior angle.

Test very thin (about 0·01 mm.), surface covered with minute pits closely arranged.

Dimensions of holotype in mm. :—

Length of glabella		3·35
,, ,, front		1·50
,, ,, occipital ring and part of spine		2·50
Width of glabella at base		3·00
,, at anterior angles	C^a	4·20
,, at palpebral lobes	C^a	5·00
,, at posterior angles	C^a	6·00
Length of palpebral lobe		0·75

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Associated with this species there are several small cranidia, possibly young individuals but beyond the meraspid stage. They differ a little from the larger forms, being wider and having a more cylindrical glabella, well rounded in front; the extra relative width across the front causes the space occupied by the coalescent fixed cheeks to be less concentric around the apex of the glabella; the postero-lateral angles are also wider apart, and lines drawn from them as tangents to the anterior facial sutures would meet at a greater angle than similar lines for *Agr. robustus* (adult).

The figures of this variety are drawn to a larger scale than those of the type form. The dimensions in mm. are :—

	[51726] fig. 7.	[51727] fig. 9.
Length, excluding occipital ring and spine	2·50	1·30
Length of glabella	1·65	1·05
Width of glabella	1·20	0·80
,, across anterior sutures	2·00	1·70
,, across palpebral lobes	2·50	2·00
,, posterior sutures	3·50	2·70

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, the *P. forchhammeri* Grit.

A photograph of the specimen shown in fig. 7 is reproduced on an enlarged scale in fig. 8, in order to show the thick secondary coat that covers the posterior half and obliterates the axial and occipital furrows.

AGRAULOS HUMILIS, sp. nov., fig. 5, Pl. 43.

Three incomplete cranidia occur in one of the loose blocks carrying the *P. bohemicus salopiensis* Fauna which are evidently allied to *Agr. robustus*, sp. nov., from the *P. forchhammeri* Grit.

Holotype.—A cranidium [51793].

Paratype.—A partial cranidium, test preserved [51797].

Description.

Cranidium.—In general form very like *Agr. robustus* (see p. 376), but wider and less strongly convex.

There are the same prominent glabella and horizontally projecting occipital spine, eyes situate about the mid-length of the shield (excluding the spine), cheeks coalescing in front of the glabella, but they do not form so concentric a band round the apex :—the axial furrow is non-existent, being only represented by the change of curvature at the margins of the glabella :—the test, which is very thin, shows no sign of punctæ and is quite smooth :—the extension of the postero-lateral border is unknown.

Dimensions of holotype in mm. :—

Length of cranidium excluding occipital ring	5·00
,, ,, glabella	3·25
,, ,, occipital ring and spine	2·50
Width of glabella	2·55
,, across anterior sutures	4·50
,, across palpebral lobes	5·00
,, between postero-lateral angles	C^a 6·00

Locality and Horizon.—Rushton, loc. 3.—Middle Cambrian, from a loose block with the *P. bohemicus salopiensis* Fauna.

(vii) CONCHOSTRACA, Sars.

In this section the work of Ulrich and Bassler has been of the greatest assistance and their classification and nomenclature have been followed ; the only exception is, that in describing these valves, " length," " depth," and " thickness " are used, where they use " length," " height," and " thickness."

Most of the species in the collection are represented by but one or two specimens, but, generally, preserve their original convexity, occasionally with local damage prior to entombment. The forms referred to *Indianites* and *Aluta* are, however, plentiful and frequently have the valves united. In the specimens found in sandstone the surfaces are rarely well preserved ; it appears that the tests may have consisted of two layers and that on opening the rock the outer layer either adheres to the matrix, or is largely destroyed, the fossil then showing no sculpture, but having a scabrous appearance.

BRADORIIDÆ, Matthew.

BRADORIA, Matthew.

BRADORIA ROBUSTA (Matthew). Fig. 8, Pl. 41.

Aparchites (?) *robusta*, Matthew, 1898, p. 132, Pl. 1, figs. 4 *a–c*.——*Bradoria robusta* (Matthew), Ulrich, and Bassler (1931), p. 22, Pl. 1, figs. 1–5, and Pl. 2, figs. 1–4. With a full synonymy.

A specimen of the exterior of a right valve [51692], with its counterpart, seems to indicate this species as redefined by Ulrich and Bassler. It has been damaged at the antero-dorsal angle before fossilization, with the result that this angle is pushed out of shape and its original contour destroyed. The sculpture, consisting of irregular linear rugosities, arranged sub-parallel to the margins, is well seen in the external impression, but only partially on the exterior, apparently due to the tearing away of a presumed outer pellicle, which remains in the concavity. This specimen and the next two to be noticed afford instances of the flexibility of the test while fresh.

Approximate dimensions :—

Length, 3·7 ; depth, 2·7 ; thickness of one valve 0·7 mm. Convexity (ratio of thickness to length), 0·25.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, from the *Acrothele prima* Shale.

BRADORIA cf. *OBESA*, MATTHEW. Fig. 6, Pl. 41.

Bradoria vigilans, mut. *obesa*, MATTHEW (1902), p. 455.——*Bradoria obesa* (MATTHEW), ULRICH and BASSLER (1931), p. 27, Pl. 1, fig. 27, and Pl. 3, fig. 13 (with other references).

A single specimen and its counterpart [51690], is referred to this species, though somewhat damaged by crushing which interferes with the convexity.

In general form it agrees with the figures quoted above, but the ocular tubercle is situated relatively farther back ; this tubercle is large and surrounded by a wide flattened or slightly concave space, which may have been accentuated by pressure.

The surface is thickly covered with minute raised granules, about 30 in 1 mm. linear.

Approximate dimensions.—Length, 3·4 ; depth, 3·1 ; thickness, 0·5 mm.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, from the *Acrothele prima* Shale.

Remarks.—ULRICH and BASSLER note that *B. perspicator* (MATTHEW), *B. spectator* (MATTHEW) and *B. obesa* are very much alike in outline. Our specimen is nearest to their copy of MATTHEW's outline (their fig. 27).

The reference is necessarily given with reserve. The border is too obscure for close description, without other specimens.

BRADORIA BENEPUNCTATA (MATTHEW). Fig. 7, Pl. 41.

Bradoria observator, var. *benepuncta*, MATTHEW (1902), p. 449, Pl. 1, fig. 16 and (1903), p. 161, Pl. 12, fig. 16.——*Bradoria benepunctata* (MATTHEW), ULRICH and BASSLER (1931), p. 18, Pl. 1, fig. 16, Pl. 2, figs. 6, 7, and Pl. 3, fig. 7 (with other references).

The single right valve [51691] answers well to ULRICH and BASSLER's description, notwithstanding the damage to the posterior end, which accentuates the ventral angle ; the surface is finely punctate, but whether fine enough to indicate their var. *spissa* cannot be decided. In our specimen the punctæ are spaced about 40 to the millimetre (linear), forming a sort of network, the interspaces being flat, smooth, and shining. It is clear that they are confined to the outer pellicle of the test, for where this has been worn away they have disappeared. This occurs often in minute patches, which then appear to be irregular pits eight or ten times as large as the punctæ themselves; towards the margins the punctæ tend to appear closer together and to have an arrangement in lines, giving the effect of linear rugosities.

The ocular tubercle is unfortunately broken off, but its position is clearly indicated a little behind the antero-dorsal angle.

Approximate dimensions.—Length, 3·5; depth, 3·0; thickness of one valve, 0·75 mm.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, from the *Acrothele prima* Shale.

BEYRICHONIDÆ, Ulrich and Bassler.

BEYRICHONA, Matthew.

BEYRICHONA TINEA, Matthew (?). Fig. 9, Pl. 41.

Beyrichona tinea, Matthew (1885), p. 66, Pl. 6, figs. 21, 21*a* and *b*; and (1895), p. 131, Pl. 7, figs. 6*a–c*.——Ulrich and Bassler, 1931, p. 43, Pl. 6, figs. 1, 2, 5, 7, and Pl. 7, fig. 4.

One external impression of a defective right valve [51693] is doubtfully referred to Matthew's species. A sketch is given of the plasticine cast.

The surface character comes out rather well. It consists of irregular linear rugosities arranged sub-parallel to the margins of the valve and concentric about the highest point.

Dimensions.—Length, 2·25 mm.; depth, 2·5; thickness unknown.

The precise margins of this valve cannot be ascertained, the sketch shows such approximation as may be inferred by the increasing convexity at the border, the hinge line also cannot be ascertained; upon it would depend the inclination of the anterior and posterior curves.

Locality and Horizon.—Rushton, loc. 6.—Lower Cambrian, from the *Acrothele prima* Shale.

BEYRICHONA, cf. *ROTUNDATA*, Matthew. Fig. 10, Pl. 41.

Beyrichona rotundata, Matthew (1895 *b*), p. 136, Pl. 7, fig. 9.—Ulrich and Bassler (1931), p. 46, Pl. 6, fig. 12, and Pl. 7, figs. 11, 12.

A left valve numbered [51694], now detached from the rock and with margin damaged, is doubtfully referred to this species.

Dimensions:—Length and depth, about 1 mm., length of hinge-line about 0·75 mm., greatest thickness (below the mid-line), 0·3 mm. A flat space extends from the hinge-line for about 0·6 mm. towards the ventral margin.

The drawing was made, and later, in the endeavour to clear up the exact hinge-line, the major portion of the valve came away and is now preserved separately. The surface is rough with fine-grained angular particles visible under high magnification.

Locality and Horizon.—Rushton, sub-area on the south-eastern side of the Wrekin, loc. 2, Hazlehurst Coppice (south end). Lower Cambrian, from the Lower Comley Sandstone.

ALUTA, MATTHEW, emend. ULRICH and BASSLER.

ALUTA cf. *ROTUNDATA* (WALCOTT), var. *SALOPIENSIS* nov. Fig. 14, Pl. 41.

Aristozoe rotundata, WALCOTT (1887), p. 193, Pl. 1, fig. 6; (1890), p. 627, Pl. 80, fig. 3.
Aluta rotundata (WALCOTT), ULRICH and BASSLER, 1931, p. 60, Pl. 8, figs. 18, 19.

WALCOTT'S species was founded on a single specimen from limestone. One specimen [51698] from Rushton appears to be referable to it, but differs in the depth of the sinus, and possibly in the marginal rim, which is described as consisting of "a strong marginal groove within a rounded marginal rim"; in our specimen it appears, so far as seen, to be almost flat.

In it the sinus is very shallow and does not penetrate the body of the valve so far as shown in ULRICH and BASSLER'S photograph (their fig. 19).

The dimensions are:—Length, 2·5; depth, 2·0; thickness of one valve, 0·80 mm.

There is a very minute triangular area at the anterior angle, somewhat depressed and having upon it a little prominence. In line with this prominence a slightly-raised ridge is seen on the body of the valve, curving away towards the centre—the nature of this has not been made out. It may be adventitious.

Locality and Horizon.—Rushton, loc. 4.—Lower Cambrian, from the Lower Comley Sandstone.

ALUTA ULRICHI, sp. nov. Figs. 11–13, Pl. 41.

This species is chiefly distinguished by its comparatively short hinge-line and the beak-like anterior extension of the carapace, the upper limit of which is not in the same line as the hinge. In size and form it is, when partially buried in matrix, very like *Indianites exigua*, sp. nov.

Holotype.—A complete carapace and its counterpart [51695].

Paratypes Nos. [51696, 51697].

Description.

Carapace: Small (2 mm. long), moderately convex. Valves equal, somewhat oblique, pointed anteriorly, rounded ventrally and posteriorly, thickest a little behind the mid-length, with distinct margin and beak-like anterior projection. Border:—hinge-line about one-half the total length, antero-dorsal angle about 160°, followed by an almost straight short length forming the upper limit of the beak which ends in a rounded point, antero-ventral curve also nearly straight; ventral, post-ventral, and post-dorsal sides forming one nearly circular curve to the postero-dorsal angle (about 145°). The valves in the holotype gape a little on the ventral side, the gape increasing at the two ends. Test: very thin (inner layer not detected), externally exfoliating readily and usually pitted or tuberculate from sand grains, black, chitinous, apparently smooth. In the left valve of the holotype a rounded curved line seems to mark off the beak portion from the body of the valve, no trace of this line is seen on the right valve, nor in other specimens referred to this species.

In the paratype (a fragile internal cast), fig. 13, one-half of the beak has come away leaving the outline of the other half; the beak thus appears to have been distinctly separate from and thinner than the body of the carapace.

Dimensions of holotype :—Length, excluding margin, 2·13 ; depth, 1·58 ; thickness of the two valves, 1·12 ; width of margin, about 0·10 mm.

Locality and Horizon.—Rushton, loc. 4, also from locs. 1, 2, and (?) 6.—Lower Cambrian, from the lower Comley Sandstone.

Remarks.—In three respects this species does not agree with ULRICH and BASSLER's emended diagnosis (1931), p. 49. (i) The valves gape, and the gape increases towards the ends, so that they would not meet unless forced together. (ii) The dorsal side is not straight and the hinge must have ceased to function as such at the base of the beak. (iii) There is no indication of a " ridge-like swelling " passing to a raised node low down on the body of the valve. The generic reference is consequently given with reserve.

INDIANITIDÆ, ULRICH and BASSLER.*

INDIANITES, ULRICH and BASSLER.

INDIANITES EXIGUA, sp. nov. Figs. 15 and 16, Pl. 41.

Many specimens referred to this form occur in the collection made by J. RHODES (Senior) in 1892–3.

Holotype.—An almost perfect carapace with the valves in apposition [51699].

Paratype.—[51700].

Description.

Carapace small, globular, bordered on the free margins. Valves, apparently equal. Hinge-line, straight, length about half that of the valve. Postero-dorsal angle obtuse, antero-dorsal angle less so, both somewhat rounded off. Anterior end projecting to a rounded angle. Ventral curve approaching flatness as far as the deepest part of the valve and thence boldly rounded to the posterior angle and passing in a short, gentle curve (parallel with the first part of its course) to the postero-dorsal angle. Highest point near the centre of the valve. Test apparently of two layers, the outer usually much damaged giving a general scabrous appearance, but where large enough spaces have escaped the surface is covered with minute pits, not penetrating to the, presumed, inner layer and set about 30 to the millimeter (linear), the interspaces being flat and glistening.

Dimensions of Holotype.—Length, 1·9 ; hinge-length, about 1·0 ; depth, 1·55 mm.

* The family and generic names *Indianidæ* and *Indiana* of ULRICH and BASSLER (1931) were emended later to *Indianitidæ* and *Indianites* respectively by the same authors. ('J. Wash. Acad. Sci.,' vol. 21, p. 364 (1931).)

Thickness of one valve 0·45, and of the specimen with its gape, about 1·00 mm. Other specimens have lengths varying about 20%.

Locality and Horizon.—Rushton, loc. 7.—Lower Cambrian, from the Lower Comley Sandstone.

Remarks.—The preservation of the tests of these specimens leaves much to be desired, and very frequently the border is much broken away, nevertheless it is distinctly present. There appears to be some variation in the shape. In some the length and depth are more nearly equal, and the relative length of the hinge-line may be a little greater.

The species is near to *I. faba* and *I. curta*, ULRICH and BASSLER (1931, pp. 79–81, Pl. 5, figs. 9–14), but differs radically in size and in having a definitely visible border.

The test of the holotype has sundry depressions in its surface and one or two raised tubercle-like spots, all which are regarded as adventitious.

In point of size and general aspect, this species is very similar to *Aluta ulrichi*, sp. nov., from which it differs (i) in the absence of the beak; (ii) in the obliquity of the carapace to the hinge-line; (iii) in the proportion of length to depth. With insufficiently prepared specimens there is considerable difficulty in separating them.

INDIANITES OBTUSA, sp. nov. Fig. 17, Pl. 41.

Holotype.—A left valve [51701].

Description.

This is a very small form of which only one solitary specimen has been found. It is very convex, the thickness of one valve being 0·25 of the length. Hinge-line straight, 0·6 of the length; depth 0·66 of the same. Antero-dorsal angle about 100°, anterior curve nearly straight for about 0·4 of the depth, antero-ventral curve rather flat, ventral and posterior curve almost a semicircle, postero-dorsal angle about 135°, no marginal rim is seen in the specimen.

Test very thin, black, somewhat exfoliated posteriorly and fractured elsewhere, between the fractures obscure punctæ are seen.

Dimensions.—Length, 1·00; depth, 0·66; thickness of one valve, 0·25 mm.

Locality and Horizon.—Rushton, loc. 8.—Lower Cambrian, from the *Lapworthella* Limestone.

Remarks.—This specimen is reminiscent in rotundity and size, of *Aluta enyo*, WALCOTT, from China, but has not the tubercle-like swellings near the antero-dorsal angle seen in the figures given by ULRICH and BASSLER (1931, Pl. 8, figs. 5 and 6). It is perhaps more like *Indianites primæva* (MATTHEW) in form, but cannot be identified with his species as figured and described, for that form is relatively less deep and has the anterior angle more nearly 90°.

This is the sole representative of the Conchostraca as yet recorded from the *Lapworthella* Limestone.

DIELYMELLA, Ulrich and Bassler.

DIELYMELLA (?) *CORPULENTA*, sp. nov. Fig. 18, Pl. 41.

It is doubtful under what genus this species should be placed. In some respects it has much in common with *Dielymella*, in others it seems like some species of *Indianites*, and yet again it has an aspect reminiscent of *Bradoria*. Only two examples are known, and both are unsatisfactorily exposed.

Holotype.—A right valve, damaged at the hinge-line [51702].

Paratype.—A left valve [51803].

Description.

Right valve.—A robust and very convex oval with both hinge-line and depth about two-thirds of the length, and with a strong border only seen posteriorly, but probably continuous round the ventral margin to the anterior end. Hinge-line straight from the blunt posterior angle (nearly 180°) to the sharp anterior angle (90°). Anterior margin,—vertical and almost straight. Ventral margin, one almost uniform curve from end to end. Posterior margin,—a continuation of the same curve, but of a longer radius and ending almost tangentially to the hinge-line. Body of valve, rising rapidly from the border, curving over towards the middle of the valve, without tubercle or depression. Maximum thickness at a point a little in front of the mid-length and about equal to one-third of the depth of the valve. A slight irregularity in the surface extends forwards in a curve towards the anterior angle. Border,—flat, with well-rounded edge accompanied by a groove, which is impressed sideways into the body of the valve. (This is shown in the diagrams of the dorsal outline, fig. 18*c*.)

Test—thick, smooth, black but not polished; a very irregular network of flat raised lines may be seen under high magnification (fig. 18*d*).

Dimensions :—Length, 7·00 mm.; depth, 3·00; thickness of one valve, about 1·20; thickness of test, approximately 0·10 where seen at a fracture at the posterior end.

Locality and Horizon.—Rushton, loc. 9.—Middle Cambrian, from the *P. forchhammeri* Grit.

Remarks.—It has been impossible with the small amount of material to determine whether the valves in this species had any gape at all; usually the genus has this, and it widens posteriorly. It is also described as having a long hinge-line and the published figures show this more decidedly than *D. corpulenta*.

Of the species figured, the nearest seems to be *D. dorsalis*, Ulrich and Bassler (1931, Pl. 10, fig. 1), but the hinge-line is relatively much longer than in the Rushton form. The convexity is about the same.

D. brevis, Ulrich and Bassler (1931, Pl. 10, figs. 12, 13) compares well as to relative length and depth, but is twice as long as and much less convex than *D. corpulenta*.

Compared with the genotype, *D. recticardinalis* (Ulrich and Bassler, 1931, p. 86, Pl. 10, figs. 3–7), our species has a similar curve in its posterior margin, but is a much shorter form, and considerably more convex; also the antero-dorsal angle is not so clearly marked.

VII. THE HORIZONS OF THE RUSHTON CAMBRIAN AND THEIR FAUNAL ASSEMBLAGES IN ASCENDING ORDER.

Note.—The names used for the horizons are those adopted for the Comley area (COBBOLD, 1921) where applicable. New names are printed within inverted commas.

A. LOWER CAMBRIAN.

1. *The Wrekin Quartzite.*

No fossils collected.

2. *The Lower Comley Sandstone.*

The collections were made from isolated exposures and cannot be recorded in their true stratigraphical order, with the exception of that from " the *Acrothele prima* Shale," which appears to occur within the lowest 100 ft. of the division, and is the earliest known fossiliferous horizon in the Rushton area.

The remainder are recorded together in one list but, as it appears probable that further detailed work will separate two or more faunal assemblages, the locality numbers are placed, in brackets, after each species.

2*a*. " *The* Acrothele prima *Shale* " *Fauna* Loc. 6.

Hyolithellus tortuosus . . p. 321
Hyolithellus micans (?) . p. 321
Lingulella sp. indet.
Acrothele prima . . . . p. 330
Acrotreta gemmula . . . p. 330
Acrotreta sagittalis taconica
Bradoria robusta . . . p. 378
Bradoria benepuncta . . p. 379
Bradoria cf. *obesa* . . . p. 379
Beyrichona tinea . . . p. 380
Numerous fragments of tubular fossils and a problematical polyzoon p. 325

2*b*. *Arenaceous faunas from the Lower Comley Sandstone.*

Locality numbers for each species in brackets.

Worm tracks and castings (1)
Hyolithellus micans (2, 4, and 5) . . . . p. 321
Torellella scabra (5) . . . p. 323
Kutorgina (?) *anglica* (2 and 5) . . . . p. 328
Beyrichona cf. *rotundata* (2) . . . . p. 380
Aluta rotundata salopiensis (4) . . . . . . p. 381
Aluta ulrichi (1 and 4) . p. 381
Indianites exigua (2 and 4) . . . . p. 382

3. "*The* Callavia *Beds*."

Specimens obtained from limestone and decalcified sandstone. Locs. 3 and 8.

Polyzoon	p. 325
Hyolithellus micans	p. 321
Micromitra (*P.*) *labradorica*	p. 326
M. (*P.*) *minor*	p. 326
Lingulella viridis	p. 327
Obolella atlantica comleyensis	p. 329
Helcionella rugosa	p. 333
Pagetia attleborensis	p. 345
P. annio	p. 345
Callavia callavei	p. 345
Callavia spp.	
Ellipsocephalus nordenskjöldi	p. 374

The fauna, though poor in species, is extremely rich in individuals. Fragments of *Callavia* are very abundant, as also are specimens of *Obolella* and *Pagetia*.

The remaining species are represented in the collection by from 1 to 8 or 10 specimens. *Micmacca*, plentiful at Comley, is absent.

4. *The* Eodiscus bellimarginatus *Limestone.*

Locs. 3 and 8.

This Limestone occurs immediately above the calcareous sandstone at the top of the *Callavia* Beds and is faunally connected with it by the profusion of fragments of *Callavia*, but distinguished by its almost equal profusion of *Protolenus pustulatus* which is absent from the beds below.

Hyolithellus micans	p. 321
Micromitra (*P.*) *labradorica*	p. 326
Micromitra (*P.*) *minor*	p. 326
Obolus parvulus	p. 326
Obolella atlantica comleyensis	p. 329
Obolella atlantica transversa	p. 329
Pagetia attleborensis	p. 345
Callavia callavei	p. 345
Callavia spp., very numerous fragments.	
Protolenus pustulatus plentiful	p. 375

5. *The* Strenuella *Limestone.*

Locs. 3 and 8.

It has already been pointed out (p. 315) that the *Strenuella* Limestone yielded no recognizable fossils in the trench at loc. 8, but that some of the species, characteristic of this horizon at Comley, occur in the collection from loc. 3, where the sequence of beds could not be made out in full detail.

The most prevalent of these forms is *Obolella atlantica transversa*, and those species that occur in the same blocks with it are included in this faunal list.

Helenia cancellata . . .	p. 322	*Obolella atlantica transversa*	p. 329
Lapworthella nigra . . .	p. 322	*Obolella atlantica comleyensis*	p. 329
Micromitra (*P.*) *minor gibbosa* (?)	p. 326	Trilobite, fragments numerous.	
Obolus parvulus (?) . .	p. 326		
Obolella atlantica . . .	p. 329		

6. *The* Protolenus *Limestone.*

Locs. 8 and 11.

At Rushton this bed was only seen in two narrow trenches; in some parts of the small extent exposed, trilobite fragments occur in profusion, but cannot be identified. The typical character of the bed is there, but only eight or ten of the 30 different species of the Comley fauna were obtained; there was, however, a noticeable increase in the number of the Annelida.

Species marked with an asterisk are those also found in the type exposure at Comley.

*Hyolithellus micans** . .	p. 321	*Hyolithus crassus.**	
Hyolithellus cingulata . .	p. 321	*Hyolithus* (*O.*) *bayonet** .	p. 338
*Lapworthella nigra** . .	p. 322	*Eodiscus lobatus** . . .	p. 344
*Helenia cancellata** . . .	p. 322	*Eodiscus speciosus** . .	p. 345
Rushtonia lata . . .	p. 324	Fragments of trilobites, some with sculpture like that of *Protolenus latouchei.**	
Micromitra (*P.*) *minor* .	p. 326		
*Obolus parvulus** . . .	p. 326		
Obolus sp. indet. . . .	p. 327		

7. *The* Lapworthella *Limestone.*

Locs. 3, 7, and 8.

The Comley Limestones at Rushton carry a quantity of dark nodules and patches, some of which are phosphatic, this material tends to form divisional planes between the arenaceous limestone beds or within them. The phosphate appears in small quantity in the *Callavia* Beds and increases in higher horizons, culminating in the *Lapworthella* Limestone.

In hand specimens from the last-named horizon, one part may be a fine-grained compact, arenaceous limestone, not a hand's breadth away the rock is a calcareous grit with rounded grains of quartz and other rocks, and at another part, round and irregular lumps of the dark phosphatic matter appear, which are compact, homogeneous, and without obvious inclusions. Between these diverse materials the phosphate may be seen drawn out into strings and plates of irregular thickness as though it had accumulated in a plastic state and had been subsequently disturbed. In addition there are numerous rounded lumps with concentric structure of dark and paler material, which, it has been suggested, may be of algal origin. The fossils occur equally in the fine grained and in the more gritty parts and consist of Brachiopoda, Annelida, Polyzoa, one bivalved crustacean (*Indianites*), and one trilobite fragment. The fauna is as follows :—

Hyolithellus micans . .	p. 321	*Acrothyra sera*	p. 332
Hyolithellus (?) *cingulatus*	p. 321	*Acrothyra sera*, var. . .	p. 332
Lapworthella nigra . . .	p. 322	*Acrotreta* (?).	
Polyzoon	p. 325	*Indianites obtusa* . . .	p. 383
		Trilobite fragment.	

Hyolithellus micans, *Lapworthella*, and *Acrothyra* practically dominate the fauna, the other species being represented by 1 to 3 or 4 specimens only.

B. Middle Cambrian.

8. "*The* Paradoxides groomi *Grit.*"

Loc. 8.

This is a coarse, quartzose, glauconitic grit with calcareous patches or lenticles containing innumerable fragments of trilobites of various species aggregated together as though deposited in hollows in the coarse sands, analogous to the "calcareous clots" described from the Comley Quarry (Cobbold, 1911, p. 283) and containing the same fauna with some additions.

Minute rods	p. 324	*Conocoryphe emarginata longifrons*	p. 351
Acrothele (*R.*) *granulata* . .	p. 330	*Paradoxides* cf. *groomi* .	p. 348
Acrotreta socialis	p. 331	*Paradoxides œlandicus* .	p. 348
Acrothyra comleyensis . .	p. 332	*Corynexochus pusillus* .	p. 370
Helcionella oblonga . . .	p. 333	*Corynexochus illingi* . .	p. 371
H. oblonga, var.	p. 333	*Dorypyge lakei*	p. 373

9. "*The* Paradoxides bohemicus salopiensis *Fauna.*"

Loc. 3.

Collected from 2 or 3 loose blocks of gritty limestone lying in the soil over the *Callavia* Beds and, presumably, residual from Middle Cambrian grits in the near vicinity.

Minute rods	p. 324	*Agnostus stenorrhachis* .	p. 332
Lingulella cf. *ferruginea* .	p. 327	*Paradoxides bohemicus*, var. *salopiensis* . . .	p. 346
Acrothele (*R.*) *granulata* .	p. 330	*Paradoxides œlandicus* .	p. 348
Acrotreta sagittalis . . .	p. 331	*Liostracus comleyensis* .	p. 355
Acrotreta socialis . . .	p. 331	*Solenopleura acadica elongata*	p. 362
Acrothyra comleyensis . .	p. 332	*Solenopleura rushtonensis*	p. 366
Agnostus fissus, var. *mancus*	p. 340	*Agraulos humilis* . . .	p. 377
Agnostus gibbus	p. 341		

This fauna is evidently from a low horizon of the Middle Cambrian.

Agn. gibbus and *Agn. fissus* indicate a proximity to the *Ctenocephalus exsulans* fauna of Scandinavia, while *P. œlandicus*, *Acrothele* (*R.*) *granulata* and *Acrotreta socialis* point to the lower horizon of *P. œlandicus* of Scandinavia. *Agn. stenorrhachis* was described by GRÖNWALL from the *P. davidis* Zone of Bornholm.

10. "*A* Paradoxides hicksi *Fauna.*"

Loc. 7.

The complexity of the stratigraphical relations of the Lower and Middle Cambrian rocks of Cherme's Dingle has already been discussed. RHODES collected his specimens from four varieties of rock distinguished below by letters A, B, C, D.

10A is clearly the *Lapworthella* Limestone, the species from which are listed on pp. 387–388 along with those from other exposures.

10B is a pink limestone mottled with green apparently lying upon the *Lapworthella* Limestone. It yielded :—

Hyolithellus sp.		*Dorypyge sp.* indet.	
Obolus parvulus (?)	. . p. 326	Trilobite fragments.	

It is not certain whether this is Lower or Middle Cambrian, though it is possible that one of the paratypes of *P. groomi* came from it.

10C is a dark calcareous rock, denominated " Conglomerate " in RHODES' field notes. The fossils included :—

Acrothele intermedia	. . p. 329	*Agnostus sp.* indet.	
Acrotreta sp. indet.		*Paradoxides*, one fragment.	
Hyolithus sp.		A pygidium of uncertain relations.	
Agnostus incertus.			

A. incertus was figured and described by LAKE, 1907, p. 29, Pl. 3, figs. 1–3.

10D is a dark limestone with well-preserved trilobite fragments and other fossils.

Obolus sp.		*Paradoxides bohemicus*,	
Lingulella sp.		var. *salopiensis* . . .	p. 346
Acrothele intermedia	. . p. 329	*Agraulos* cf. *quadrangularis*.	
Acrotreta cf. *sagittalis*	. . p. 331		
Paradoxides hicksi	. . p. 351	*Liostracus sp.* indet.	

The two species of *Paradoxides* were figured and described by COBBOLD, 1913 *b*, pp. 45, 47, Pl. 4, figs. 1–17.

11. " Liostracus bruno *Shale.*"

Loc. 9.

This shale occurs about one foot below the *P. forchhammeri* Grit and has yielded the species named below :—

Paradoxides tessini	p. 349	*Liostracus bruno*	p. 356
Paradoxides fragments in abundance.			

12. " *The* Paradoxides forchhammeri *Grit.*"

Loc. 9.

A coarse, calcareous, and bituminous quartz grit (with pebbles up to 1 inch long) which by its fauna is evidently the equivalent of the " Andrarum Limestone " and the " *Hyolithus* Limestone " of Scandinavia. The fauna includes :—

Micromitra pusilla	p. 326	*Liostracus bruno*	p. 356
Acrotreta sagittalis	p. 331	*Liostracus dubius*	p. 358
Billingsella exporrecta	p. 332	*Liostracus sp.* (pygidia)	p. 358
Hyolithus araneus angustus	p. 336	*Liostracus* (*Agaso*) *rushtonensis*	p. 359
Hyolithus obscurus anglicus	p. 334	*Liostracus* (*Agaso*) *pococki*	p. 360
Hyolithus operosus	p. 335	*Liostracus* (*Agaso*) *pringlei*	p. 367
Hyolithus tenuistriatus	p. 333	*Liostracus* (*Agaso*) *sp.* (?), pygidia	p. 367
Hyolithus pennatuloides	p. 336	*Solenopleura angustiora*	p. 363
Hyolithus (*O.*) *cor*	p. 337	*Solenopleura applanata*	p. 365
Hyolithus (*O.* ?) *ornatus*	p. 338	*Solenopleura* (?) *sp.* indet.	p. 369
Agnostus lens	p. 342	*Solenopleura brachymetopa*	p. 365
Agnostus lundgreni	p. 342	*Solenopleura brachymetopa nuntia*	p. 365
Agnostus parvifrons Vars.	p. 343	*Solenopleura bucculenta*	p. 366
Agraulos robustus	p. 376	*Dorypyge rushtonensis*	p. 373
Paradoxides forchhammeri	p. 347	*Dielymella* (?) *corpulenta*	p. 384
Paradoxides sp. indet. A	p. 349		
Paradoxides sp. indet. B	p. 350		

13. " Agnostus lævigatus *Shale.*"

Loc. 10.

A stratum of shale intercalated with the highest beds of Middle Cambrian quartzose grits yielded the following sparse fauna, believed to represent the *Agn. lævigatus* Zone of Scandinavia.

Acrotreta sagittalis	p. 331	*Hyolithus sp.* indet.
Acrotreta parvula	p. 331	*Agnostus*, cf. *Agn. lævigatus similis* (?).
Acrotreta sp. minute forms.		

Acrotreta parvula is only known from the *Agn. lævigatus* Horizon of Scandinavia. *A. sagittalis* is quoted by WALCOTT (1912, p. 705) from the lowest part of the Middle Cambrian to the top of the Upper Cambrian. The *Agnostus* is too much damaged to be identified with certainty.

UPPER CAMBRIAN.

14. "Leptoplastus-Ctenopyge *Horizon*."

Loc. 12.

The fossiliferous exposures of Upper Cambrian in the Rushton area are very meagre, and the only fauna of this division that is of any extent is provided by the loose blocks of bituminous limestone found in the course of Dryton Brook below the coalfield of Dryton (see p. 317).

Five of these blocks have yielded the following fauna :—

Obolus sp. indet.		*Ctenopyge flagellifera* . .	p. 351
Lingulella cf. *concinna* .	p. 327	*Ct. flagellifera angusta* .	p. 351
Leptoplastus raphidophorus	p. 351	*Ctenopyge drytonensis* .	p. 352
Eurycare angustatum . .	p. 351	*Sphærophthalmus* (?) *parabola*	p. 353

This fauna appears to represent a junction between WESTERGÅRD'S Zone 4 (with *Leptoplastus* and *Eurycare*) and his sub-zone 5*a* (with *Ctenopyge flagellifera* and *Protopeltura præcursor*) (1922, p. 182).

VIII. THE SHROPSHIRE CAMBRIAN AS DEVELOPED AT RUSHTON, COMLEY, AND BENTLEYFORD BROOK.

The study of the faunas of Rushton has thrown some light on the conditions of life and sedimentation in Cambrian times within the Shropshire area.

When treating of those of Rushton, it is impossible to exclude considerations derived from the Comley and Bentleyford areas.

LOWER CAMBRIAN.

Wrekin Quartzite.—In all three areas the Wrekin Quartzite occurs at the base. The initial deposit has not been seen at Comley, but is visible in two places near Rushton (see pp. 309 and 310). On the other hand, Rushton has given us no clear section of the final deposit, but this has been studied in two exposures in the more southern area (COBBOLD (1921), p. 369; (1927), p. 560). There it graduates by intercalation into sandstone through thin conglomerates, shale, and quartz grits, in which the *Obolella groomi* Fauna occurs.

Lower Comley Sandstone.—In both areas the Lower Comley Sandstone has a considerable thickness (estimated at about 500 feet) and consists of alternations of sandstone, flaggy grit, and shale ; the individual beds rarely exceed 3 feet in thickness.

Acrothele prima *Shale*—Approximately 100 feet above the quartzite there is at Rushton (loc. 6) the "*Acrothele prima* Shale," with its fauna of Annelida, Brachiopoda, and Conchostraca. This has not been found at Comley, but somewhere near the same horizon slabs of sandstone and beds of shale yielded tracks and obscure annelid tubes (COBBOLD (1927), p. 560, under division Ab 2).

Holmia *Horizon.*—At Comley, near the middle of the Lower Comley sandstone, a single cephalon of a trilobite and a few fragments were found in a nodule of calcareous sandstone (COBBOLD (1921), pp. 369 and 379); (1927), p. 554, Excavation No. 30).

This trilobite was recorded in 1910 (Rep. Brit. Assoc., 1911 (Sheffield, 1910), p. 119) as *Olenellus.* In 1921 it was listed as *Holmia* and later it was submitted to RAW, who says it is probably identical with *Holmia lundgreni*, MOBERG. This *Holmia* Horizon has not been met with at Rushton.

Aluta-Indianites *Beds.*—Above it, at Comley, we have many isolated exposures of sandstone with calcareous nodules scattered or in bands and carrying Conchostraca, not yet identified, but similar to those referred to *Aluta* and *Indianites* in this paper.

Returning to the Rushton area the fauna (or faunas) of the 400 feet of strata above the *Acrothele prima* Shale cannot be placed in stratigraphical order for want of consecutive sections, they are (as stated above, p. 385) therefore listed together as one fauna of a sandstone facies, consisting again of Annelida, Brachiopoda, and Conchostraca, to the almost entire exclusion of other groups of organisms.

Comley Limestones.—In both areas the "Comley Limestones" come in at the summit of the sandstone group with their several faunal changes and crowded with trilobites (see p. 315 for details).

MIDDLE CAMBRIAN.

Basal Beds of Middle Cambrian.—Of the unconformity seen at Comley between the Lower and Middle Cambrian, there is no visible evidence at Rushton, but the change of fauna is very abrupt and is accompanied by an equally abrupt change of sedimentation.

P. œlandicus *Fauna.*—Coarse glauconitic quartz grit, with pebbles up to 2 inches in length and carrying the *P. œlandicus* Fauna in lenticular patches of calcareous sandstone, are evidently closely parallel to the features seen in the Comley Quarry. The only difference is the absence (so far as the small amount of material seen in the trench could indicate) of blocks of Lower Cambrian sandstone and limestone which occur in profusion in the basal 2 feet of the Comley Quarry Ridge Grit.

Paradoxides *Fauna from Loose Blocks.*—The loose blocks of Middle Cambrian limestone found in the surface soil at loc. 3, Rushton, have yielded an extensive fauna new to Shropshire (see p. 390) which is tentatively placed a little above the *P. groomi* Fauna, but it also has some relation to the *C. exsulans* Fauna of Scandinavia at the base of the *P. tessini* Zone.

P. hicksi *Fauna.*—The next fauna of the Rushton district is probably that containing *P. hicksi* and *P. bohemicus*, var. *salopiensis*, from loc. 7 in Cherme's Dingle, where the strata are so much disturbed by faulting that the stratigraphical sequence has not yet been made out. The fauna seems to indicate a horizon rather low in the *P. tessini* Zone and possibly the equivalent of the Lower *Hicksi* Fauna at Hartshill, Nuneaton (ILLING (1916), p. 397, and Table H, p. 436, horizons B1–B3).

P. intermedius *Fauna*.—From faunal considerations the next Shropshire horizon known is probably that of *P. intermedius* at Comley, found typically in the Comley Breccia Bed (COBBOLD (1913), pp. 37–44).

Horizon with P. rugulosus.—Above this, after an unexplored interval, comes the *P. rugulosus* Horizon of Comley (COBBOLD (1911), p. 297), with a very scanty fauna.

Horizon with P. davidis.—This is followed by about 14 ft. of sandstones and grits with the *P. davidis* Fauna.

P. forchhammeri *Fauna*.—A very few feet higher in the continuous Comley section of these beds a band occurs containing nine species of Brachiopoda, eight of which are known from the *P. forchhammeri* Zone of Scandinavia. This band was tentatively referred to that zone in 1921 (COBBOLD (1921), p. 373, Horizon Bc, *Billingsella* Beds).

Reverting again to the Rushton area, confirmation of this reference is found in the stream section at loc. 9. The lower beds at this spot (see text-fig. 4, p. 316) are coarse sandy shales containing many specimens of *Liostracus bruno*, sp. nov., and one cranidium of *P. tessini*, which species in Scandinavia ranges up to the top of the *P. davidis* Zone. Less than two feet higher very coarse quartz grits come in somewhat abruptly, and near their base an exceedingly rich bed of gritty limestone is found with a full *P. forchhammeri* fauna (see fig. 4). This is the faunal equivalent of the Andrarum Limestone together with the *Hyolithus* Limestone, which at Andrarum lies about 12 inches below as a separate band (MOBERG (1910), p. 56, Zone 14).

From surface features and blocks, these grits, with intervening coarse flags and sandy shales, appear to cover a surface width of some 400 to 500 feet of ground in the direction of dip, and if the dip be maintained, there would be room for from 80 to 100 feet of beds before we reach their upper limit, but it is highly probable that this is much in excess of the actual thickness.

Agnostus lævigatus *Horizon* (?).—The limit is believed to be seen at loc. 10 where the unsatisfactory fauna detailed on p. 384 was collected from fine, soft shales intercalated with coarse grits, tentatively referred to the *Agnostus lævigatus* Zone.

At Comley the beds that appear from their position to represent the *P. forchhammeri* Grit of Rushton were seen to be about 6 feet thick, and to graduate with apparent conformity into soft shale, which, at about 18 feet higher, contained *Orusia*. Whatever the actual thickness of the glauconitic quartz grits of Rushton may be, it is almost certain that they are much thicker than their equivalents at Comley.

Such are the facts, so far as they have been observed, their meaning remains obscure. but considering that the Upper Cambrian is in Shropshire essentially a deposit of soft fine shale, the discrepancy above noted may find an explanation in the changing conditions of land and sea which were responsible for the advent of shale without grits.

Upper Cambrian.

The exposures of Upper Cambrian in the Rushton area are most meagre and have produced no consecutive section.

That some beds of a *Leptoplastus-Eurycare-Ctenopyge* horizon occur is indicated by the loose blocks in Dryton Brook, the fauna of which is given above (p. 391).

Stubblefield has come to our help with his section of Bentleyford Brook and proves their position in relation to the *Dictyonema* Beds above, and to the *Orusia lenticularis* Beds below, in which he has found *Parabolinella* aff. *williamsoni* (Belt) and, lower down, *Beltella* cf. *bucephala* (Belt), and in another exposure of similar shale at Comley he found *Parabolina spinulosa* (Wahlenberg) and the same *Beltella* in a similar position (Cobbold (1927), p. 587, and Stubblefield (1930), p. 57).

The characters of the Lower Comley Sandstone and its faunas are the same as those described by Matthew for his Lower Etcheminian :—alternations of arenaceous and argillacious beds with faunas of Conchostraca, Acrotretidæ and " Tubicolous Worms."—The general conditions of sedimentation, such as shallowness of water-contiguity and elevation of land areas, supply of terrigenous material, and diastrophism must surely have been of the same character.

IX. CORRELATION AND SUMMARY.

The principal objects of the correlation table (Pl. 45) are (i) to give a synopsis of the Shropshire Cambrian horizons, (ii) to show their relations with the various zones or divisions established in other areas, (iii) to indicate the missing portions of the sequence.

The wide central column contains a summary of the Rushton, Comley, and Bentleyford horizons in descending order so far as they can be inferred from the available information. Additional work in the Rushton area would probably reveal further horizons, particularly in the Lower and Upper divisions, and adjust those of the Middle division with more certainty.

The left-hand column gives abridgments of the current zonal names of the European zones, or formations.

The intermediate columns to the left of the centre give summaries of sequences in areas to the west of the Shropshire meridian, except those in the Spanish Peninsula, which are shown on the right.

Areas on the east of our meridian are represented by columns to the right of the centre.

No attempt is made to indicate the lithological character or thicknesses of the strata.

References to authorities consulted will be found in the last line of the table.

UPPER CAMBRIAN.

In **Shropshire** only two of the six Scandinavian zones have been recognized. Three or four are known in North Wales, two or three from **Malvern** and **Nuneaton,** six are distributed in the Island of **Cape Breton** (**Nova Scotia**) and **Newfoundland,** and two, or more, in **Poland.** In all these areas, Tremadocian Beds directly succeed the Upper Cambrian (*sensu stricto*).

In the **Montagne Noire** (**Hérault**) the highest known beds with *Paradoxides* are immediately followed by about 500 feet of thin bedded, quartzose grits and shales, which have up to the present yielded no recognizable fossils, though fairly well charged with fragments of trilobites and cystids. These beds are considered to be of Upper Cambrian age, and are followed by another set of beds with a very rich Lower Tremadoc fauna.

MIDDLE CAMBRIAN.

Seven horizons (not necessarily zones) have been recognized for **Shropshire,** two are referred to the *P. forchhammeri* Zone, three appear to come within the *P. tessini* Zone, and two in the *P. œlandicus* Zone.

Arranged in descending order the Shropshire *Paradoxides* species are :—

P. forchhammeri ; with *Paradoxides spp.* indet. A and B.—Rushton.
P. tessini ; Rushton, from 2 feet below the *P. forchhammeri* Grit.
P. davidis ; Comley, from 2 or 3 feet below the bed yielding 8 species of brachiopoda characteristic of the *P. forchhammeri* Fauna.
P. rugulosus ; Comley, from about 14 feet below the *P. davidis* horizon.
P. intermedius ; Comley, Breccia Bed.
P. hicksi ; Rushton, with type specimen of *P. bohemicus salopiensis.*
P. bohemicus salopiensis ; with *P. œlandicus.*
P. groomi ; with *P. sjögreni* and *P. œlandicus.*

The same general order appears to obtain in **Newfoundland, South Wales, Nuneaton, Norway, Sweden, Denmark,** and possibly **Poland ;** but in **Bohemia** there is a striking anomaly, *P. bohemicus* comes near the top of the series and *P. rugulosus* in the lowest of the " zones " given by CHOUFF (1928). He tabulates the beds in five " zones," as follows :—

e. Zone of *Lingulella matthewi.*
d. ,, *Ellipsocephalus hoffi*, with *Paradoxides spinosus* and *P.* cf. *lyelli.*
c. ,, *P. bohemicus*, with *P. spinosus*, *Conocoryphe sulzeri* and *Lichenoides priscus.*
b. ,, *Stromatocystites pentangularis*, with *P. spinosus*, *Cono. sulzeri* and *Agn. integer.*
a. ,, *P. rugulosus* with *P. spinosus*, *Cono. sulzeri*, *Lichenoides priscus* and *P. sacheri.*

It is difficult to decide with which horizons this group of beds should be correlated. The occurrence of *P. spinosus* in *a–d*, of *Cono. sulzeri* in *a–c*, the repetition of *Lichenoides* in *a* and *c*, all seem to point to the group being equivalent to one portion of the more northerly sequences and this portion rather with the *P. davidis* part of the *P. tessini* Zone, than lower down ; *Agn. integer* is recognized from the Menevian (Porth-y-rhaw), South Wales. To whatever position this group is assigned, the anomaly as to the relative position of *P. bohemicus* and *P. rugulosus* remains and suggests several questions. (i) Is the Shropshire form of *P. bohemicus salopiensis* a variety or a distinct species ? (ii) Are there two or even three distinct forms recorded as *P. rugulosus* ?

This last species is discussed by LINNARSSON (1882, pp. 6–10) under *P. brachyrrhachis ;* by BRÖGGER (1879, p. 23) ; by GRÖNWALL (1902, pp. 113–115), who makes *P. brachyrrhachis* a synonym.

It also seems possible that *P. rugulosus* may have a greater range of zone or of variation than other species.

In the Middle Cambrian, **Poland** has much in common with Scandinavia and Britain. Species are noted by CZARNOCKI (1927, p. 9 of the paper, as issued separately, and 1932, p. 77), which he compares very closely with *P. bohemicus salopiensis* and *P. intermedius.*

In **Germany** two deep borings, near **Dobrilugk** in the **Nieder-Lausitz** (about 100 km. south of Berlin), penetrated Cambrian rocks. The cores contained well-preserved fragments of trilobites including *P.* cf. *rugulosus* CORDA, *P.* cf. *spinosus* BOECK and other genera, indicating part of the *P. tessini* Zone (PICARD (1928), vol. 80, p. 20. Also PICARD and GOTHAN (1931), vol. 10, p. 131).

Another occurrence of Middle Cambrian is found in the **Ober-Lausitz** near **Görlitz,** characterized by *Billingsella rœmingeri* (BARRANDE) and other brachiopoda, in contact with Lower Cambrian, see below, p. 398.

Other exposures of Middle Cambrian occur in the **Frankenwald, Bavaria,** and have been studied by WURM (1924), p. 67 ; (1925), p. 71 ; and (1928), p. 31, who describes two faunas : (1) in 1924 and 1925, from the Wilderstein district with *Paradoxides spinosus* BOECK, *Ptychoparia striata* EMMRICH and other fossils of the Bohemian sequence ; (ii) in 1928, from the neighbourhood of Lippertsgrün with *Conocoryphe heberti* MUN.-CHALM. and BERGERON and several species of the Acadien moyen of the Montagne Noire, as listed by MIQUEL (1912, p. 10).

Middle Cambrian is well developed in **Hérault, France,** where MIQUEL (1912) recognizes three successive faunas with *Paradoxides*, somewhat closely comparable with those of Britain and Scandinavia.

Some portions of these faunas have been recognized in **Spain** and possibly in **Portugal.**

LOWER CAMBRIAN.

The Shropshire horizons referred to the Lower Cambrian may be summarized thus :—

	Horizons.	
(½ foot, 0·12 m.)	*Lapworthella* Beds	p. 387
The Comley Limestone (*ca* 6 ft., 2m.)	*Protolenus* Limestone	p. 387
	Strenuella Limestone	p. 386
	E. bellimarginatus Limestone	p. 386
	Callavia Beds	p. 386
Lower Comley Sandstone (*ca* 500 ft, 150 m.)	Upper portion with Conchostraca	p. 385
	Middle portion with *Holmia lundgreni*	p. 398
	Lower portion ii. *Acrothele prima*	p. 385
	i. *Obolella groomi*	p. 398
Quartzite (30—100 ft., 10—30 m.)	Wrekin Quartzite.	

In the extreme east and west of the geographical area covered by the correlation table we find Lower Cambrian faunas comparable with ours.

On the banks of the **River Lena,** at **Olenek** in **Siberia**, our species of *Pagetia* and *Eodiscus* from the *Callavia* beds are almost exactly represented (Cobbold, 1910*a*, pp. 24, 25).

At **North Attleborough,** in **Massachusetts,** several collecting stations have yielded a number of related forms or species found in Shropshire, including *Callavia crosbyi*, Walcott (= *O. callavei*, Lapworth), *Eodiscus speciosus* (Ford), *Pagetia attleborensis* (Ford), *Strenuella strenua* (Billings), *Obolella atlantica*, Walcott. Evidently the faunas there are the same as in our area and, curiously, the rocks have the same lithological aspect. Unfortunately, we have no detailed account of the sequence of the beds at Attleborough, and cannot tell if the order of appearance of species is the same.

In south-eastern **Canada** and **Newfoundland** we have the same faunas, with the *Callavia* beds always below those with *Protolenus*. At **Manuel's,** *Callavia* [Walcott's figured specimen (1891, Pl. 91) of *Callavia bröggeri* was found near Manuel's Station] occurs within 30 or 40 feet of the base of the *Paradoxides* Beds, and about the same distance above the basal conglomerate. Howell (1925, pp. 24, 25) summarizes the succession at this locality. The details of the beds have yet to be unravelled. **New Brunswick** and **Cape Breton Island (Nova Scotia)** provide numerous sections where the strata are closely comparable with the Shropshire Lower Cambrian.

Only general correlations can be made with **Greenland** and north-west **Scotland.** Only a few of the species in those Lower Cambrian faunas are closely related to Shropshire forms.

In **Wales** we have beds which can only be correlated from stratigraphical considerations and then with little certainty.

Much has yet to be learned of the details of the Lower Cambrian at **Nuneaton.** *Callavia* occurs (ILLING (1916) p. 436) low down in the Purley shales. At a distance estimated at 200 to 300 feet of thickness, the well-known *Hyolithus* Limestone is found capping the upper group of quartzite. The fauna of this limestone (COBBOLD, 1919) is not strictly comparable with any of the Shropshire horizons, though its general aspect is certainly Lower Cambrian. It is very different in character from any among the Comley Limestones ; it is not the same as the *Obolella groomi* Fauna near the top of the Wrekin and Malvern Quartzite ; though much of the mass of the Lower Comley Sandstone is covered, the absence of this limestone fauna suggests that it may be older than the Shropshire Cambrian base. Further, though the Nuneaton Quartzite is an equivalent in sedimentation of the Wrekin Quartzite, it is not necessarily its equivalent in time. Possibly the Cambrian sea arrived at Nuneaton before it reached Shropshire. There are many indications of such a transgression in **Scandinavia,** too numerous to mention in detail ; in the **Baltic region** a *Hyolithus* band occurs very low down below the *Volborthella, Discinella, Platysolenites, Mickwitzia* horizons (ÖPIK, 1929).

It seems probable to the writer that all the strata of Esthonia described by ÖPIK (1929, p. 15) from the vicinity of Tallinna (Reval) may be earlier than any of our Shropshire horizons and no column for this district is entered in the table. ÖPIK records *Holmia kjerulfi* in quantity from the lower beds and a conglomerate at the very base of the " Blaue Ton " resting on " Urgebirge." It may be remarked that *Holmia kjerulfi*, LINNARSSON is recorded from Poland in the lowest arenaceous beds known as well as high up in the same group of strata. In Shropshire we have only one species of *Holmia* (*H. lundgreni*, MOBERG), and that comes in the median portion of the Lower Comley Sandstone.

In **Germany** Lower Cambrian sediments are recorded by SCHWARZBACH (1932, p. 454), in the **Ober-Lausitz,** near **Görlitz,** with an *Olenellus* (s. s.) fauna specially characterized by plentiful remains of *Eodiscus speciosus* (FORD), and in another band many *Protolenus* fragments. Considerable interest will arise when the forms are fully described.

In **Poland** the whole of the Lower Cambrian (as well as the Middle and Upper Cambrian) is present, except any basal beds. The Lower division is essentially composed of arenaceous deposits with some hundreds of feet of successive beds.*

The sequence of Lower Cambrian zones is generally comparable with those of Shropshire, the faunas occurring in the following order below several zones with *Paradoxides* :—

(v) *Ellipsocephalus*, with *Strenuella* and *Eodiscus*.——(iv) *Protolenus*, with *Ellipsocephalus* and *Eodiscus*.——(iii) *Holmia*, with *Strenuella*.——(ii) *Holmia* (3 spp.) with *Kjerulfia* and *Strenuella* (2 spp.) *Conchostraca*, *Obolella*, etc.—— (i) *Holmia*, with *Torellella* and *Volborthella*.

The Polish Cambrian succession taken as a whole may prove the most complete in the European area. The missing zones at present are those of *Acerocare*, *Olenus*, *Para-*

* CZARNOCKI, 1927, p. 18, estimates the total thickness of the Cambrian in the mountains of Swietycryz at 1500 to 2000 m. (5000 to 6500 feet).

doxides œlandicus, *Lapworthella*, and possibly the equivalent of the " Blaue Ton " of Esthonia.

It appears from these considerations that *Holmia* replaces *Callavia* to a certain extent and has a very wide range within the Lower Cambrian.

In the **south of France** the Cambrian succession of the Montagne Noire is almost as complete as that of Poland, but is somewhat different in character. The Lower Cambrian is represented by the arenaceous beds of the Grès de Marcory which appear to rival those of Poland in thickness, but up to May, 1933, had only yielded one fossiliferous horizon with a fauna of two species of trilobites and, from another locality, a poorly preserved brachiopod referred by MIQUEL (1912, p. 7) to *Kutorgina cingulata*, BILLINGS.

[Since this was written M. MARCEL THORAL has kindly informed me that he has discovered another fossiliferous horizon in the Lower Cambrian of the Montagne Noire, near the apparent base of the series and resting upon metamorphic rocks.

The fauna is under investigation. It seems at first sight to consist of innumerable *Hyolithellus*-like annelids, some bivalved crustaceans, and perhaps early gastropods, but no trilobites.

January, 1934. E. S. C.]

The stratigraphy and structure have recently been described by BLAYAC and THORAL (1931), and the trilobites by the present writer (COBBOLD, 1931 *b*). They are referred to *Olenopsis* and a new genus, *Blayacina*, and indicate a fauna more or less out of relation to those of the more northern areas. The dome of Marcory is surrounded by massive beds of "*Archæocyathus*" limestone which are followed, with "complete concordance," by the *Paradoxides* shales referred to above (p. 396).

It seems that here we are reaching a southerly limit of the Cambrian development of northern Europe.

In the **north of France** the massive limestones, conglomerates, and slate series of the Armorican Massif (BIGOT, 1926) speak of conditions of sedimentation and life very different from those that obtain in more northern areas.

From his researches in the area, BIGOT suggests that the Cambrian transgression over the Archean land-mass was very gradual, and that the basal deposits consequently occur at varying horizons ; whether any should be correlated with Lower Cambrian remains an open question.

No Lower Cambrian has been identified in the **north of Spain.** The fauna from Haut Alemtejo in **Portugal** described by DELGADO (1904, p. 327, *et seq.*) appears to the writer as probably a southern equivalent of the upper part of the Lower Cambrian or of passage beds to the Middle Cambrian.

ACKNOWLEDGMENTS.

We have to acknowledge our indebtedness to many other workers, but first we would render special thanks to the Director of H.M. Geological Survey for permission to publish the results of the junior author's field work. To the senior author it has been both a privilege and a pleasure to work up the faunas of a little-known British-Cambrian area ; he accepts full responsibility for the determinations and lists. Both of us are very grateful to the late Dr. F. L. Kitchin and members of the Survey staff for much help and many valuable suggestions. We also tender hearty thanks to Colonel Sowerby and Mr. J. L. Sinnett for permission to dig trenches, and to their tenants for the necessary facilities and access to the ground.

The senior author also tenders very hearty thanks to many friends both here and abroad. Professor Grönwall, Dr. A. H. Westergård, Dr. Leif Störmer, and Mr. Trygve Strand have been most kind in showing him the collections in their keeping, in lending specimens for comparison, and in conducting him to several of the classic exposures of Scandinavia. In Poland he is very greatly indebted to M. Jan Czarnocki, Professor Koslowski, and Dr. Samsonowitz for conducting him to some of the exposures in that country that are destined to become famous among the European Cambrian localities. To Dr. J. Koliha he owes many thanks for giving up much of his time on the occasion of a visit to the Barrandeum collections in the National Museum at Prague and for kind replies to letters. Very hearty thanks are also due and given to Professor J. Blayac, of Montpellier, to M. Jean Miquel, and to M. Marcel Thoral for their kind welcome on the occasion of a recent visit to the Montagne Noire, for showing him their collections and for their valued friendship and correspondence.

In America he has received much help from Dr. E. O. Ulrich, Professor B. F. Howell, Dr. C. E. Resser, and many others, always so ready to lend specimens and reply to enquiries. At home help and encouragement has been given on all sides, particularly by Professor W. W. Watts. Mr. Philip Lake has most kindly advised as to trilobites, Dr. W. F. Whittard was very helpful in reading over the typescript and making valuable suggestions, while Dr. C. J. Stubblefield has not only revised the determinations of all the Olenids, but has rendered very great assistance with the subject of correlation and in the construction of the table.

In conclusion, we would point out that our work has provided only an outline of the stratigraphy and faunal sequences of the area, and that there are considerable possibilities at Rushton for obtaining a much more complete idea of the Shropshire Cambrian.

From the mapping we now know fairly well where to look for further information and, from the study of the fossils, what lacunæ it may be possible to fill. In the absence of natural exposures however, especially among the softer beds, there is but little more that can be learned without a considerable amount of excavation on carefully prepared lines.

In the central part of the area the beds are generally lying at comparatively gentle angles and are cut into blocks by faults trending more or less at right angles to the strike, so that any block may well contain some consecutive and readable part of the sequence.

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EXPLANATION OF PLATES.

Numbers in square brackets refer to those registered in the Geological Survey Collection, London.

Each individual specimen figured has a separate figure-number assigned to it. Where more than one separate drawing of an individual fossil is given they are indicated by the addition of *a*, *b*, *c*, etc., to the figure-number.

All the specimens are from the Rushton area, Shropshire.

Drawings are made to scale from measurements taken on the specimens.

PLATE 38.

Sketch Map of the Cambrian Area of Rushton, Shropshire.

PLATE 39.

Correlation of the Shropshire Cambrian with probable equivalents in some other areas of the Northern Hemisphere.

PLATE 40.

FIGS. 1, *a–c*, *Rushtonia lata*, Gen. et sp. nov. Holotype × $6\frac{2}{3}$. *a*, top view; *b*, side view before damage occurred; *c*, outline of section. [51658.]——*Protolenus* Limestone, loc. 11.

FIG. 2.—*Torellella inornata*, sp. nov. Holotype × $5\frac{1}{3}$. Side view, with section. [51659.]——*Callavia* beds, loc. 8.

FIG. 3.—*Torellella scabra*, sp. nov. Holotype × $6\frac{2}{3}$. [51660.]——Lower Comley Sandstone, loc. 5.

FIG. 4.—*Hyolithellus* (?) *tortuosus*, sp. nov. Holotype × $6\frac{2}{3}$. [51661.]——Lower Comley Sandstone, shale facies, loc. 6.

FIG. 5.—*Hyolithellus* (?) *cingulatus*, sp. nov. Holotype × $6\frac{2}{3}$. [51662.] *Lapworthella* Limestone, loc. 11.

FIG. 6.—*Hyolithus* (*Orthotheca* ?) *ornatus*, sp. nov. Holotype × $6\frac{2}{3}$. [51663.] Dorsal view with apertural and axial sections.——*P. forchhammeri* Grit, loc. 9.

Figs. 7 and 8.—Polyzoa (?) Gen. et sp. indet $\times 13\frac{1}{3}$.

Fig. 7.—*Lapworthella* Limestone, loc. 7. [51664.]

Fig. 8.—Same horizon, loc. 11. [51665.]

Fig. 9.—*Lingulella* cf. *concinna*, Matthew $\times 6\frac{2}{3}$. [51666.]——Upper Cambrian, loose block of *Ctenopyge-Leptoplastus* Limestone, loc. 12.

Fig. 10.—*Obolus*, *sp*. indet. $\times 6\frac{2}{3}$. [51667.]——*Protolenus* Limestone, loc. 8.

Figs. 11–15.—*Kutorgina* (?) *anglica*, sp. nov.

Fig. 11.—Ventral valve $\times 6\frac{2}{3}$. [51668A.]

Fig. 12.—Dorsal valve $\times 6\frac{2}{3}$. [51668B.]

Fig. 13.—Dorsal valve $\times 5\frac{1}{3}$. Holotype. [51669.]

Fig. 14.—Ventral valve $\times 5\frac{1}{3}$. Paratype. [51670.]

Fig. 15.—Dorsal valve $\times 2\frac{2}{3}$, crushed almost flat. [51671.]

Lower Comley, Sandstone, loc. 5.

Figs. 16 and 17.—*Acrotreta gemmula*, Matthew $\times 6\frac{2}{3}$. Ventral valves, interior and exterior. [51672, 51673.]——Lower Comley Sandstone, shale facies, loc. 6.

Fig. 18.—*Acrotreta sagittalis taconica*, Walcott $\times 6\frac{2}{3}$. [51674.] Dorsal valve, with side outline, specimen destroyed, but see Pe. 2387.——Lower Comley Sandstone, shale facies, loc. 6.

Fig. 19.—*Acrothele prima* (Matthew) $\times 6\frac{2}{3}$. [51675.] Ventral valve, with side outline.——Lower Comley Sandstone, shale facies, loc. 6.

Fig. 20.—[Specimen missing.] *Acrothele intermedia*, Linnarsson $\times$ 8, specimen missing. Copy of drawing made 1918. [51676.]——*P. hicksi* fauna, loc. 7.

Figs. 21 and 22.—*Hyolithus œlandicus*, Holm $\times$ 4.

Fig. 21.—Ventral face. [51677.]

Fig. 22.—Dorsal face. [51782.]——From loose block with *P. bohemicus salopiensis* fauna, loc. 3.

Fig. 23.—*Hyolithus* (*Orthotheca*) *cor*, Holm $\times$ 4. [51678.] Dorsal face.——*P. forchhammeri* Grit, loc. 9.

Figs. 24 and 25.—*Hyolithus pennatuloides*, sp. nov.

Fig. 24.—Holotype, ventral face and section $\times 13\frac{1}{3}$. [51679.]

Fig. 25.—Side view of another specimen. $\times 6\frac{2}{3}$. [51680.]——*P. forchhammeri* Grit, loc. 9.

Fig. 26.—*Hyolithus tenuistriatus* Linnarsson, $\times 2\frac{2}{3}$. Dorsal view; section. [51681.]——*P. forchhammeri* Grit, loc. 9.

Fig. 27.—*Hyolithus araneus*, Holm, var. *angustus* nov. Holotype $\times 6\frac{2}{3}$. [51682.] Dorsal, ventral, side views, and section.——*P. forchhammeri* Grit, loc. 9.

Fig. 28.—*Hyolithus*, *sp*. "Fin support." $\times 2\frac{2}{3}$, with section $\times 5\frac{1}{3}$. [51683.]——*P. forchhammeri* Grit, loc. 9.

Fig. 29.—*Hyolithus obscurus*, Holm, var. *anglicus* nov. Holotype $\times 6\frac{2}{3}$. [51684.] Exfoliated dorsal face and section.——*P. forchhammeri* Grit, loc. 9.

Plate 41.

Figs. 1–5.—*Hyolithus operosus*, sp. nov. $\times 2\frac{2}{3}$.

Fig. 1.—Holotype, dorsal face, and 1*a* section. [51686.]

Fig. 2.—Ventral face. [51687.]

Fig. 3.—Apical portion, showing curvature and septum. [51688.]

Fig. 4.—Dorsal face, sculpture very rugose. [51689.]

Fig. 5.—Dorsal face, showing malformation of striæ. [51783.]

P. forchhammeri Grit, loc. 9.

Fig. 6.—*Bradoria* cf. *obesa* (Matthew). [51690.] Right valve, with anterior view. $\times 6\frac{2}{3}$; sculpture $\times$ *Ca* 50.——*Acrothele prima* Shale, loc. 6.

FIG. 7.—*Bradoria benepuncta* (MATTHEW). [51691.] Right valve and anterior outline. × $6\frac{2}{3}$; sculpture × C^a 67.——*Acrothele prima* Shale, loc. 6.

FIG. 8.—*Bradoria robusta* (MATTHEW). [51692.] Right valve and anterior outline. × $6\frac{2}{3}$; sculpture × C^a 67.——*Acrothele prima* Shale, loc. 6.

FIG. 9.—*Beyrichona tinea*, MATTHEW [51693].——Right valve × $6\frac{2}{3}$, sculpture, × 50, drawn from plasticine cast. *Acrothele prima* Shale, loc. 6.

FIG. 10.—*Beyrichona* cf. *rotundata*, MATTHEW × 20. [51694.]——Left (?) valve, with end outline. Lower Comley Sandstone, loc. 1.

FIGS. 11–13.—*Aluta ulrichi*, sp. nov. × $13\frac{1}{3}$.

Fig. 11.—Holotype, *a*, left; *b*, right valves; *c*, anterior outline, loc. 4. [51695.]

Fig. 12.—Interior of right valve, loc. 1. [51696.]

Fig. 13.—Internal cast of left valve, loc. 1. [51697.]——The Lower Comley Sandstone.

FIG. 14.—*Aluta rotundata*, WALCOTT, var. *salopiensis* nov., × $13\frac{1}{3}$. [51698.]——Right valve and anterior outline. Lower Comley Sandstone, loc. 4.

FIGS. 15 and 16.—*Indianites exigua*, sp. nov. × $13\frac{1}{3}$.

Fig. 15.—Holotype, left valve and anterior view. [51699.]

Fig. 16.—Right valve. [51700.]——Lower Comley Sandstone, loc. 4.

FIG. 17.—*Indianites obtusa*, sp. nov. × 20. Holotype, left valve exfoliated posteriorly; with anterior outline. [51701.]——*Lapworthella* Limestone, loc. 8.

FIG. 18.—*Dielymella* (?) *corpulenta*, sp. nov. × 4. [51702.] Holotype, right valve, exfoliated anteriorly, hinge line damaged; *a*, side view; *b*, dorsal outline showing damage; *c*, anterior outline. × 4; *d*, portion of test. × C^a 53.——*P. forchhammeri* Grit, loc. 3.

FIGS. 19, 20.—*Corynexochus illingi*, sp. nov. × $13\frac{1}{3}$.

Fig. 19.—Holotype, cranidium with side and posterior outlines. [51703.]

Fig. 20.—Partial cranidium. [51704.] *P. groomi* Grit., loc. 8.

FIG. 21.—*Corynexochus pusillus*, ILLING. × $13\frac{1}{3}$. Nearly complete cranidium, test preserved with side and posterior outlines. [51784.]——*P. groomi* Grit, loc. 8.

FIG. 22.—*Conocoryphe marginata longifrons*, COBBOLD. × $6\frac{2}{3}$. Nearly perfect cranidium, test partially preserved. [51705.]——*P. groomi* Grit, loc. 8.

FIG. 23.—*Dorypyge rushtonensis*, sp. nov. × about $5\frac{1}{3}$. Reconstruction of pygidium based upon photograph of the Holotype and upon the Paratypes. [51706, 51707, 51800, 51708.]——*P. forchhammeri* Grit, loc. 9.

PLATE 42.

FIGS. 1, 2, 3.—*Paradoxides bohemicus salopiensis*, COBBOLD. × $1\frac{1}{3}$.

Fig. 1*a*.—Cranidium, right cheek missing. 1*b*.—Side view of same. [51709.]

Fig. 2.—Hypostoma. Side outline of same. [51710.]

Fig. 3.—Pygidium. [51711.]——Loose block, loc. 3, with *P. bohemicus salopiensis* Fauna.

FIGS. 4, 5, 6.—*Paradoxides* cf. *œlandicus*, SJÖGREN. × $1\frac{1}{3}$.

Fig. 4.—Part cranidium, facial suture stretched. [51712.]

Fig. 5.—Part glabella, measured drawing. [51713.]——Loose block, loc. 3.

Fig. 6.—Interior of free cheek, showing suture. [51785.]——*P. groomi* Grit, loc. 8.

FIGS. 7, 8.—*Paradoxides forchhammeri*, ANGELIN. × $1\frac{1}{3}$.

Fig. 7.—Part cranidium, outline slightly retouched. [51714.]

Fig. 8.—Hypostoma, outline retouched; the part to the right is faulted down under that on the left. [51715.]——*P. forchhammeri* Grit, loc. 9.

FIG. 9.—*Paradoxides, sp.* indet. A. Pygidium. × $5\frac{1}{3}$.

A composite drawing, reconstructed from two specimens, an exfoliated interior and an exterior. [51786.] [51788.]——*P. forchhammeri* Grit, loc. 9.

FIG. 10.—*Paradoxides, sp.* indet. B. free cheek, exterior. × $2\frac{2}{3}$. [51716.]——*P. forchhammeri* Grit, loc. 9.

FIG. 11.—*Paradoxides tessini*, BRONGNIART. × $1\frac{1}{3}$. A flattened cranidium. [51787.] —— Shale immediately below the *P. forchhammeri* Grit, loc. 9.

FIGS. 12–14, and (?) 15, *a* and *b* and 16. *Solenopleura rushtonensis*, sp. nov.

Fig. 12.—Holotype, × 2, cranidium, much bruised in front and sides. [51717.]——Outline restored in places from paratypes.

Fig. 13.—Paratype, × 2, much damaged at front and sides, but showing great width of posterior border and position of palpebral lobe ; with posterior outline. [51789.]

Fig. 14.—Paratype × 2, a better preserved specimen, showing the occipital ring and much elevated palpebral lobe ; with side and posterior outlines. [51718.]

FIGS. 15*a* and *b*.—Two views of one associated free cheek, ×$2\frac{2}{3}$, *a*, as it lies flat in the rock ; *b*, when tilted to bring the margin horizontal. Anterior process not quite complete. [51790.]

FIG. 16.—Pygidium, associated with paratype. [51719.] × $2\frac{2}{3}$.——All from the two loose blocks with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIG. 17.—*Solenopleura acadica elongata*, MATTHEW. × $2\frac{2}{3}$. Nearly complete cranidium [51791], with front border restored in outline from other fragments.——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 18*a* and *b*.—*Solenopleura bucculenta*, GRÖNWALL. × $2\frac{2}{3}$. *a*, Partial cranidium, test preserved. [51720.] *b*, counterpart of same, showing position of palpebral lobe. [51721.]——*P. forchhammeri* Grit, loc. 9.

PLATE 43.

FIG. 1.—*Solenopleura applanata* (SALTER). × 4. Cranidium, partly exfoliated, with side and posterior outlines. [51722.]——*P. forchhammeri* Grit, loc. 9.

FIG. 2.—*Solenopleura brachymetopa nuntia*, GRÖNWALL. × $2\frac{2}{3}$. Cranidium largely exfoliated, with side and posterior outlines. [51723.]——*P. forchhammeri* Grit, loc. 9.

FIG. 3.—*Solenopleura* (?), *sp.* indet × 4. Partial cranidium, with side and posterior outlines. [51724.] ——*P. forchhammeri* Grit, loc. 9.

FIG. 4.—*Solenopleura* (?) *angustiora*, sp. nov. × 4. Cranidium. Holotype, with side and posterior outlines, and photograph × $2\frac{2}{3}$. [51792.]——*P. forchhammeri* Grit, loc. 9.

FIG. 5.—*Agraulos humilis*, sp. nov. × 4. Holotype, a well-preserved cranidium, postero-lateral angles missing, with side outline. [51793.]——Loose block, with *P. bohemicus salopiensis* Fauna.

FIGS. 6–9.—*Agraulos robustus*, sp. nov.

Fig. 6.—Holotype, cranidium, spine added from the counter part ; with side and posterior outline. × 4. [51725.]

Fig. 7.—Cranidium, with strong secondary coating, with side outline, referred with reserve to this species (see p. 35). × $6\frac{2}{3}$. [51726.]

Fig. 8.—Photograph of same specimen. × $10\frac{2}{3}$.

Fig. 9.—Minute cranidium 1·7 mm. long, excluding occipital ring. ×$6\frac{2}{3}$. [51727.] *P. forchhammeri* Grit, loc. 9.

FIGS. 10 and 11 and (?) 12, 13.—*Liostracus bruno*, sp. nov.

Fig. 10.—Holotype cranidium, test preserved and partially obscured by a thin secondary coating; with side outline. [51794.]

Fig. 11.—Paratype cranidium, with side outline, test largely exfoliated, and cast weathered. × 4. [51728.]——Both from the calcareous *P. forchhammeri* Grit, loc. 9.

Fig. 12.—Two cranidia, flattened and distorted. × $2\frac{2}{3}$. [51729.]

Fig. 13.—Another cranidium flattened and less distorted. × $2\frac{2}{3}$. [51730.]——Both from the sandy shale immediately below the *P. forchhammeri* Grit, loc. 9, referred with reserve to this species, associated with *P. tessini*.

Fig. 14.—*Liostracus dubius*, COBBOLD. × 4. The largest cranidium seen. 5·5 mm. long, with side and posterior outlines. [51731.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 15–17.—Pygidia associated with *Liostracus* and *Solenopleura*.

FIG. 15.—Two pygidia, × $2\frac{2}{3}$, test preserved. [51732.]——Probably *Liostracus sp.*

Fig. 16.—Distorted pygidium, × $5\frac{1}{3}$, without test, probably *Solenopleura*. [51733.]

Fig. 17.—External impression of immature pygidium. × $13\frac{1}{3}$. [51734.]

P. forchhammeri Grit, loc. 9.

PLATE 44.

FIGS. 1, 2.—*Agnostus rotundus*, GRÖNWALL.

Fig. 1.—Fragmentary pygidium, estimated total length over 5 mm. with transverse section. × $2\frac{2}{3}$. [51735.]

Fig. 2.—Internal cast of small but complete pygidium. × $6\frac{2}{3}$. [51736.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 3, 4.—*Agnostus gibbus*, LINNARSSON. × $6\frac{2}{3}$.

Fig. 3.—Cephalon. [51737.]

Fig. 4.—Pygidium. [51738.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 5–8.—*Agnostus lens*, GRÖNWALL. × $6\frac{2}{3}$.

Fig. 5.—Cephalon, with side and posterior outlines. [51739.]

Fig. 6.—Cephalon, with posterior outlines. [51740.]

Fig. 7.—Pygidium, interior with side and posterior outlines. [51741.]

Fig. 8.—Pygidium, exterior with side and posterior outlines. [51742.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 9–12.—*Agnostus fissus*, LUNDGREN, var. *mancus*, nov. × $6\frac{2}{3}$.

Figs. 9–11.—Cephala, with variation in the length of the fissure. [51743, 51744, 51745.]

Fig. 12.—Pygidium. [51746.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 13–19.—*Agnostus parvifrons*, LINNARSSON. × $6\frac{2}{3}$.

FIGS. 13, 14.—Cephala, with short glabellas. [51747, 51748.]

Figs. 15, 16.—Cephala, with long glabellas, recalling *A. brevifrons*. [51749, 51750.]

Figs. 17, 18, 19.—Pygidia, recalling BRÖGGER's var. *mammillatus*, with posterior margins variously developed. [51751, 51752, 51753.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 20, 21.—*Agnostus lundgreni*, BRÖGGER. × $6\frac{2}{3}$.

Fig. 20.—Cephalon, with side outline. [51754.]

Fig. 21.—Pygidium, with side and posterior outline. [51755.]——*P. forchhammeri* Grit, loc. 9.

FIG. 22.—*Agnostus stenorrhachis*, GRÖNWALL. × $6\frac{2}{3}$. [51756.] Measured drawing, with defects made good from specimen. [51757.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 23, 24.—*Eodiscus speciosus* (FORD). × $6\frac{2}{3}$. Internal casts of pygidia, badly preserved. [51758, 51759.]——*Protolenus* Limestone, loc. 8.

FIG. 25.—*Ellipsocephalus nordenskjöldi*, LINNARSSON. × $2\frac{2}{3}$. Distorted internal cast of cranidium. [51760.]——*Callavia* beds, loc. 3.

FIG. 26.—Polyzoon. × C^a 20. [51685.]——Rough sketch of object to show general characters. Lower Cambrian, *Acrothele prima* Shale, loc. 6.

PLATE 45.

FIG. 1*a–d*.—*Liostracus* (*Agaso*) *pringlei*, sp. nov. holotype. × $2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view of cranidium; *b*, side outline; *c*, posterior outline; *d*, × $1\frac{1}{3}$. [51762.]—*P. forchhammeri* Grit, loc. 9.

2*a–d*. *L.* (*Agaso*) *pococki*, sp. nov. holotype. × $2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view; *b*, side outline; *c*, posterior outline; *d*, × $1\frac{1}{3}$. [51764.]——*P. forchhammeri* Grit, loc. 9.

3*a–d*. *L.* (*Agaso*) *rushtonensis*, sp. nov. holotype. × $2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view; *b*, side outline; *c*, posterior outline; *d*, × $1\frac{1}{3}$. [51763.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 4–6.—Pygidia referred with reserve to this sub-genus. × $2\frac{2}{3}$.

Fig. 4.—Reconstruction, from the three specimens photographed in figs. 5 and 6. [51765, 51766.]

Fig. 5.—Two pygidia; the greater part of the upper one was removed exposing traces of the anterior margin, which was not otherwise visible. [51765.]

Fig. 6.—Another pygidial fragment [51766.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 7–19.—Olenidæ from loose blocks of bituminous limestone in Dryton Brook, loc. 13.

FIGS. 7, 8.—*Eurycare angustatum*, ANGELIN.

Fig. 7.—Free cheek doubtfully referred to this species. × $6\frac{2}{3}$. [51774.]

Fig. 8.—Cranidium. × $6\frac{2}{3}$. [51775.]——Block A.

FIG. 9*a–d*.—*Ctenopyge drytonensis*, sp. nov. holotype. × $5\frac{1}{3}$.

a. Cranidium dorsal view; *b*, side outline; *c*, posterior outline; *d*, anterior outline.* [51776.] (See also fig. 19.)——Block A.

Fig. 10.—*Sphærophthalmus* (?) *sp.* indet., minute free cheek with visual surface preserved. × $6\frac{2}{3}$. [51777.]—Block A.

Figs. 11*a*–13.—*Sphærophthalmus* (?) *parabola*, sp. nov. × $5\frac{1}{3}$.

Fig. 11.—Holotype. *a*, dorsal view; *b*, side outline; *c*, posterior outline; *d*, anterior outline. [51778.]

Fig. 12.—Paratype A. [51779.]

Fig. 13.—Paratype B. [51780.]——Block A.

FIG. 14.—*Ctenopyge flagellifera*, var. *angusta*, WESTERGÅRD (?). × $6\frac{2}{3}$. Free cheek. [51781]——Block A.

FIG. 15.—Group of cranidia. *Ctenopyge spp.* × $2\frac{2}{3}$.

a. Appears to be *Ct. drytonensis*, sp. nov. [51767]; *b*, is probably *Ct. flagellifera* (ANGELIN). [51768.]. *c* and *d* may be WESTERGÅRD'S var. *angusta*. [51769.]——Block D.

FIGS. 16, 17.—*Ctenopyge flagellifera* (ANGELIN).

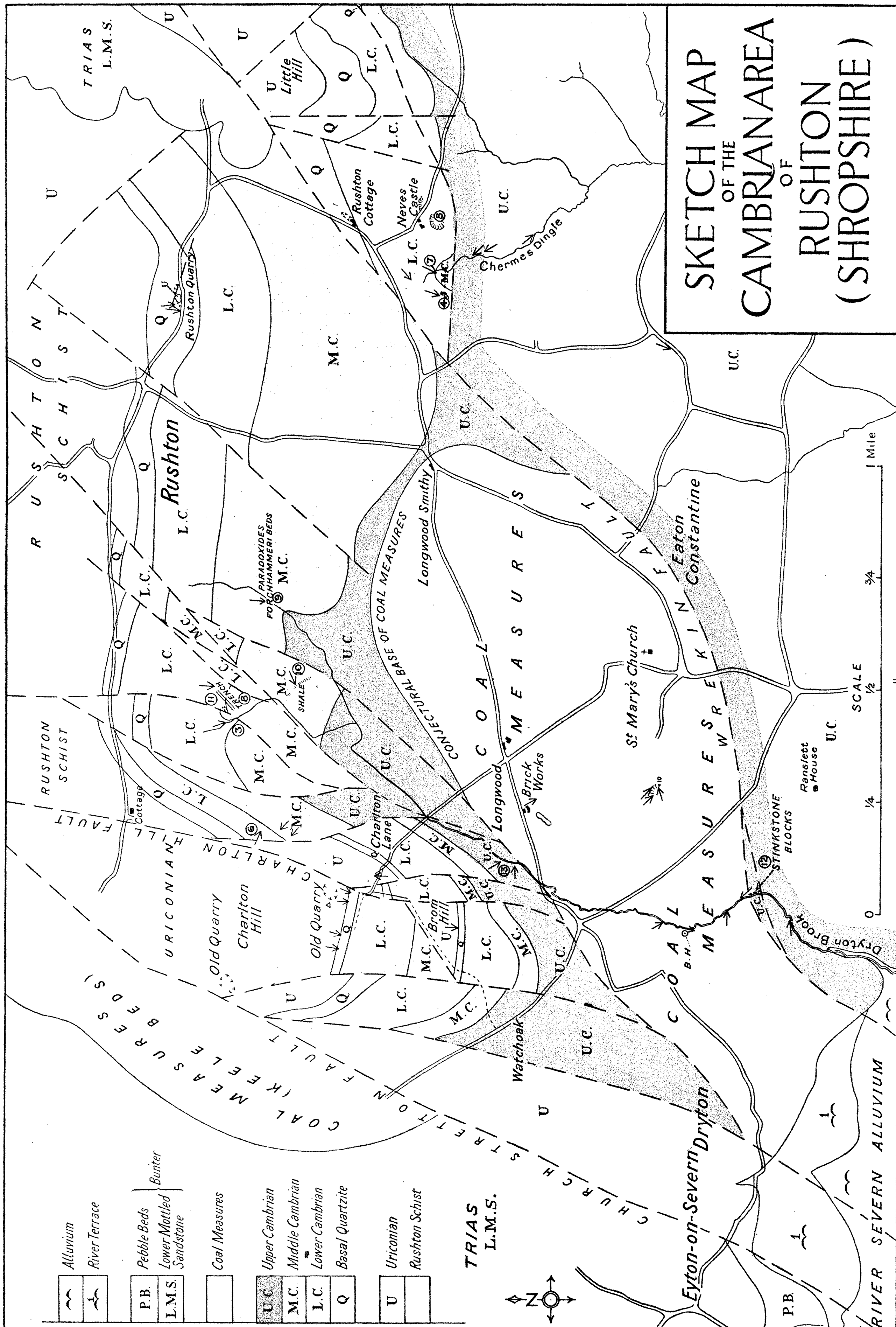
Fig. 16.—Free cheek. × $6\frac{2}{3}$. [51770.]

Fig. 17.—Small but nearly perfect cranidium with side and posterior outlines. × $5\frac{1}{3}$. [51771.] ——Block A.

FIG. 18.—*Leptoplastus raphidophorus*, ANGELIN. Two free cheeks. × $5\frac{1}{3}$. [51772.]

FIG. 19.—*Ctenopyge drytonensis*, sp. nov. × $5\frac{1}{3}$. [51773.] A small but nearly perfect cranidium.——Block A.

* These outlines were overlooked during revision and are incorrect.


SKETCH MAP OF THE CAMBRIAN AREA OF RUSHTON (SHROPSHIRE)
Alluvium
River Terrace
P.B. Pebble Beds
L.M.S. Lower Mottled Sandstone
Bunter
TRIAS L.M.S.
Coal Measures
U.C. Upper Cambrian
M.C. Middle Cambrian
L.C. Lower Cambrian
Q Basal Quartzite
U Uriconian
Rushton Schist
SCALE
0
1/4
1/2
3/4
1 Mile
RUSHTON SCHIST
URICONIAN
CHARLTON HILL FAULT
CHURCH STRETTON FAULT
COAL MEASURES (KEELE BEDS)
COAL MEASURES
WREKIN FAULT
CONJECTURAL BASE OF COAL MEASURES
PARADOXIDES FORCHHAMMERI BEDS
SHALE
STINKSTONE BLOCKS
RIVER SEVERN ALLUVIUM
TRIAS L.M.S.
Rushton
Rushton Quarry
Rushton Cottage
Neves Castle
Chermes Dingle
Little Hill
Longwood Smithy
Eaton Constantine
St Mary's Church
Brick Works
Longwood
Charlton Lane
Charlton Hill
Old Quarry
Brom Hill
Watchoak
Eyton-on-Severn
Dryton
Dryton Brook
Ranslett House
Cottage
B.H.

		ZONES.	MASSACHUSETTS AND VERMONT.	S.E. CANADA AND NEWFOUNDLAND.	N. West
CAMBRIAN.	UPPER.	*Acerocare.*		*Parabolina heres* (3).	
		Peltura, Sphærophthalmus, Ctenopyge.		*Peltura and Ctenopyge.*	
		Leptoplastus, Eurycare.		*Leptoplastus.*	
		Parabolina spinulosa.		*Parabolina spinulosa.*	
		Olenus.		*Olenus.*	
		Agnostus pisiformis.		*Agnostus pisiformis.*	
	MIDDLE.	*Agnostus lævigatus.*			
		Paradoxides forchhammeri.	St. Albans Formation. *Centropleura* (1).		
		P. tessini. *Paradoxides davidis.*		*Paradoxides davidis* (3).	Cape Wood Fo *Dorypyge.*
		Conocoryphe æqualis.			
		Agnostus parvifrons.			
		Paradoxides hicksi.		*Paradoxides hicksi.*	
		Ctenocephalus exsulans.	Braintree (2).		
		Paradoxides salopiensis.	*Paradoxides harlani.*		
		Paradoxides ölandicus.		*Paradoxides bennetti.*	
	LOWER.	Comley Limestones. *Lapworthella.*		*Catadoxides* Zone (4).	Cape Kent Fo
		Protolenus.		*Protolenus* Zone.	*Olenellus.*
		Strenuella. *Eodiscus bellimarginatus.*	North Attleborough Beds.		Wulff River mation.
		Callavia.	*Callavia, etc.* (*Olenellus* in Vermont).	*Callavia* Zone.	*Callavia, Olenell*
		Arenaceous Beds.	?		
		Holmia.	?		
		Basal Beds (often Quartzite).	Base Unknown.	Conglomerates, etc. ~~~~~ Volcanics.	
		REFERENCES.	(1) Howell, 1932. (2) Grabau, 1900.	(3) Matthew, 1903. (4) Howell, 1926.	Poulsen, 19

(E.S.C. 1933.)

CORRELATION OF THE SHROPSHIRE CAMBRIA[N]

GREENLAND.		N.W. SCOTLAND.	WALES.	
N. WEST.	EAST.		SOUTH.	NORTH.
			LINGULA FLAGS (5). *Lingulella davisi.* *Olenus.*	LINGULA FLAGS. *Peltura, Sphærophthalmus, et* *Eurycare* (?) *Parabolina spinulosa.* *Lingulella davisi.* *Olenus.*
[W]OOD FORMATION. *ge.*		?	MENEVIAN BEDS. *Orthis hicksi.* *Paradoxides davidis.* *Paradoxides hicksi.* SOLVA BEDS. *Paradoxides aurora.* *Paradoxides solvensis.* *Paradoxides harknessi.*	MENEVIAN BEDS. *Dorypyge* (ST. TUDWAL'S only) (6). *Paradoxides davidis* (5) (6). *Paradoxides hicksi* (5) (6). HARLECH SERIES.
[K]ENT FORMATION. *s.* FF RIVER FORMATION. *a, Olenellus.*	ELLA ISLAND FORMATION. *Olenellus, Strenuella.* BASTION FORMATION. *Olenellus.* SPIRAL CREEK FORMATION. TILLITE CANYON FORMATION. TILLITE.	SERPULITE GRIT (5). FUCOID BEDS. *Olenellus.* PIPE ROCK. QUARTZITE. TORRIDONIAN.	CAERFAI BEDS. *Olenellus* (?) CONGLOMERATE. PEBIDIAN.	CONGLOMERATE. VOLCANICS.
LSEN, 1927.	POULSEN, 1930.	(5) WATTS in EVANS & STUBBLEFIELD, 1929.		(6) NICHOLAS, 1916.

BRIAN HORIZONS WITH PROBABLE EQUIVALENTS IN SOME OTHER

	SHROPSHIRE. Comley-Rushton-Bentleyford.		MALVERN.	NUNEATON.	NORWA
LAGS.			Whiteleaved Oak Shale.	Monk's Park Shale (5).	*Parabolina here*
almus, etc.			*Peltura, Sphærophthalmus.*	*Peltura, Sphærophthalmus.*	2*d*. *Peltura, Sphærop*
	Ctenopyge, Leptoplastus ...	R. & B.			
			Polyphyma.		2*c*. *Leptoplastus*
sa.	*Parabolina spinulosa* ...	C. & B.			2*b*. *Parabolina*
				Moorwood Shales. Outwood's Shales.	2*a* β. *Olenus.*
				Olenus.	
	Probable Disconformity.				2*a* α. *Agnostus*
BEDS.	*Agnostus lævigatus*	R.			1*d* β. *Agnostus*
WAL'S only) (6).	*Paradoxides forchhammeri* ...	C. & R.		Abbey Shales (6).	1*d* α. *Paradoxid forch*
s (5) (6).	*Paradoxides davidis*... ...	C. & R.		*Paradoxides davidis.*	1*c* δ. *Paradoxid*
	Paradoxides rugulosus ...	C.		*Paradoxides rugulosus.*	*Paradoxides rug*
	Paradoxides intermedius ...	C.			1*c* γ. *Paradoxid*
(5) (6).	*Paradoxides hicksi*	R.		*Paradoxides hicksi.*	
				Paradoxides aurora.	1*c* β. *Ctenoceph*
RIES.	*Paradoxides salopiensis* ...	R.		Purley Shale Upr.	
	Paradoxides groomi ...	C. &R.(?)	?	*Paradoxides sjögreni.*	1*c* α. *Paradoxid*
	Unconformity.				
	Lapworthella Limestone ...	C. & R.			
					Tömten
	Protolenus Limestone ...	C. & R.		Purley Shale Lr.	
	Strenuella Limestone ...	C. & R.			1*b* β. *Strenuella Torellella.*
	Eodiscus bellimarginatus Limestone	C. & R.		*Callavia.*	1*b* α. *Holmia Hyolithell*
	Callavia Beds	C. & R.			
				Camp Hill Beds (5).	
			Hollybush Sandstone.		
	Lower Comley Sandstone.			*Hyolithus.*	
	Holmia	C.		*Callavia* (?)	1*a* β. *Volborthel*
					1*a* α. *Discinella*
	Acrothele prima	R.			
				Tuttle Hill Quartzite.	
	Obolella groomi	C.	*Obolella groomi.*		
ATE.	Wrekin Quartzite.		Malvern Quartzite.	Park Hill Quartzite.	
.	Uriconian, Rushton Schist.		Volcanics, Gneiss.	Caldecote Volcanics.	Sparagmite
16.	C. = seen at Comley. R. = seen at Rushton. B. = seen at Bentleyford.		Groom, 1902.	(6) Illing, 1916. (5) Watts, 1929.	(7) Strand, (8) Kiær, 1 Notation of I and Voc

NORWAY.	SWEDEN-DENMARK.	GERMANY.	CZECHO-SLOVAKIA.	POLAND.
lina heres. ltura, *Sphærophthalmus.* otoplastus. rabolina spinulosa. Olenus. Agnostus pisiformis.	6. *Acerocare* 5. { *Parabolina longicornis* *Peltura scarabæoides* *Peltura minor* *Ctenopyge* } 4. *Leptoplastus* 3. *Parabolina spinulosa* 2. *Olenus* 1. *Agnostus pisiformis*			*Peltura* (13). *Sphærophthalmus.* *Beltella.* *Parabolina, Orusia.*
Agnostus lævigatus. Paradoxides *forchhammeri.* Paradoxides davidis, xides rugulosus. Paradoxides tessini. Ctenocephalus *exsulans.* Paradoxides *œlandicus.*	16. *Agnostus lævigatus* 14 and 15. *Paradoxides forchhammeri* 13. *Paradoxides davidis* 8–12. *Paradoxides tessini* 7. *Ctenocephalus exsulans* 6. *Paradoxides œlandicus*	DOBRILUGK BORING (9). (NIEDERLAUSITZ). *Paradoxides spp.* NEAR GÖRLITZ (10). (OBERLAUSITZ). *Billingsella ræmingeri.*	JINCE (11). 5. *Lingulella matthewi* 4. *Ellipsocephalus hoffi.* 3. *Paradoxides bohemicus* 2. *Stromatocystites.* 1. *Paradoxides rugulosus.*	*Paradoxides,* *Solenopleura* VIII.—*Conocoryphe,* *Ellipsocepha* VII.—*Paradoxides.*
TÖMTEN. Strenuella, Torellella. Holmia Hyolithellus. Volborthella. Discinella. RAGMITE, ETC.	ÖLAND. *Hyolithellus* (?) *Bradoria* (?) *Discinella.*	*Protolenus.* *Olenellus.* *Eodiscus speciosus.* *Archæocyathus* LIMESTONE (300 feet seen)		VI { *Protolenus.* *Ellipsocephalu* } V { *Protolenus.* *Hyolithus.* } IV { *Callavia* (?) *Holmia.* } III { *Holmia.* *Kjerulfia.* *Obolella.* } II { *Conchostraca.* *Holmia.* *Mickwitzia.* } I { *Holmia.* *Volborthella.* }
STRAND, 1929. KIÆR, 1916. ion of BRÖGGER and VOGT.	WESTERGÅRD, 1922 and 1929. MOBERG, 1910.	(9) PICARD, 1928. (10) SCHWARZBACH, 1932.	(11) CHOUFF, 1928.	(13) CZARNOCKI, (14) CZARNOCKI, 19

AND.	FRANCE.		SPAIN AND PORTUGAL.	RUSSIA.
	HÉRAULT.	NORMANDY (CARTERÊT).		
. *ılmus.* *Orusia.*	POTSDAMIEN.			
, *ıopleura* (14). *ocoryphe,* *psocephalus.* *loxides.*	ACADIEN. III.—*Paradoxides forchhammeri.* II.—*Paradoxides mediterraneus.* I.—*Paradoxides rouvillei.* *Archæocyathus.*	(16) *Archæcyathus* LIMESTONE, with *Ptychoparia.*	SPAIN (17). (CHAÎNE CANTABRIQUE). *Paradoxides pradoanus.* *Archœocyathus.* PORTUGAL (18). (HAUT ALEMTEJO.) *Paradoxides spp.*	BENNETT ISLAND (19). *Paradoxides forchhammer* fauna. LENA RIVER (20). *Archœocyathus* LIMESTONE *Agnostus.*
enus. *ocephalus.* *enus.* *hus.* *ia* (?) *a.* *a.* *fia.* *a.* *ostraca.* *a.* *itzia.* *a.* *thella.*	GÉORGIEN (GRÈS DE MARCORY). *Olenopsis.* *Blayacina.* *Hyolithus*, &c. (?) BASE *Igneous.*		{ *Olenopsis* (?) *Olenellus* (?) *Eodiscus.* *Pagetia* (?) }	*Eodiscus.* *Pagetia.* *Olenellus* (?)
RNOCKI, 1927. OCKI, 1932.	(15) BLAYAC & THORAL, 1931.	(16) BIGOT, 1926.	(17) DE VERNEUIL & BARRANDE. *See* PRADO, 1860. (18) DELGADO, 1904.	(19) WESTERGÅRD, 1930. (20) VON TOLL, 1899.

..

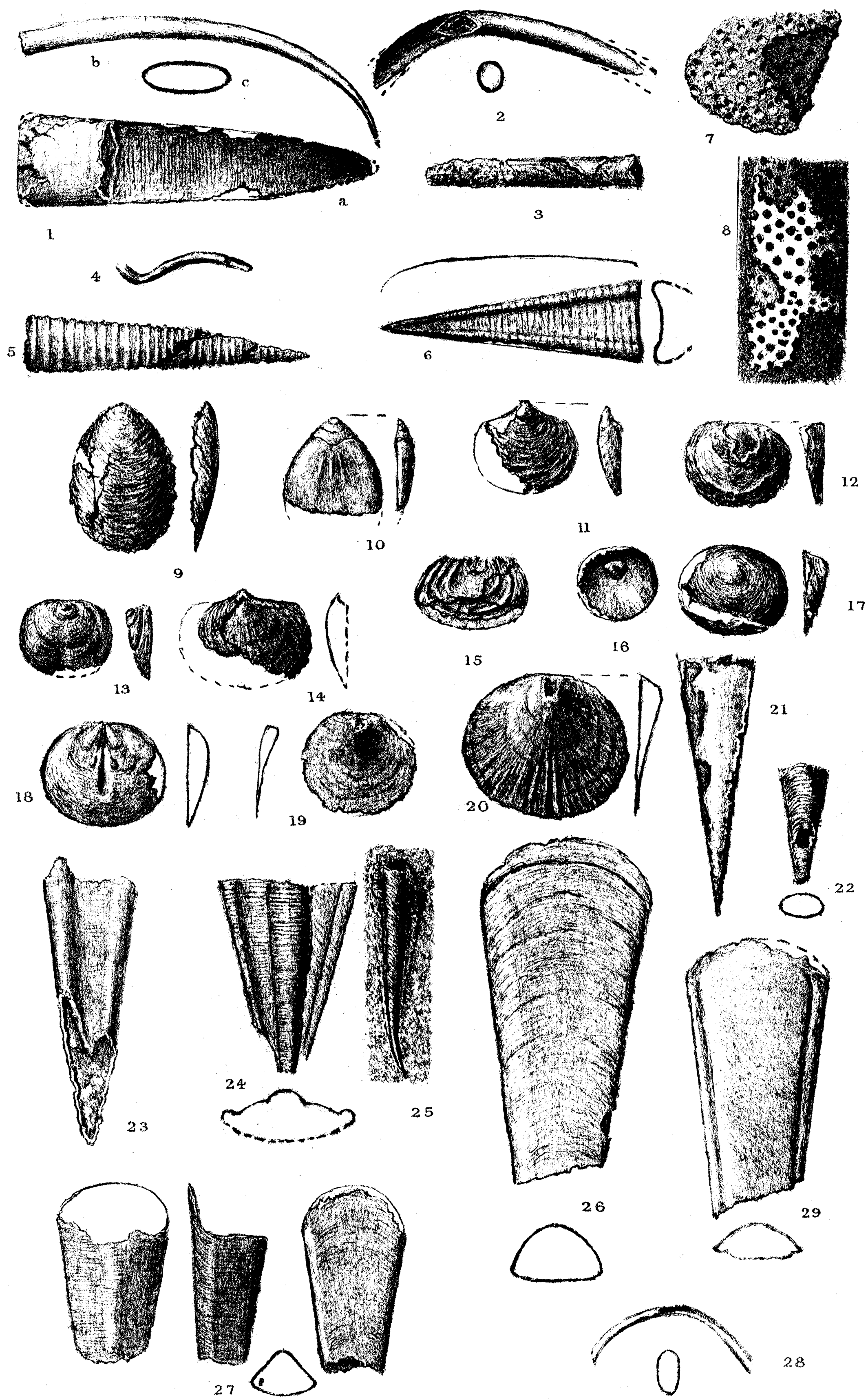
ND (19).

hhammeri

(20).

MESTONE.

RD, 1930.
LL, 1899.



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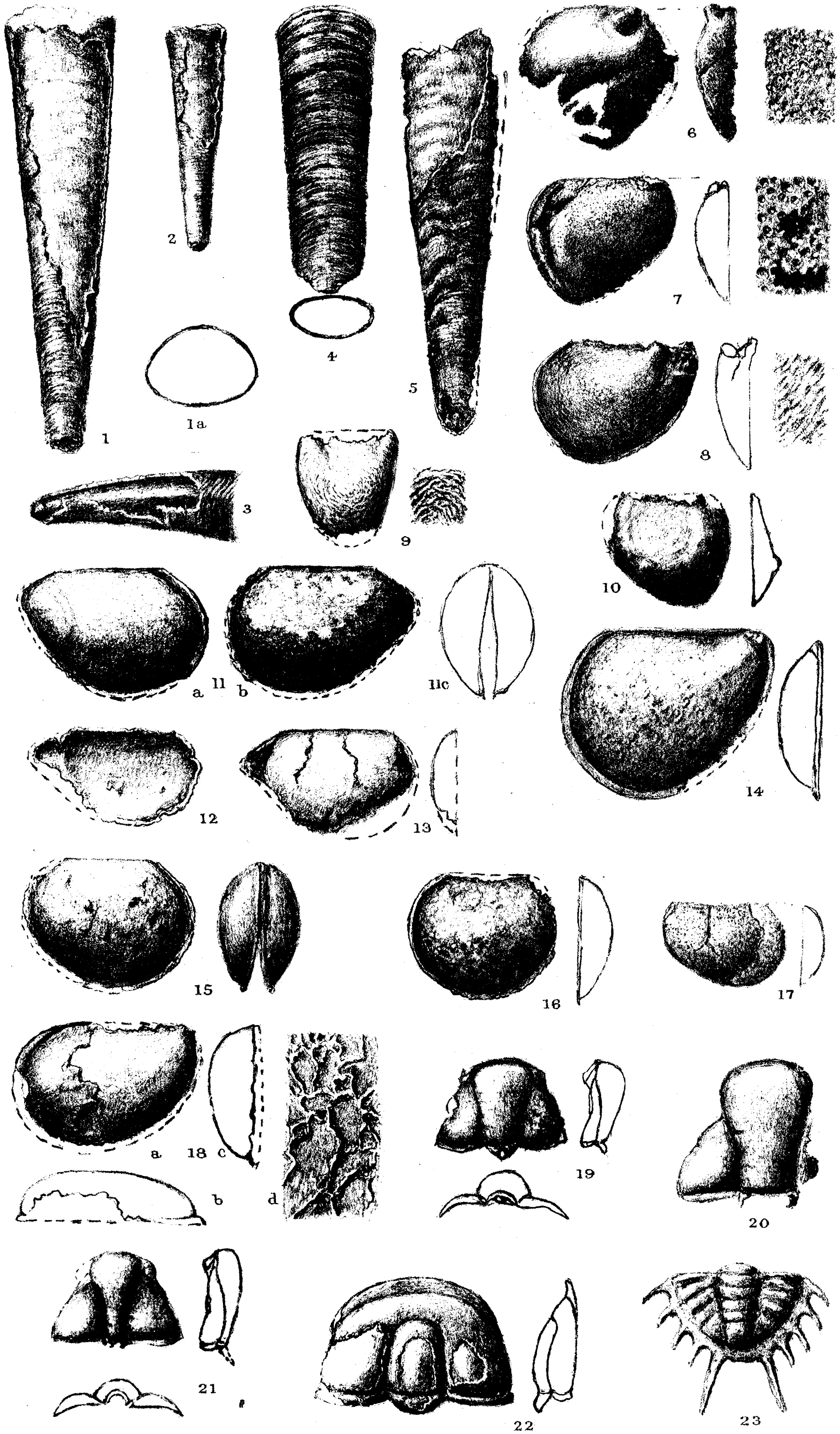
ANNELIDA, BRACHIOPODA, POLYZOA, HYOLITHIDÆ.



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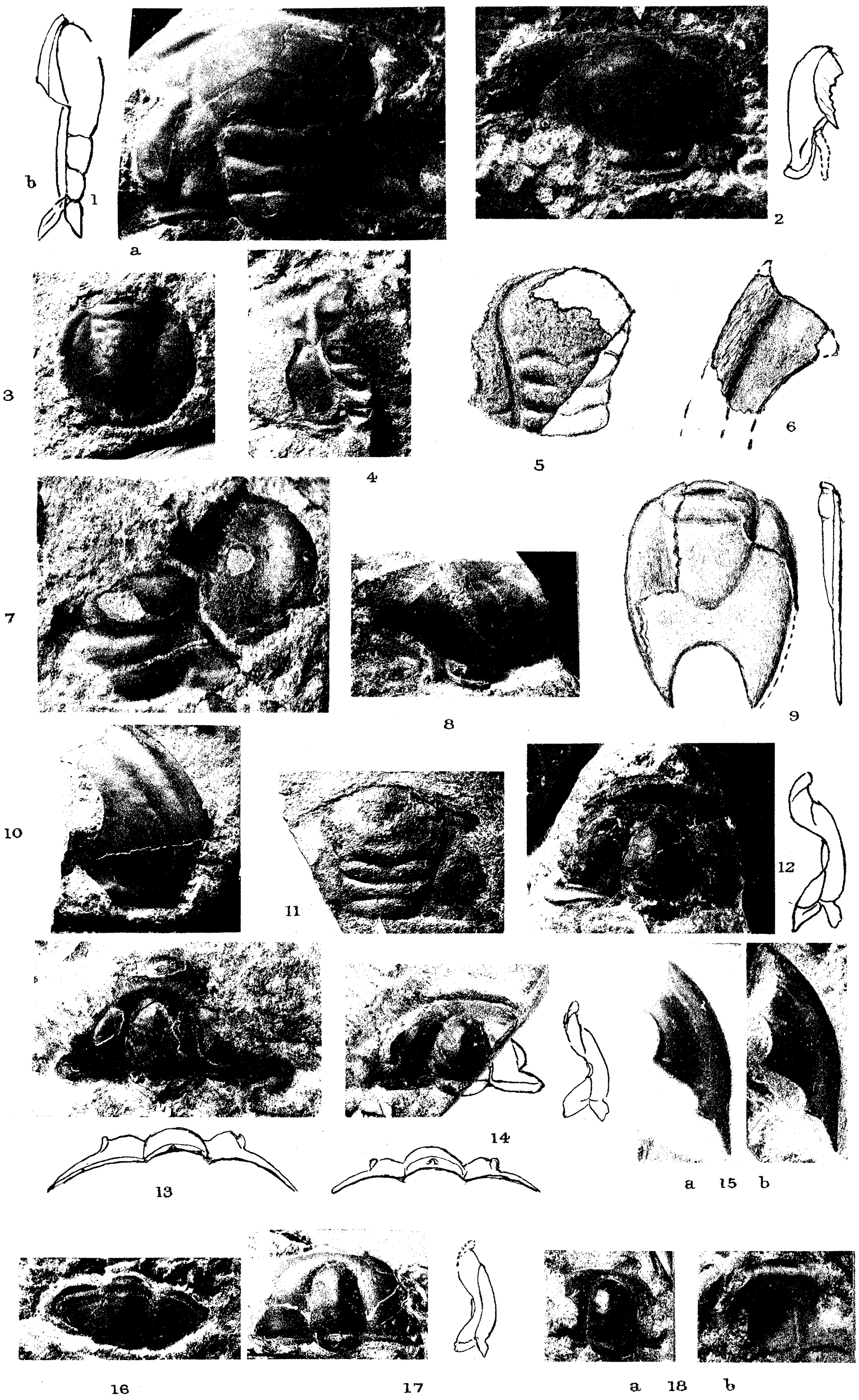
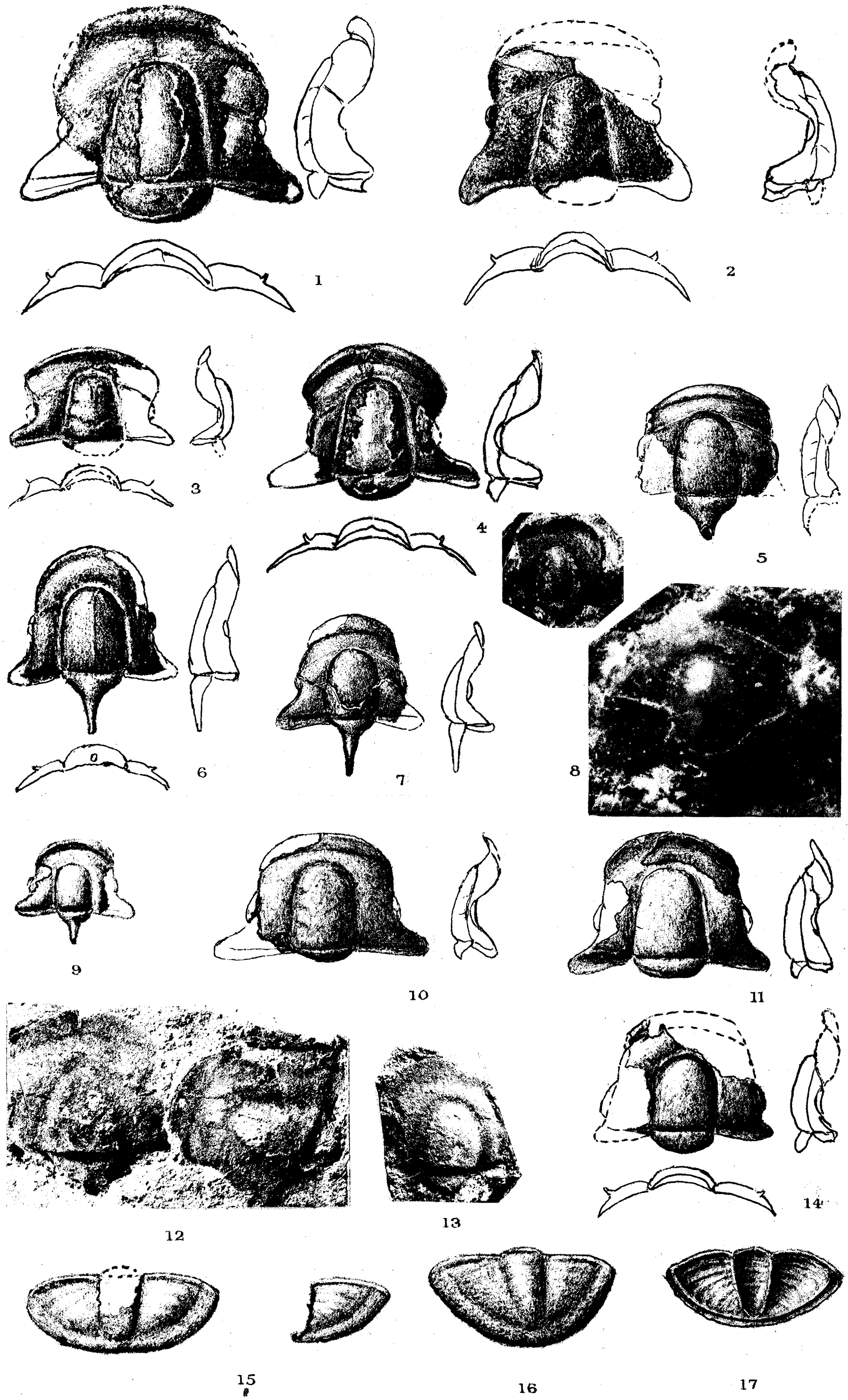
HYOLITHIDÆ, CONCHOSTRACA, CORYNEXOCHUS AND DORYPYGE.



E. S. C. del. et phot. Huth coll.

PARADOXIDES AND SOLENOPLEURA.



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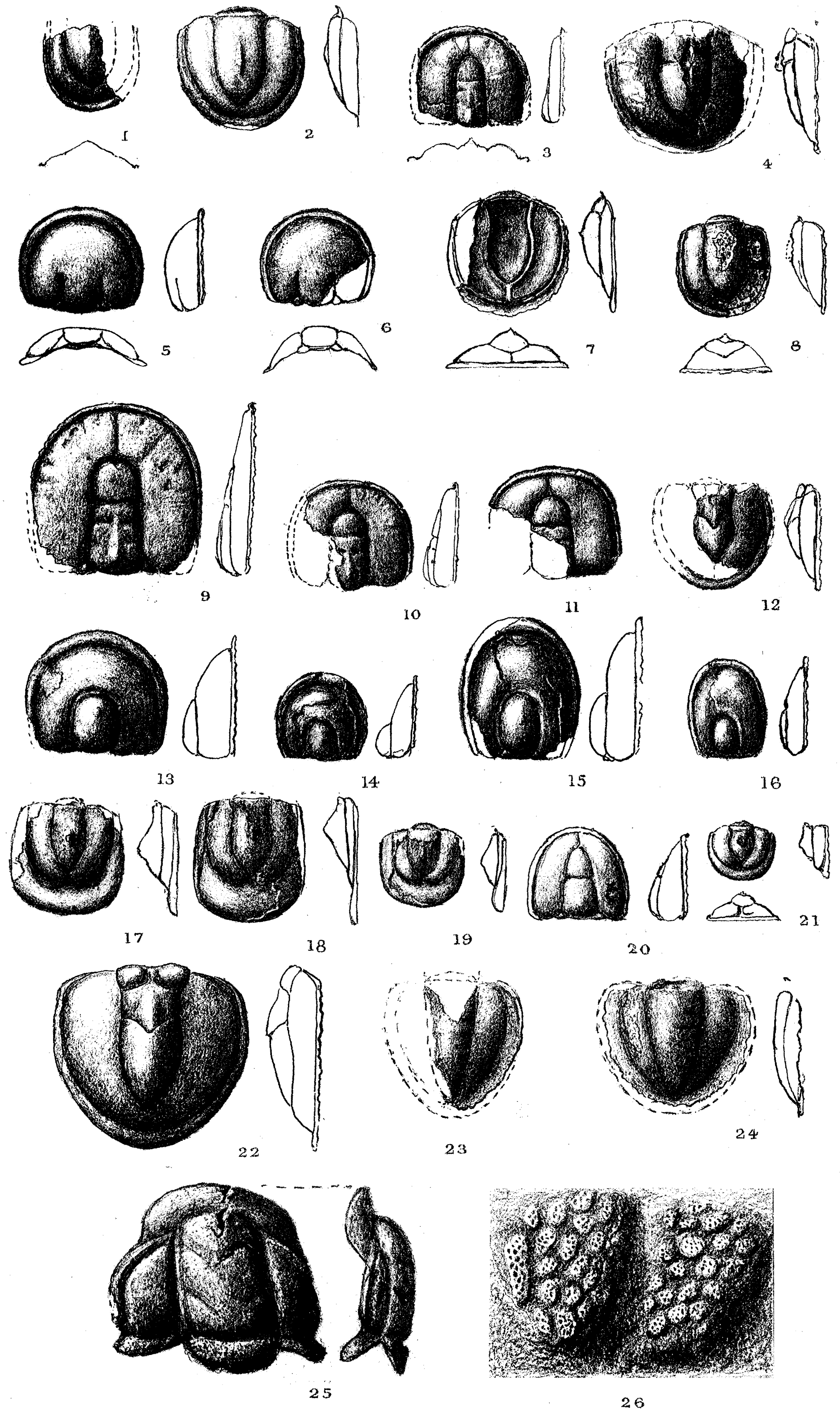
SOLENOPLEURA, AGRAULUS AND LIOSTRACUS.



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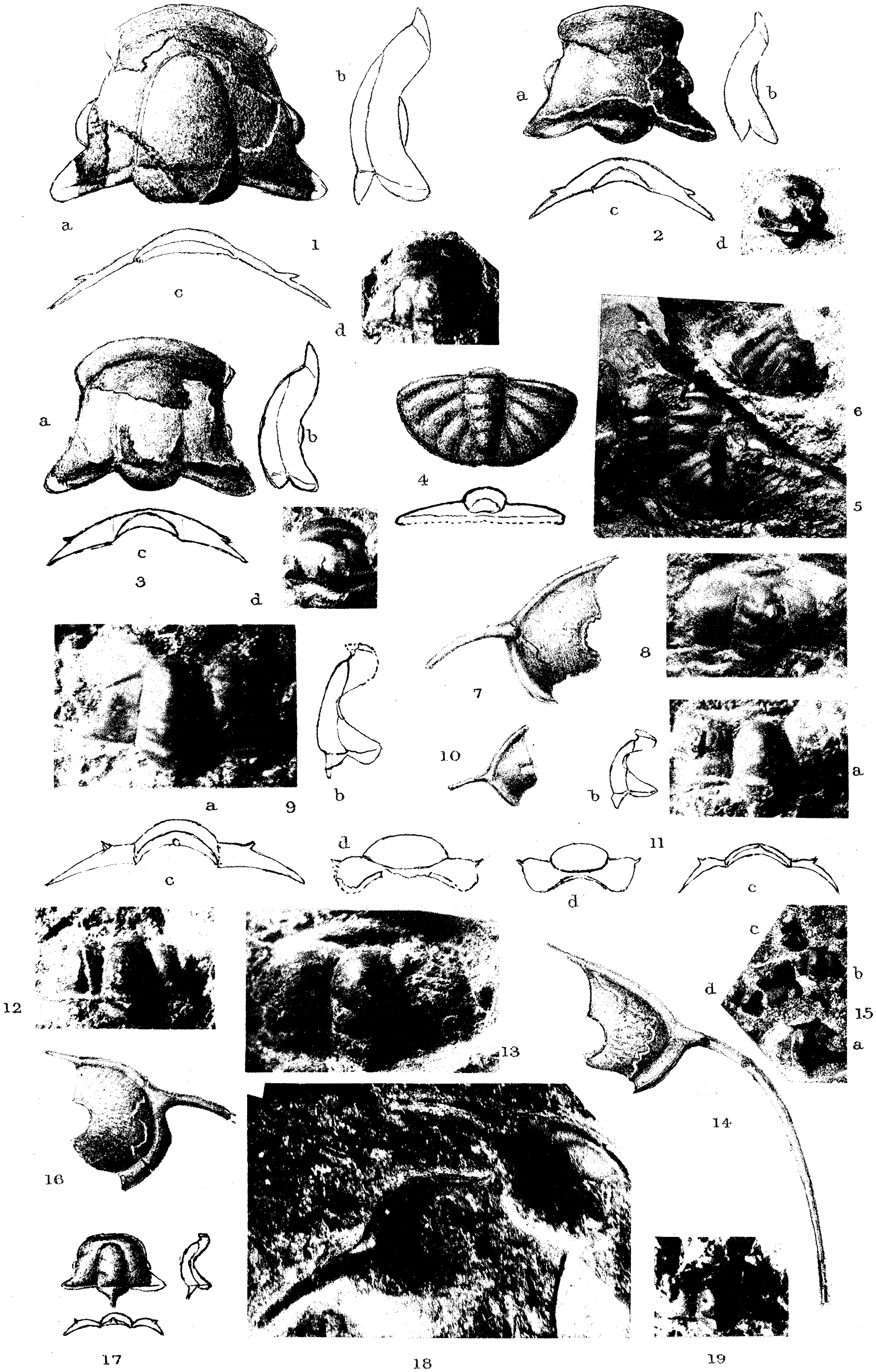
AGNOSTUS, EODISCUS, ELLIPSOCEPHALUS, POLYZOA.



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LIOSTRACUS (AGASO), CTENOPYGE, SPHÆROPHTHALMUS & LEPTOPLASTUS.

PLATE 38.

Sketch Map of the Cambrian Area of Rushton, Shropshire.

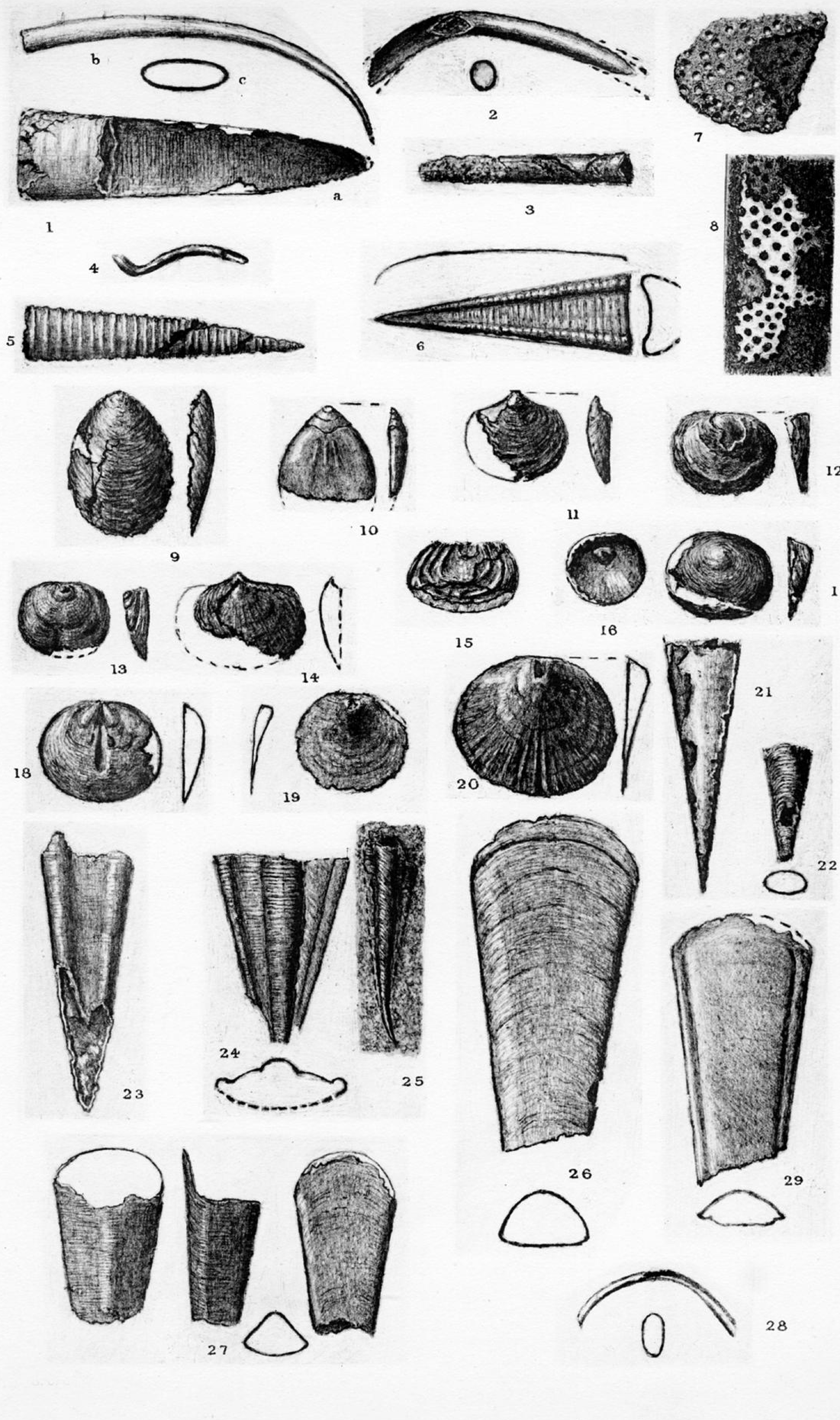
CORRELATION OF THE SHROPSHIRE CAMBRIAN HORIZONS WITH PROBABLE EQUIVALENTS IN SOME OTHER AREAS OF THE NORTHERN HEMISPHERE.

CAMBRIAN.	Zones.	Massachusetts and Vermont.	S.E. Canada and Newfoundland.	Greenland. N. West.	Greenland. East.	N.W. Scotland.	Wales. South.	Wales. North.
Upper.	*Acerocare.* *Peltura, Sphærophthalmus, Ctenopyge.* *Leptoplastus, Eurycare.* *Parabolina spinulosa.* *Olenus.* *Agnostus pisiformis.*		*Parabolina heres* (3). *Peltura and Ctenopyge.* *Leptoplastus.* *Parabolina spinulosa.* *Olenus.* *Agnostus pisiformis.*				Lingula Flags (5). *Lingulella davisi.* *Olenus.*	Lingula Flags. *Peltura, Sphærophthalmus, etc.* *Eurycare* (?) *Parabolina spinulosa.* *Lingulella davisi.* *Olenus.*
Middle.	*Agnostus lævigatus.* *Paradoxides forchhammeri.* *P. tessini.* *Paradoxides davidis.* *Conocoryphe æqualis.* *Agnostus parvifrons.* *Paradoxides hicksi.* *Ctenocephalus exsulans.* *Paradoxides salopiensis.* *Paradoxides ælandicus.*	St. Albans Formation. *Centropleura* (1). Braintree (2). *Paradoxides harlani.*	*Paradoxides davidis* (3). *Paradoxides hicksi.* *Paradoxides bennetti.*	Cape Wood Formation. *Dorypyge.*		?	Menevian Beds. *Orthis hicksi.* *Paradoxides davidis.* *Paradoxides hicksi.* Solva Beds. *Paradoxides aurora.* *Paradoxides solvensis.* *Paradoxides harknessi.*	Menevian Beds. *Dorypyge* (St. Tudwal's only) (6). *Paradoxides davidis* (5) (6). *Paradoxides hicksi* (5) (6). Harlech Series.
Lower.	Comley Limestones. *Lapworthella.* *Protolenus.* *Strenuella.* *Eodiscus bellimarginatus.* *Callavia.* Arenaceous Beds. *Holmia.* Basal Beds (often Quartzite).	North Attleborough Beds. *Callavia, etc.* (*Olenellus* in Vermont). ? ? Base Unknown.	*Catadoxides* Zone (4). *Protolenus* Zone. *Callavia* Zone. Conglomerates, etc. ~~~~~ Volcanics.	Cape Kent Formation. *Olenellus.* Wulff River Formation. *Callavia, Olenellus.*	Ella Island Formation. *Olenellus, Strenuella.* Bastion Formation. *Olenellus.* Spiral Creek Formation. Tillite Canyon Formation. ~~~~~ Tillite.	Serpulite Grit (5). Fucoid Beds. *Olenellus.* Pipe Rock. Quartzite. ~~~~~ Torridonian.	Caerfai Beds. *Olenellus* (?) Conglomerate. ~~~~~ Pebidian.	Conglomerate. ~~~~~ Volcanics.
References.		(1) Howell, 1932. (2) Grabau, 1900.	(3) Matthew, 1903. (4) Howell, 1926.	Poulsen, 1927.	Poulsen, 1930.	(5) Watts in Evans & Stubblefield, 1929.		(6) Nicholas, 1916.

CAMBRIAN.	Shropshire. Comley-Rushton-Bentleyford.	Malvern.	Nuneaton.	Norway.	Sweden-Denmark.
Upper.	*Ctenopyge, Leptoplastus* ... R. & B. *Parabolina spinulosa* ... C. & B. Probable Disconformity.	Whiteleaved Oak Shale. *Peltura, Sphærophthalmus.* *Polyphyma.*	Monk's Park Shale (5). *Peltura, Sphærophthalmus.* Moorwood Shales. Outwood's Shales. *Olenus.*	*Parabolina heres.* 2*d*. *Peltura, Sphærophthalmus.* 2*c*. *Leptoplastus.* 2*b*. *Parabolina spinulosa.* 2*a* β. *Olenus.* 2*a* α. *Agnostus pisiformis.*	6. *Acerocare* 5. { *Parabolina longicornis*, *Peltura scarabæoides*, *Peltura minor*, *Ctenopyge* } 4. *Leptoplastus* 3. *Parabolina spinulosa* 2. *Olenus* 1. *Agnostus pisiformis*
Middle.	*Agnostus lævigatus* ... ... R. *Paradoxides forchhammeri* ... C. & R. *Paradoxides davidis*... ... C. & R. *Paradoxides rugulosus* ... C. *Paradoxides intermedius* ... C. *Paradoxides hicksi* ... ... R. *Paradoxides salopiensis* ... R. *Paradoxides groomi* ... C. &R. (?) Unconformity.	?	Abbey Shales (6). *Paradoxides davidis.* *Paradoxides rugulosus.* *Paradoxides hicksi.* *Paradoxides aurora.* Purley Shale Upr. *Paradoxides sjögreni.*	1*d* β. *Agnostus lævigatus.* 1*d* α. *Paradoxides forchhammeri.* 1*c* δ. *Paradoxides davidis, Paradoxides rugulosus.* 1*c* γ. *Paradoxides tessini.* 1*c* β. *Ctenocephalus exsulans.* 1*c* α. *Paradoxides ælandicus.*	16. *Agnostus lævigatus* 14 and 15. *Paradoxides forchhammeri* 13. *Paradoxides davidis* 8–12. *Paradoxides tessini* 7. *Ctenocephalus exsulans* 6. *Paradoxides ælandicus*
Lower.	*Lapworthella* Limestone ... C. & R. *Protolenus* Limestone ... C. & R. *Strenuella* Limestone ... C. & R. *Eodiscus bellimarginatus* Limestone C. & R. *Callavia* Beds ... ... C. & R. Lower Comley Sandstone. *Holmia* ... ... C. *Acrothele prima* ... ... R. *Obolella groomi* ... ... C. Wrekin Quartzite. ~~~~~ Uriconian, Rushton Schist.	Hollybush Sandstone. *Obolella groomi.* Malvern Quartzite. ~~~~~ Volcanics, Gneiss.	Purley Shale Lr. *Callavia.* Camp Hill Beds (5). *Hyolithus.* *Callavia* (?) Tuttle Hill Quartzite. Park Hill Quartzite. ~~~~~ Caldecote Volcanics.	Tömten. 1*b* β. *Strenuella, Torellella.* 1*b* α. *Holmia Hyolithellus.* 1*a* β. *Volborthella.* 1*a* α. *Discinella.* ~~~~~ Sparagmite, etc.	Öland. *Hyolithellus* (?) *Bradoria* (?) *Discinella.*
References.	C. = seen at Comley. R. = seen at Rushton. B. = seen at Bentleyford.	Groom, 1902.	(6) Illing, 1916. (5) Watts, 1929.	(7) Strand, 1929. (8) Kiær, 1916. Notation of Brögger and Vogt.	Westergård, 1922 and 1929. Moberg, 1910.

CAMBRIAN.	Germany.	Czecho-Slovakia.	Poland.	France. Hérault.	France. Normandy (Carterêt).	Spain and Portugal.	Russia.
Upper.			*Peltura* (13). *Sphærophthalmus.* *Beltella.* *Parabolina, Orusia.*	Potsdamien.			
Middle.	Dobrilugk Boring (9). (Niederlausitz). *Paradoxides spp.* Near Görlitz (10). (Oberlausitz). *Billingsella ræmingeri.*	Jince (11). 5. *Lingulella matthewi* 4. *Ellipsocephalus hoffi.* 3. *Paradoxides bohemicus* 2. *Stromatocystites.* 1. *Paradoxides rugulosus.*	*Paradoxides, Solenopleura* (14). VIII.—*Conocoryphe, Ellipsocephalus.* VII.—*Paradoxides.*	Acadien. III.—*Paradoxides forchhammeri.* II.—*Paradoxides mediterraneus.* I.—*Paradoxides rouvillei.* *Archæocyathus.*	(16) *Archæocyathus* Limestone, with *Ptychoparia.*	Spain (17). (Chaîne Cantabrique). *Paradoxides pradoanus.* *Archæocyathus.* Portugal (18). (Haut Alemtejo.) *Paradoxides spp.*	Bennett Island (19). *Paradoxides forchhammeri* fauna. Lena River (20). *Archæocyathus* Limestone. *Agnostus.*
Lower.	*Protolenus.* *Olenellus.* *Eodiscus speciosus.* *Archæocyathus* Limestone (300 feet seen)		VI { *Protolenus.* *Ellipsocephalus.* } V { *Protolenus.* *Hyolithus.* } IV { *Callavia* (?) *Holmia.* } III { *Holmia.* *Kjerulfia.* *Obolella.* } II { *Conchostraca.* *Holmia.* *Mickwitzia.* } I { *Holmia.* *Volborthella.* }	Géorgien (Grès de Marcory). *Olenopsis.* *Blayacina.* *Hyolithus*, &c. (?) Base *Igneous.*		{ *Olenopsis* (?) *Olenellus* (?) *Eodiscus.* *Pagetia* (?) }	*Eodiscus.* *Pagetia.* *Olenellus* (?)
References.	(9) Picard, 1928. (10) Schwarzbach, 1932.	(11) Chouff, 1928.	(13) Czarnocki, 1927. (14) Czarnocki, 1932.	(15) Blayac & Thoral, 1931.	(16) Bigot, 1926.	(17) De Verneuil & Barrande. *See* Prado, 1860. (18) Delgado, 1904.	(19) Westergård, 1930. (20) von Toll, 1899.

(E.S.O. 1933.)



ANNELIDA, BRACHIOPODA, POLYZOA, HYOLITHIDÆ.

PLATE 40.

FIGS. 1, *a–c*, *Rushtonia lata*, Gen. et sp. nov. Holotype × $6\frac{2}{3}$. *a*, top view; *b*, side view before damage occurred; *c*, outline of section. [51658.]——*Protolenus* Limestone, loc. 11.

FIG. 2.—*Torellella inornata*, sp. nov. Holotype × $5\frac{1}{3}$. Side view, with section. [51659.]——*Callavia* beds, loc. 8.

FIG. 3.—*Torellella scabra*, sp. nov. Holotype × $6\frac{2}{3}$. [51660.]——Lower Comley Sandstone, loc. 5.

FIG. 4.—*Hyolithellus* (?) *tortuosus*, sp. nov. Holotype × $6\frac{2}{3}$. [51661.]——Lower Comley Sandstone, shale facies, loc. 6.

FIG. 5.—*Hyolithellus* (?) *cingulatus*, sp. nov. Holotype × $6\frac{2}{3}$. [51662.] *Lapworthella* Limestone, loc. 11.

FIG. 6.—*Hyolithus* (*Orthotheca* ?) *ornatus*, sp. nov. Holotype × $6\frac{2}{3}$. [51663.] Dorsal view with apertural and axial sections.——*P. forchhammeri* Grit, loc. 9.

FIGS. 7 and 8.—Polyzoa (?) Gen. et sp. indet × $13\frac{1}{3}$.

Fig. 7.—*Lapworthella* Limestone, loc. 7. [51664.]

Fig. 8.—Same horizon, loc. 11. [51665.]

FIG. 9.—*Lingulella* cf. *concinna*, MATTHEW × $6\frac{2}{3}$. [51666.]——Upper Cambrian, loose block of *Ctenopyge-Leptoplastus* Limestone, loc. 12.

FIG. 10.—*Obolus*, *sp.* indet. × $6\frac{2}{3}$. [51667.]——*Protolenus* Limestone, loc. 8.

FIGS. 11–15.—*Kutorgina* (?) *anglica*, sp. nov.

Fig. 11.—Ventral valve × $6\frac{2}{3}$. [51668A.]

Fig. 12.—Dorsal valve × $6\frac{2}{3}$. [51668B.]

Fig. 13.—Dorsal valve × $5\frac{1}{3}$. Holotype. [51669.]

Fig. 14.—Ventral valve × $5\frac{1}{3}$. Paratype. [51670.]

Fig. 15.—Dorsal valve × $2\frac{2}{3}$, crushed almost flat. [51671.]

Lower Comley, Sandstone, loc. 5.

FIGS. 16 and 17.—*Acrotreta gemmula*, MATTHEW × $6\frac{2}{3}$. Ventral valves, interior and exterior. [51672, 51673.]——Lower Comley Sandstone, shale facies, loc. 6.

FIG. 18.—*Acrotreta sagittalis taconica*, WALCOTT × $6\frac{2}{3}$. [51674.] Dorsal valve, with side outline, specimen destroyed, but see Pe. 2387.——Lower Comley Sandstone, shale facies, loc. 6.

FIG. 19.—*Acrothele prima* (MATTHEW) × $6\frac{2}{3}$. [51675.] Ventral valve, with side outline.——Lower Comley Sandstone, shale facies, loc. 6.

FIG. 20.—[Specimen missing.] *Acrothele intermedia*, LINNARSSON × 8, specimen missing. Copy of drawing made 1918. [51676.]——*P. hicksi* fauna, loc. 7.

FIGS. 21 and 22.—*Hyolithus œlandicus*, HOLM × 4.

Fig. 21.—Ventral face. [51677.]

Fig. 22.—Dorsal face. [51782.]——From loose block with *P. bohemicus salopiensis* fauna, loc. 3.

FIG. 23.—*Hyolithus* (*Orthotheca*) *cor*, HOLM × 4. [51678.] Dorsal face.——*P. forchhammeri* Grit, loc. 9.

FIGS. 24 and 25.—*Hyolithus pennatuloides*, sp. nov.

Fig. 24.—Holotype, ventral face and section × $13\frac{1}{3}$. [51679.]

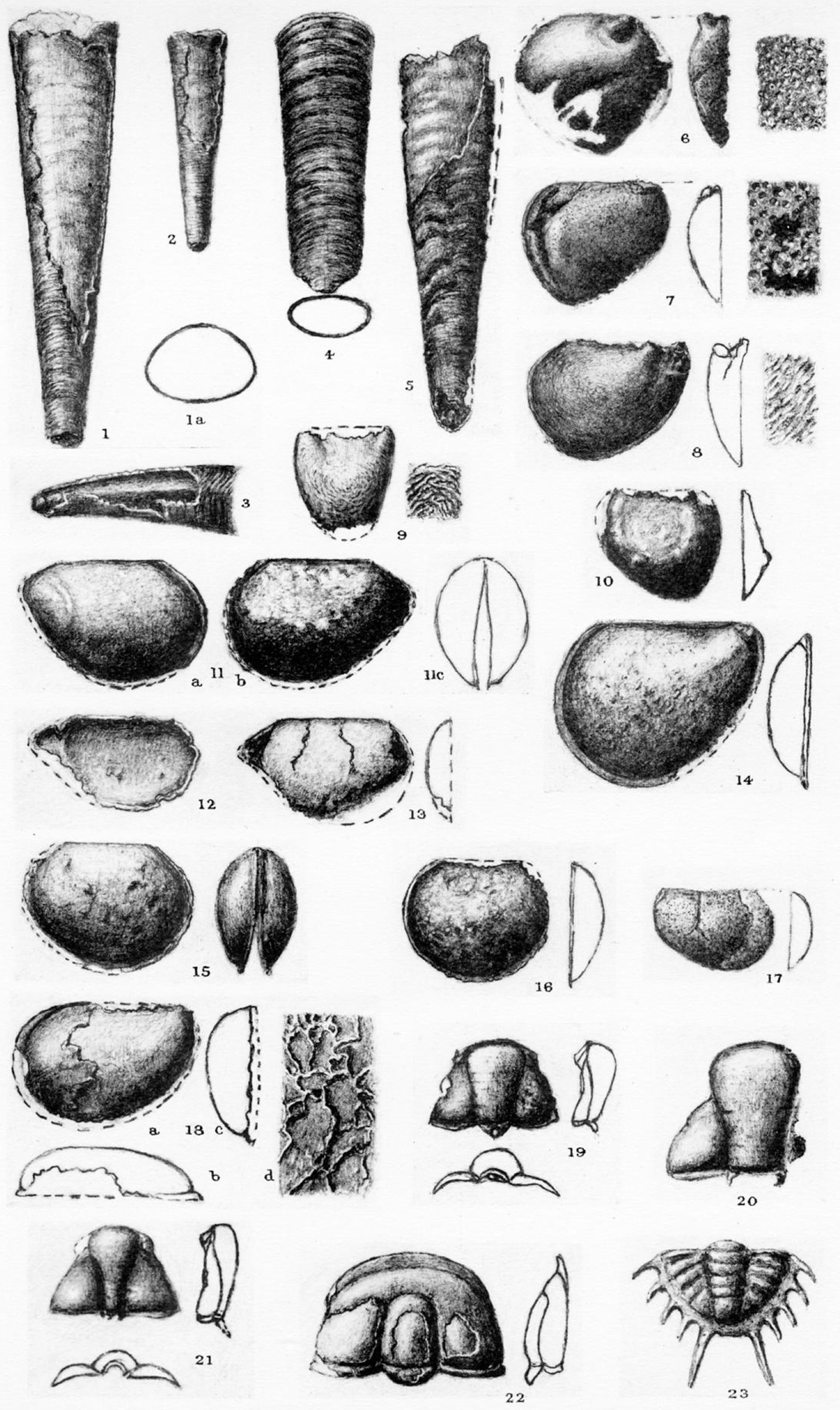
Fig. 25.—Side view of another specimen. × $6\frac{2}{3}$. [51680.]——*P. forchhammeri* Grit, loc. 9.

Fig. 26.—*Hyolithus tenuistriatus* LINNARSSON, × $2\frac{2}{3}$. Dorsal view; section. [51681.]——*P. forchhammeri* Grit, loc. 9.

Fig. 27.—*Hyolithus araneus*, HOLM, var. *angustus* nov. Holotype × $6\frac{2}{3}$. [51682.] Dorsal, ventral, side views, and section.——*P. forchhammeri* Grit, loc. 9.

Fig. 28.—*Hyolithus*, *sp.* "Fin support." × $2\frac{2}{3}$, with section × $5\frac{1}{3}$. [51683.]——*P. forchhammeri* Grit, loc. 9.

Fig. 29.—*Hyolithus obscurus*, HOLM, var. *anglicus* nov. Holotype × $6\frac{2}{3}$. [51684.] Exfoliated dorsal face and section.——*P. forchhammeri* Grit, loc. 9.



HYOLITHIDÆ, CONCHOSTRACA, CORYNEXOCHUS AND DORYPYGE.

PLATE 41.

FIGS. 1–5.—*Hyolithus operosus*, sp. nov. $\times 2\frac{2}{3}$.

Fig. 1.—Holotype, dorsal face, and 1*a* section. [51686.]

Fig. 2.—Ventral face. [51687.]

Fig. 3.—Apical portion, showing curvature and septum. [51688.]

Fig. 4.—Dorsal face, sculpture very rugose. [51689.]

Fig. 5.—Dorsal face, showing malformation of striæ. [51783.]

P. forchhammeri Grit, loc. 9.

FIG. 6.—*Bradoria* cf. *obesa* (MATTHEW). [51690.] Right valve, with anterior view. $\times 6\frac{2}{3}$; sculpture $\times C^a$ 50.——*Acrothele prima* Shale, loc. 6.

FIG. 7.—*Bradoria benepuncta* (MATTHEW). [51691.] Right valve and anterior outline. $\times 6\frac{2}{3}$; sculpture $\times C^a$ 67.——*Acrothele prima* Shale, loc. 6.

FIG. 8.—*Bradoria robusta* (MATTHEW). [51692.] Right valve and anterior outline. $\times 6\frac{2}{3}$; sculpture $\times C^a$ 67.——*Acrothele prima* Shale, loc. 6.

FIG. 9.—*Beyrichona tinea*, MATTHEW [51693].——Right valve $\times 6\frac{2}{3}$, sculpture, $\times$ 50, drawn from plasticine cast. *Acrothele prima* Shale, loc. 6.

FIG. 10.—*Beyrichona* cf. *rotundata*, MATTHEW $\times$ 20. [51694.]——Left (?) valve, with end outline. Lower Comley Sandstone, loc. 1.

FIGS. 11–13.—*Aluta ulrichi*, sp. nov. $\times 13\frac{1}{3}$.

Fig. 11.—Holotype, *a*, left; *b*, right valves; *c*, anterior outline, loc. 4. [51695.]

Fig. 12.—Interior of right valve, loc. 1. [51696.]

Fig. 13.—Internal cast of left valve, loc. 1. [51697.]——The Lower Comley Sandstone.

FIG. 14.—*Aluta rotundata*, WALCOTT, var. *salopiensis* nov., $\times 13\frac{1}{3}$. [51698.]——Right valve and anterior outline. Lower Comley Sandstone, loc. 4.

FIGS. 15 and 16.—*Indianites exigua*, sp. nov. $\times 13\frac{1}{3}$.

Fig. 15.—Holotype, left valve and anterior view. [51699.]

Fig. 16.—Right valve. [51700.]——Lower Comley Sandstone, loc. 4.

FIG. 17.—*Indianites obtusa*, sp. nov. $\times$ 20. Holotype, left valve exfoliated posteriorly; with anterior outline. [51701.]——*Lapworthella* Limestone, loc. 8.

FIG. 18.—*Dielymella* (?) *corpulenta*, sp. nov. $\times$ 4. [51702.] Holotype, right valve, exfoliated anteriorly, hinge line damaged; *a*, side view; *b*, dorsal outline showing damage; *c*, anterior outline. $\times$ 4; *d*, portion of test. $\times C^a$ 53.——*P. forchhammeri* Grit, loc. 3.

FIGS. 19, 20.—*Corynexochus illingi*, sp. nov. $\times 13\frac{1}{3}$.

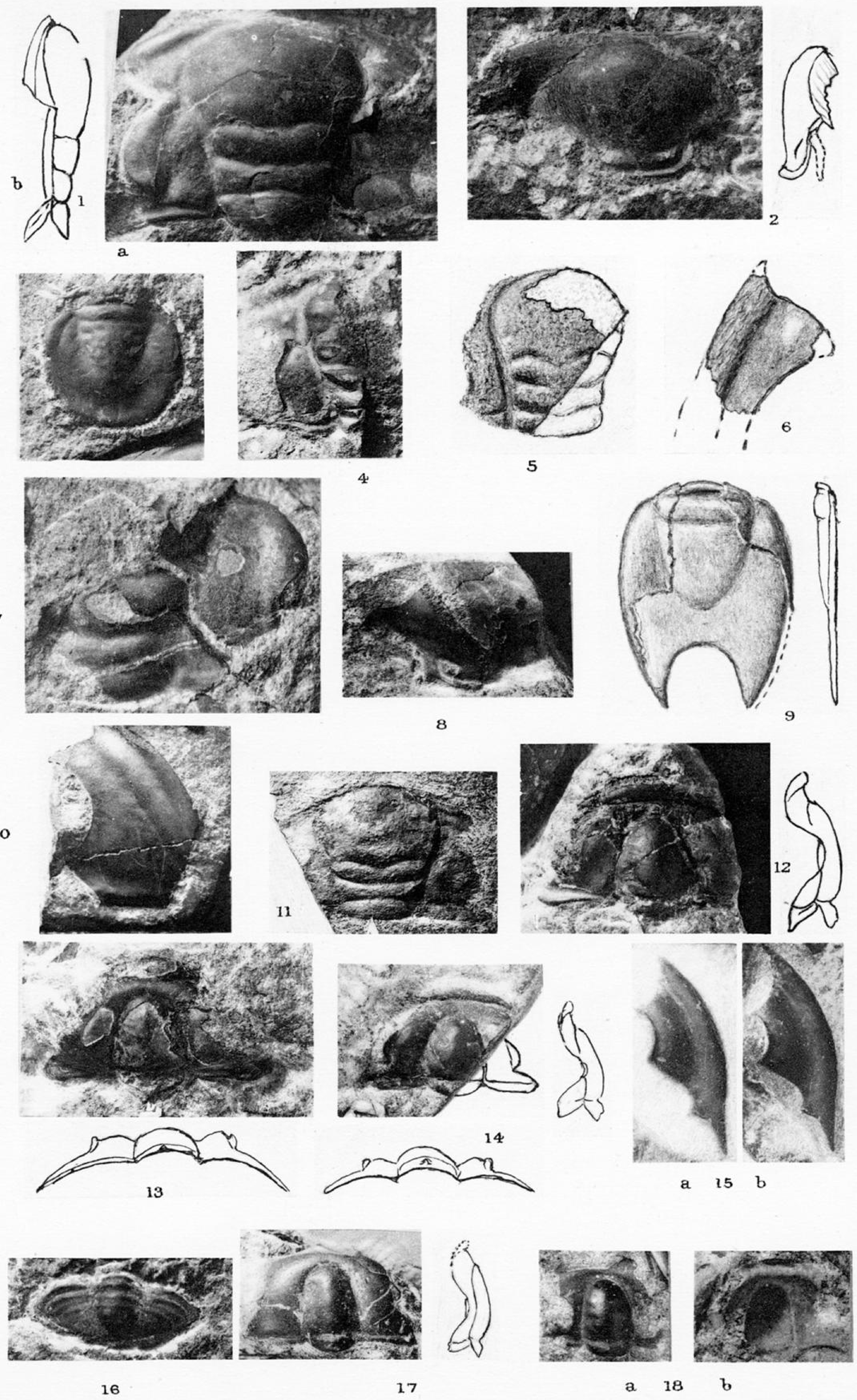
Fig. 19.—Holotype, cranidium with side and posterior outlines. [51703.]

Fig. 20.—Partial cranidium. [51704.] *P. groomi* Grit., loc. 8.

FIG. 21.—*Corynexochus pusillus*, ILLING. $\times 13\frac{1}{3}$. Nearly complete cranidium, test preserved with side and posterior outlines. [51784.]——*P. groomi* Grit, loc. 8.

FIG. 22.—*Conocoryphe marginata longifrons*, COBBOLD. $\times 6\frac{2}{3}$. Nearly perfect cranidium, test partially preserved. [51705.]——*P. groomi* Grit, loc. 8.

FIG. 23.—*Dorypyge rushtonensis*, sp. nov. $\times$ about $5\frac{1}{3}$. Reconstruction of pygidium based upon photograph of the Holotype and upon the Paratypes. [51706, 51707, 51800, 51708.]——*P. forchhammeri* Grit, loc. 9.



PARADOXIDES AND SOLENOPLEURA.

PLATE 42.

FIGS. 1, 2, 3.—*Paradoxides bohemicus salopiensis*, COBBOLD. × 1⅓.

Fig. 1*a*.—Cranidium, right cheek missing. 1*b*.—Side view of same. [51709.]

Fig. 2.—Hypostoma. Side outline of same. [51710.]

Fig. 3.—Pygidium. [51711.]——Loose block, loc. 3, with *P. bohemicus salopiensis* Fauna.

FIGS. 4, 5, 6.—*Paradoxides* cf. *œlandicus*, SJÖGREN. × 1⅓.

Fig. 4.—Part cranidium, facial suture stretched. [51712.]

Fig. 5.—Part glabella, measured drawing. [51713.]——Loose block, loc. 3.

Fig. 6.—Interior of free cheek, showing suture. [51785.]——*P. groomi* Grit, loc. 8.

FIGS. 7, 8.—*Paradoxides forchhammeri*, ANGELIN. × 1⅓.

Fig. 7.—Part cranidium, outline slightly retouched. [51714.]

Fig. 8.—Hypostoma, outline retouched; the part to the right is faulted down under that on the left. [51715.]——*P. forchhammeri* Grit, loc. 9.

FIG. 9.—*Paradoxides, sp.* indet. A. Pygidium. × 5⅓.

A composite drawing, reconstructed from two specimens, an exfoliated interior and an exterior. [51786.] [51788.]——*P. forchhammeri* Grit, loc. 9.

FIG. 10.—*Paradoxides, sp.* indet. B. free cheek, exterior. × 2⅔. [51716.]——*P. forchhammeri* Grit, loc. 9.

FIG. 11.—*Paradoxides tessini*, BRONGNIART. × 1⅓. A flattened cranidium. [51787.] —— Shale immediately below the *P. forchhammeri* Grit, loc. 9.

FIGS. 12–14, and (?) 15, *a* and *b* and 16. *Solenopleura rushtonensis*, sp. nov.

Fig. 12.—Holotype, × 2, cranidium, much bruised in front and sides. [51717.]——Outline restored in places from paratypes.

Fig. 13.—Paratype, × 2, much damaged at front and sides, but showing great width of posterior border and position of palpebral lobe; with posterior outline. [51789.]

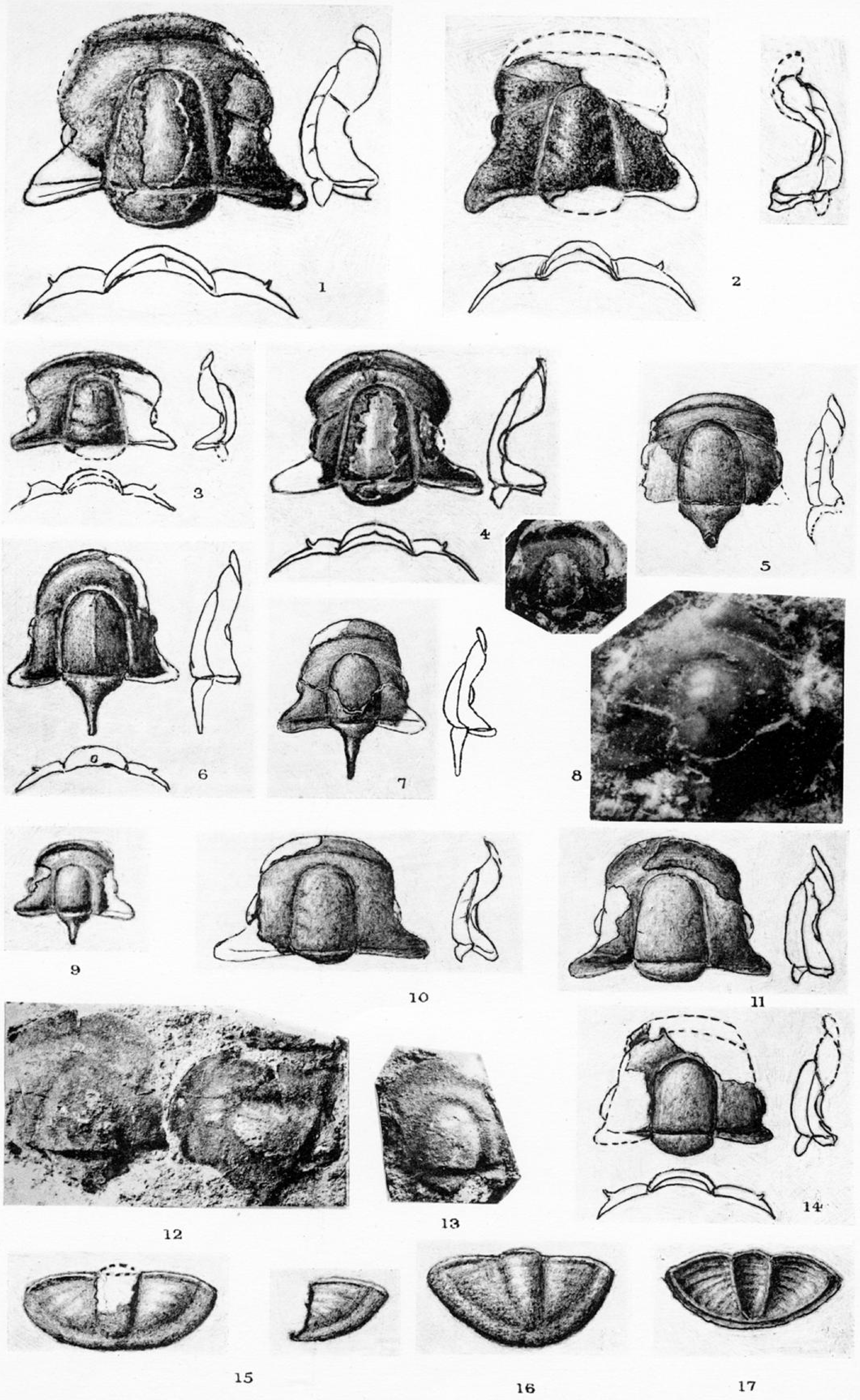
Fig. 14.—Paratype × 2, a better preserved specimen, showing the occipital ring and much elevated palpebral lobe; with side and posterior outlines. [51718.]

FIGS. 15*a* and *b*.—Two views of one associated free cheek, × 2⅔, *a*, as it lies flat in the rock; *b*, when tilted to bring the margin horizontal. Anterior process not quite complete. [51790.]

FIG. 16.—Pygidium, associated with paratype. [51719.] × 2⅔.——All from the two loose blocks with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIG. 17.—*Solenopleura acadica elongata*, MATTHEW. × 2⅔. Nearly complete cranidium [51791], with front border restored in outline from other fragments.——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 18*a* and *b*.—*Solenopleura bucculenta*, GRÖNWALL. × 2⅔. *a*, Partial cranidium, test preserved. [51720.] *b*, counterpart of same, showing position of palpebral lobe. [51721.]——*P. forchhammeri* Grit, loc. 9.



SOLENOPLEURA, AGRAULUS AND LIOSTRACUS.

PLATE 43.

FIG. 1.—*Solenopleura applanata* (SALTER). × 4. Cranidium, partly exfoliated, with side and posterior outlines. [51722.]——*P. forchhammeri* Grit, loc. 9.

FIG. 2.—*Solenopleura brachymetopa nuntia*, GRÖNWALL. × 2⅔. Cranidium largely exfoliated, with side and posterior outlines. [51723.]——*P. forchhammeri* Grit, loc. 9.

FIG. 3.—*Solenopleura* (?), *sp.* indet × 4. Partial cranidium, with side and posterior outlines. [51724.] ——*P. forchhammeri* Grit, loc. 9.

FIG. 4.—*Solenopleura* (?) *angustiora*, sp. nov. × 4. Cranidium. Holotype, with side and posterior outlines, and photograph × 2⅔. [51792.]——*P. forchhammeri* Grit, loc. 9.

FIG. 5.—*Agraulos humilis*, sp. nov. × 4. Holotype, a well-preserved cranidium, postero-lateral angles missing, with side outline. [51793.]——Loose block, with *P. bohemicus salopiensis* Fauna.

FIGS. 6–9.—*Agraulos robustus*, sp. nov.

Fig. 6.—Holotype, cranidium, spine added from the counter part; with side and posterior outline. × 4. [51725.]

Fig. 7.—Cranidium, with strong secondary coating, with side outline, referred with reserve to this species (see p. 35). × 6⅔. [51726.]

Fig. 8.—Photograph of same specimen. × 10⅔.

Fig. 9.—Minute cranidium 1·7 mm. long, excluding occipital ring. × 6⅔. [51727.] *P. forchhammeri* Grit, loc. 9.

FIGS. 10 and 11 and (?) 12, 13.—*Liostracus bruno*, sp. nov.

Fig. 10.—Holotype cranidium, test preserved and partially obscured by a thin secondary coating; with side outline. [51794.]

Fig. 11.—Paratype cranidium, with side outline, test largely exfoliated, and cast weathered. × 4. [51728.]——Both from the calcareous *P. forchhammeri* Grit, loc. 9.

Fig. 12.—Two cranidia, flattened and distorted. × 2⅔. [51729.]

Fig. 13.—Another cranidium flattened and less distorted. × 2⅔. [51730.]——Both from the sandy shale immediately below the *P. forchhammeri* Grit, loc. 9, referred with reserve to this species, associated with *P. tessini*.

Fig. 14.—*Liostracus dubius*, COBBOLD. × 4. The largest cranidium seen. 5·5 mm. long, with side and posterior outlines. [51731.]——*P. forchhammeri* Grit, loc. 9.

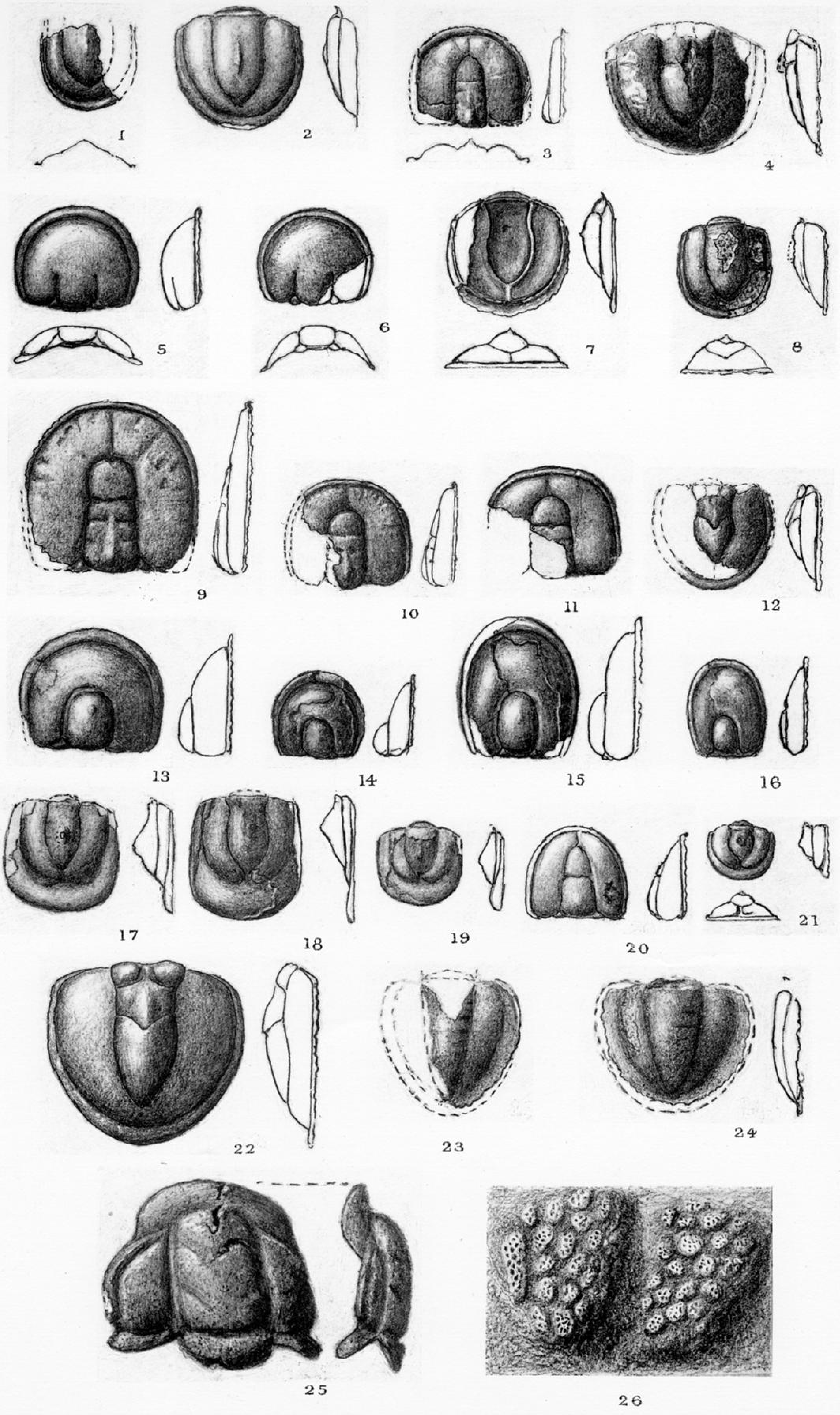
FIGS. 15–17.—Pygidia associated with *Liostracus* and *Solenopleura*.

FIG. 15.—Two pygidia, × 2⅔, test preserved. [51732.]——Probably *Liostracus sp.*

Fig. 16.—Distorted pygidium, × 5⅓, without test, probably *Solenopleura*. [51733.]

Fig. 17.—External impression of immature pygidium. × 13⅓. [51734.]

P. forchhammeri Grit, loc. 9.



AGNOSTUS, EODISCUS, ELLIPSOCEPHALUS, POLYZOA.

PLATE 44.

FIGS. 1, 2.—*Agnostus rotundus*, GRÖNWALL.

Fig. 1.—Fragmentary pygidium, estimated total length over 5 mm. with transverse section. × $2\frac{2}{3}$. [51735.]

Fig. 2.—Internal cast of small but complete pygidium. × $6\frac{2}{3}$. [51736.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 3, 4.—*Agnostus gibbus*, LINNARSSON. × $6\frac{2}{3}$.

Fig. 3.—Cephalon. [51737.]

Fig. 4.—Pygidium. [51738.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 5–8.—*Agnostus lens*, GRÖNWALL. × $6\frac{2}{3}$.

Fig. 5.—Cephalon, with side and posterior outlines. [51739.]

Fig. 6.—Cephalon, with posterior outlines. [51740.]

Fig. 7.—Pygidium, interior with side and posterior outlines. [51741.]

Fig. 8.—Pygidium, exterior with side and posterior outlines. [51742.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 9–12.—*Agnostus fissus*, LUNDGREN, var. *mancus*, nov. × $6\frac{2}{3}$.

Figs. 9–11.—Cephala, with variation in the length of the fissure. [51743, 51744, 51745.]

Fig. 12.—Pygidium. [51746.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 13–19.—*Agnostus parvifrons*, LINNARSSON. × $6\frac{2}{3}$.

FIGS. 13, 14.—Cephala, with short glabellas. [51747, 51748.]

Figs. 15, 16.—Cephala, with long glabellas, recalling *A. brevifrons*. [51749, 51750.]

Figs. 17, 18, 19.—Pygidia, recalling BRÖGGER's var. *mammillatus*, with posterior margins variously developed. [51751, 51752, 51753.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 20, 21.—*Agnostus lundgreni*, BRÖGGER. × $6\frac{2}{3}$.

Fig. 20.—Cephalon, with side outline. [51754.]

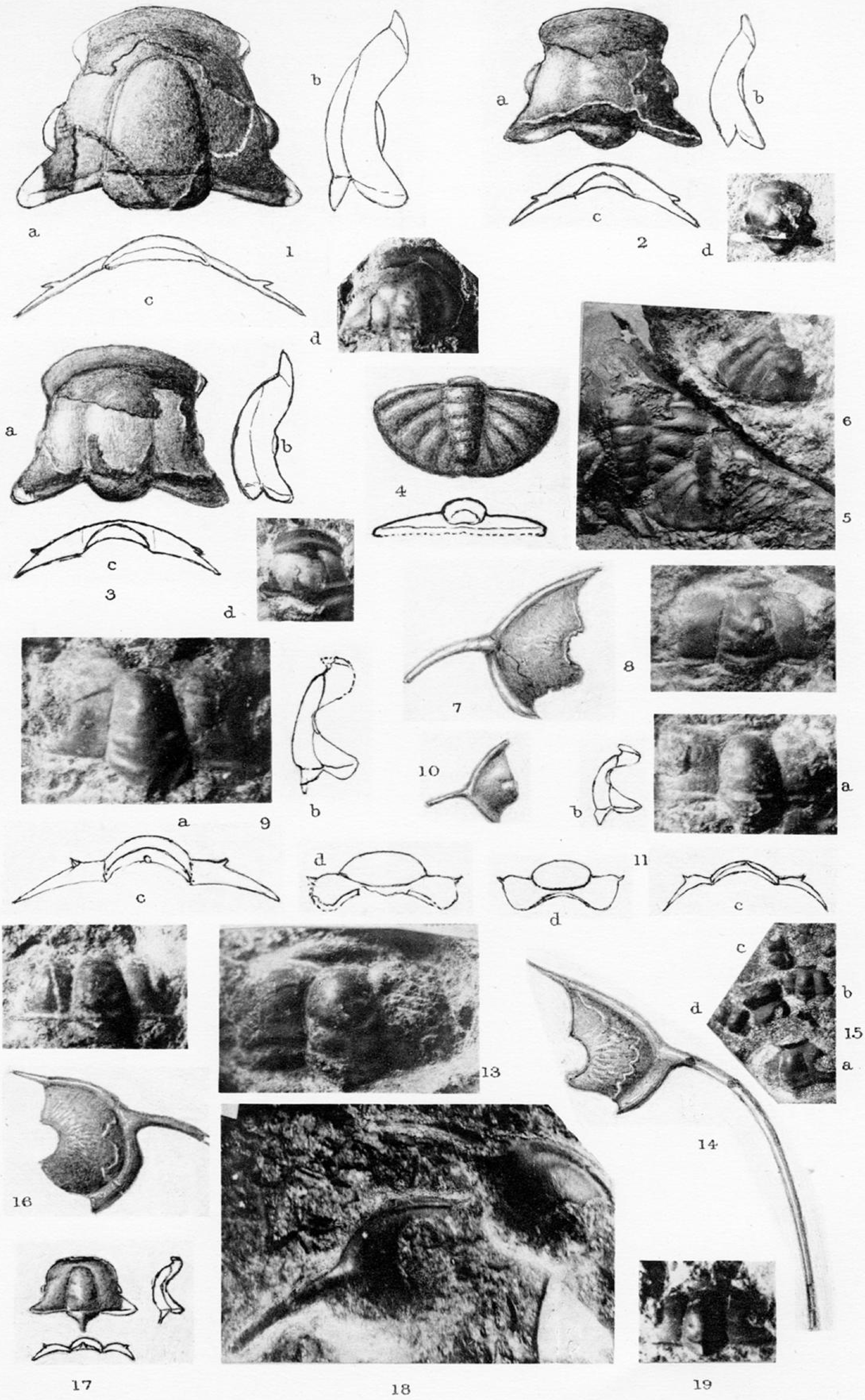
Fig. 21.—Pygidium, with side and posterior outline. [51755.]——*P. forchhammeri* Grit, loc. 9.

FIG. 22.—*Agnostus stenorrhachis*, GRÖNWALL. × $6\frac{2}{3}$. [51756.] Measured drawing, with defects made good from specimen. [51757.]——Loose block with the *P. bohemicus salopiensis* Fauna, loc. 3.

FIGS. 23, 24.—*Eodiscus speciosus* (FORD). × $6\frac{2}{3}$. Internal casts of pygidia, badly preserved. [51758, 51759.]——*Protolenus* Limestone, loc. 8.

FIG. 25.—*Ellipsocephalus nordenskjöldi*, LINNARSSON. × $2\frac{2}{3}$. Distorted internal cast of cranidium. [51760.]——*Callavia* beds, loc. 3.

FIG. 26.—Polyzoon. × C^a 20. [51685.]——Rough sketch of object to show general characters. Lower Cambrian, *Acrothele prima* Shale, loc. 6.



LIOSTRACUS (AGASO), CTENOPYGE, SPHÆROPHTHALMUS & LEPTOPLASTUS.

PLATE 45.

FIG. 1*a–d*.—*Liostracus* (*Agaso*) *pringlei*, sp. nov. holotype. $\times 2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view of cranidium ; *b*, side outline ; *c*, posterior outline ; *d*, $\times 1\frac{1}{3}$. [51762.]—*P. forchhammeri* Grit, loc. 9.

2*a–d*. *L.* (*Agaso*) *pococki*, sp. nov. holotype. $\times 2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view ; *b*, side outline ; *c*, posterior outline ; *d*, $\times 1\frac{1}{3}$. [51764.]——*P. forchhammeri* Grit, loc. 9.

3*a–d*. *L.* (*Agaso*) *rushtonensis*, sp. nov. holotype. $\times 2\frac{2}{3}$ and $1\frac{1}{3}$.

a. Dorsal view ; *b*, side outline ; *c*, posterior outline ; *d*, $\times 1\frac{1}{3}$. [51763.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 4–6.—Pygidia referred with reserve to this sub-genus. $\times 2\frac{2}{3}$.

Fig. 4.—Reconstruction, from the three specimens photographed in figs. 5 and 6. [51765, 51766.]

Fig. 5.—Two pygidia ; the greater part of the upper one was removed exposing traces of the anterior margin, which was not otherwise visible. [51765.]

Fig. 6.—Another pygidial fragment [51766.]——*P. forchhammeri* Grit, loc. 9.

FIGS. 7–19.—Olenidæ from loose blocks of bituminous limestone in Dryton Brook, loc. 13.

FIGS. 7, 8.—*Eurycare angustatum*, ANGELIN.

Fig. 7.—Free cheek doubtfully referred to this species. $\times 6\frac{2}{3}$. [51774.]

Fig. 8.—Cranidium. $\times 6\frac{2}{3}$. [51775.]——Block A.

FIG. 9*a–d*.—*Ctenopyge drytonensis*, sp. nov. holotype. $\times 5\frac{1}{3}$.

a. Cranidium dorsal view ; *b*, side outline ; *c*, posterior outline ; *d*, anterior outline.* [51776.] (See also fig. 19.)——Block A.

Fig. 10.—*Sphærophthalmus* (?) *sp.* indet., minute free cheek with visual surface preserved. $\times 6\frac{2}{3}$. [51777.]—Block A.

Figs. 11*a*–13.—*Sphærophthalmus* (?) *parabola*, sp. nov. $\times 5\frac{1}{3}$.

Fig. 11.—Holotype. *a*, dorsal view ; *b*, side outline ; *c*, posterior outline ; *d*, anterior outline. [51778.]

Fig. 12.—Paratype A. [51779.]

Fig. 13.—Paratype B. [51780.]——Block A.

FIG. 14.—*Ctenopyge flagellifera*, var. *angusta*, WESTERGÅRD (?). $\times 6\frac{2}{3}$. Free cheek. [51781]——Block A.

FIG. 15.—Group of cranidia. *Ctenopyge spp.* $\times 2\frac{2}{3}$.

a. Appears to be *Ct. drytonensis*, sp. nov. [51767] ; *b*, is probably *Ct. flagellifera* (ANGELIN). [51768.]. *c* and *d* may be WESTERGÅRD'S var. *angusta*. [51769.]——Block D.

FIGS. 16, 17.—*Ctenopyge flagellifera* (ANGELIN).

Fig. 16.—Free cheek. $\times 6\frac{2}{3}$. [51770.]

Fig. 17.—Small but nearly perfect cranidium with side and posterior outlines. $\times 5\frac{1}{3}$. [51771.] ——Block A.

FIG. 18.—*Leptoplastus raphidophorus*, ANGELIN. Two free cheeks. $\times 5\frac{1}{3}$. [51772.]

FIG. 19.—*Ctenopyge drytonensis*, sp. nov. $\times 5\frac{1}{3}$. [51773.] A small but nearly perfect cranidium.—— Block A.