TRILOBITES OF THE HENLLAN ASH, ARENIG SERIES, MERIONETH

BY

H. B. WHITTINGTON D.Sc.

Professor of Geology, Harvard University, Cambridge, Massachusetts, U.S.A.

Pp. 489–505 ; 5 *Plates*

BULLETIN OF
THE BRITISH MUSEUM (NATURAL HISTORY)
GEOLOGY Vol. 11 No. 10
LONDON : 1966

THE BULLETIN OF THE BRITISH MUSEUM (NATURAL HISTORY), *instituted in* 1949, *is issued in five series corresponding to the Departments of the Museum, and an Historical series.*

Parts will appear at irregular intervals as they become ready. Volumes will contain about three or four hundred pages, and will not necessarily be completed within one calendar year.

In 1965 *a separate supplementary series of longer papers was instituted, numbered serially for each Department.*

This paper is Vol. 11, *No.* 10 *of the Geological (Palaeontological) series. The abbreviated titles of periodicals cited follow those of the World List of Scientific Periodicals.*

TRUSTEES OF
THE BRITISH MUSEUM (NATURAL HISTORY)

Issued 19 *April,* 1966 *Price* £1 1*s.*

TRILOBITES OF THE HENLLAN ASH, ARENIG SERIES, MERIONETH

By HARRY BLACKMORE WHITTINGTON

CONTENTS

SYNOPSIS

New collections have been made from the only beds in the type area of the Arenig Series that yield a shelly fauna. These beds are termed the Henllan (rather than *Calymene*) Ash, and the Erwent (rather than *Ogygia*) Limestone is considered to be an upper member of this Ash. The five species include two identical with, and three similar to, species recently described from *extensus* Zone beds of the Mytton Flags of West Shropshire. This fauna may be widespread in Wales, and is like faunas of similar age in southern Europe but unlike those of Sweden. One new species, *Myttonia fearnsidesi*, is described.

I INTRODUCTION AND ACKNOWLEDGMENTS

In describing the geology of Arenig Fawr and Moel Llyfnant, Fearnsides (1905) introduced the terms Henllan or *Calymene*-Ashes and Erwent or *Ogygia*-Limestone for beds which contain the only shelly fauna known from the type area of the Arenig Series. The fossils were first listed by Salter (1853 : 57 ; *in* Ramsay 1866 : 255–257) and the most recent list is that of Fearnsides (1905 : 620), only the calymenid having been re-described in recent years.

Fearnsides gave no estimates of thickness in his stratigraphical column (1905 : 609), but from his map the combined thickness of the Henllan and Erwent beds is 200 feet at the minimum. It is clear from his account (cf. also his text-figs. 1, 2) that he regarded the Erwent Limestone as an uppermost, more calcareous part of the ashy beds, and he gives the thickness of this " highly fossiliferous band " as " not more

than 10 or 12 feet" (Fearnsides 1905 : 621). It is here proposed that the Erwent Limestone be regarded as a member of the Henllan Ash, and geographical names are preferred, in conformity with recommendations of the American Commission on Stratigraphic Nomenclature (1961). The present work is on fossils collected in place, and at one locality from scree material, coming from beds which lie within the Henllan Ash outcrop as mapped by Fearnsides, and close to, if not exactly on, the outcrop of the Erwent member. On the east side of Moel Llyfnant the trilobites *Ogygiocaris?* cf. *selwyni* and *Neseuretus parvifrons*, with a species of the brachiopod *Orthis*, are abundant through about 50 feet of beds, a far greater thickness than Fearnsides gives for the Erwent Limestone. Reference of the fossils to the broader stratigraphical unit, the Henllan Ash, is thus preferred.

This investigation was carried out in connection with that of the adjacent Bala area, and some localities were visited in company with Professor Alwyn Williams and Dr. D. A. Bassett. I am indebted to my wife for her help in collecting at all the localities. Professor W. F. Whittard has kindly discussed the trilobites with me, and Mr. A. G. Brighton loaned material from the Sedgwick Museum. Miss Marjorie K. Whallon has printed the photographs from my negatives and aided in preparing the plates from them. Collections were made in 1957 during the tenure of a Guggenheim Memorial Fellowship. In 1964, funds provided by National Science Foundation grant GB–1807 enabled me to make further collections and aided in the preparation of this account.

II LOCALITIES

All lie within the area of Fearnsides' map (1905, pl. 41), on the west slopes of Arenig Fawr and the east slopes of Moel Llyfnant.

1. Sixty paces upstream from north-east to south-west trending wall, 400 yards south-south-east of Hafotty Ffilltirgerig, National Grid reference 818387. Much of the material preserved in the Sedgwick Museum is labeled as coming from this locality.

2. At and above the south end of highest wall on north-east flank of Moel Llyfnant, National Grid reference 812357. The fresh rock exposed in crags is extremely difficult to break, collecting being possible only from weathered rock and scree.

3. Weathered outcrop about 1,000 feet south of locality 2.

4. Weathered outcrop, west side of Llechwedd Erwent, National Grid reference 820346.

5. Weathered outcrop, east side of Llechwedd Erwent, short distance north of south-east trending fence, National Grid reference 826344.

III AGE AND RELATIONS OF THE TRILOBITE FAUNA

The asaphid and *Neseuretus parvifrons* are abundant at all the localities investigated, *Ampyx* aff. *salteri* occurring (quite abundantly) only at locality 1, and *Myttonia fearnsidesi* sp. nov. rarely only at locality 3. The species of *Orthis* is common, and less frequent are inarticulate brachiopods. One pelecypod valve has been found,

but no cephalopods, a group stated to be abundant by Fearnsides (1905 : 620). The ash rests on beds that have yielded *Didymograptus extensus*, and is overlain by shale containing *D. hirundo* (Fearnsides 1905 : 619–622).

Whittard's (1955–64) monograph of trilobites from West Shropshire describes the following species from the Mytton Flags :

Ampyx salteri Hicks
Myttonia confusa Whittard
Neseuretus parvifrons (Salter)
Neseuretus brevisulcus Whittard
Neseuretus complanatus Whittard
Neseuretus murchisoni (Salter)
Cyclopygid
Ogygiocaris selwyni (Salter)

From the data given by Whittard it appears that most, if not all, of these species occur together at particular localities in the lower one-third of the Mytton Flags. The generic assemblage is that of the Henllan Ash, and the species are closely related or identical. Whittard (1955 : 16–17 ; 1960 : 144 ; 1964 : 236) regards the Shropshire strata as of *extensus* Zone age, and it thus appears that the Henllan Ash also belongs within this zone, an assumption also made by Whittard (1960 : 145). The occurrence in the Arenig Series of a species of *Myttonia?* in *extensus* Zone beds in Caernarvonshire (Whittard 1955 : 31), *Ampyx* in Pembrokeshire (Whittard 1955 : 17), of species of *Neseuretus* in Anglesey (*extensus* Zone, Shirley 1936 : 401–402) and Pembrokeshire (Whittard 1960 : 138–139, pl. 21, figs. 1, 2), and *Ogygiocaris? selwyni* in the Lleyn Peninsula and Ramsey Island (Whittard 1964 : 236), suggests that this fauna may be widespread in Britain.

Stubblefield (1939 : 52–53), in reviewing Arenig trilobite faunas of the Anglo-Welsh area, emphasized the absence of Scandinavian forms. In outlining faunal provinces of late Arenig time (Whittington 1963 : 18–20, text-fig. 2), I have suggested that the British faunas are like those of central and southern Europe, and that *Ampyx* is one genus common to several provinces at this time, including Britain and Scandinavia. This appears to be true of early Arenig time, for the trinucleid and *Neseuretus* represent groups unknown in Sweden (Tjernvik 1956), but present in the Montagne Noire district of southern France, according to Dr. W. T. Dean (personal communication). The affinities of the asaphid species *selwyni* are less certain (see below). To place it in *Ogygiocaris* suggests Scandinavian relations, while *Megalaspidella* is an Arenig Argentine genus which may be related to *Plesiomegalaspis* Thoral 1946, from the Montagne Noire (cf. Jaanusson *in* Moore 1959 : O347).

The relationship between Anglo-Welsh and central and southern European trilobite faunas continues through Llanvirn and Llandeilo time (Whittington 1963 : 20–21) but is modified at the beginning of the Upper Ordovician (*Nemagraptus gracilis* Zone) by the entry of Baltic elements (Whittington & Williams 1955). These elements continue to be important in younger rocks (Whittington 1962 : 12–13, 18, 21).

IV SYSTEMATIC DESCRIPTIONS

Family **TRINUCLEIDAE** Hawle & Corda 1847

Genus ***MYTTONIA*** Whittard 1955

Myttonia fearnsidesi sp. nov.

(Pl. 1, figs. 1–6)

Diagnosis. Anteriorly pits in radial rows lying between radial ridges, laterally only outer two pits in such radial sulci, inner pits irregularly arranged ; weak girder developed laterally, not anteriorly.

Description. Cephalon of width (tr.) at posterior margin about 9 mm., length (sag.) approximately 2·5 mm. Convex glabella pyriform, occipital ring not preserved in holotype, anteriorly glabella (Pl. 1, fig. 1) appears to overhang the fringe slightly. No glabellar furrows visible. Axial furrow broad beside basal part of glabella, narrowing forward. Cheek convex, no eye tubercle or reticulation preserved on external surface. Posterior border and border furrow broken on holotype. Fringe slopes gently outward and downward, exterior marginal rim broad and strongly convex, as is the posterior rim ; at genal angle these rims merge into the base of the genal spine, which is curved, has a median groove, and extends back far beyond the pygidium (Pl. 1, fig. 4). Anteriorly the upper lamella of fringe (Pl. 1, fig. 3) has pits in radial grooves between raised ridges, anterolaterally and laterally only the the outer two pits are in such grooves. This arrangement allows radii to be distinguished (as indicated in the figure) but the irregular arrangement of the pits in the inner part of the fringe anterolaterally and laterally makes the writing of a fringe-formula (Whittard 1955 : 27–29, text-fig. 3) impractical. The lower lamella is more completely preserved in the holotype (Pl. 1, figs. 5, 6) and shows the convex marginal rim, and that the pits anteriorly are situated in grooves between low radial ridges. Laterally such grooves and ridges are not evident, but a broad, smooth, gently convex area about which the fringe is flexed is suggestive of a weakly developed girder. On the upper lamella (Pl. 1, fig. 3) the pits appear to be arranged as follows. Outer row appears to bifurcate at radii 5–8, the two rows being particularly distinct in radii 8–15, while in radii 16, 19, 20, 22, 23, the outer row appears to have again doubled by bifurcation. The second row of pits from the outer margin becomes irregularly arranged after radius 7, and is conspicuous in containing very large pits laterally which lie inside the " girder " in the region of radii 15–20. The third row from the outer margin is absent in radii 0 and 1, bifurcates at radii 7–9, and beyond here consists of irregularly placed tiny pits close to the margin of the cheek lobe. The arrangement of the pits on the right side can be studied in the external mould of the lower lamella (Pl. 1, fig. 6) and radii distinguished as shown. The outermost row bifurcates at radius 5 (there appears to be an inter-radial pit between radii 5 and 6), and at radii 16, 20–22 the outermost row is seen to bifurcate again. The second row from the outer margin is developed as on the left side, the third row is clearly present in radii 1–8, being tiny and irregular beyond here, with a suggestion

of bifurcation, but the preservation is poor. The arrangement of pits thus appears to be symmetrical about the midline, and in the two other known but poorly preserved cephala it seems to be similar.

Thorax of six segments, which become narrower (tr.) posteriorly, have a strongly convex axial ring and the pleurae extending out horizontally, flexed down at the margin. The pleural furrow is broad and shallow, occupying the region between the narrow marginal ridges. The pygidium has the axis rapidly tapering but reaching to the raised marginal rim, the broad border descending vertically. Three or four axial rings may be distinguished, on the pleural regions a first, and a faint second, interpleural ridge is visible.

Holotype. Counterpart moulds of entire skeleton, incomplete on right side, B.M., It. 303 (Pl. 1, figs. 1–6), locality 3.

Other material. Two poorly preserved and incomplete cephala from same locality and horizon as holotype.

Discussion. The strong external marginal rim on the fringe, combined with the absence of a well-developed girder and the irregular arrangement of the pits, suggest that this species belongs in *Myttonia*. In the type species (Whittard 1955 : 29–31, pl. 3, figs. 5–7) the arrangement of pits is irregular in the entire fringe, and there is no suggestion of radial ridges and sulci anteriorly or laterally. However, Professor Whittard (personal communication) informs me that he has a second species of *Myttonia*, from early Arenig beds of Shropshire, in which the outer rows of pits are arranged in radial sulci, yet there is no girder. Presumably the present species is like this undescribed form from Shropshire, and may also resemble that mentioned by Whittard (1955 : 31) from Dwyrhos Quarry, Caernarvonshire, which also occurs in early Arenig strata.

Family **RAPHIOPHORIDAE** Angelin 1854

Genus ***AMPYX*** Dalman 1827

Ampyx aff. ***salteri*** Hicks

(Pl. 2, figs. 1–6)

1905. *Ampyx Salteri* (?) or *domatus* Linn. ; Fearnsides : 620.

Description. Cephalon triangular in outline, length (sagittal, excluding frontal spine) greater than half the width (tr.). In front of occipital furrow glabella expands forward progressively to maximum width at margin of cephalon, in front of here narrowing rapidly so that glabella projects only a short distance in front of anterior border. Frontal spine relatively short and upwardly curving, rounded in section. Impressed in the flank of the glabella are two subcircular areas (Pl. 2, figs. 1, 5), muscle areas 1p and 2p, the anterior slightly the larger. These areas are situated a short distance inward from the margin of the glabella, and the region between them and the axial furrow is not inflated. Axial furrow shallow, cheek convex with posterior border sloping steeply downward to broad border furrow, which latter narrows distally and dies out inside the genal angle. Narrow, outward-sloping border at

vertical margin of anterolateral part of cheek (Pl. 2, figs. 2, 3), this border apparently becoming narrower and disappearing beneath the glabella. At genal angle borders are extended by long, backwardly-directed and slightly curving spine which reaches back far beyond the posterior margin of the pygidium. Suture normal for genus, curving over outer part of cheek and running along the margin of border (Pl. 2, fig. 3, as shown by the slight displacement of the free cheek).

Thorax of six segments, typical in form with pleural furrow deepening distally. Pygidium of length (sag.) slightly greater than half width (tr.), outline of posterolateral margins rounded, outer parts of pleural regions bent steeply down to form broad border. Axis extremely faintly defined, inner part of pleural region horizontal, first pleural furrow present, deepest distally.

Material. All from locality 1 : B.M., It. 304, enrolled exoskeleton (Pl. 2, figs. 4, 5), was recovered in the present investigation, the remainder are in the W. G. Fearnsides and T. McKenny Hughes collection, SM A 41041–41054, twelve partly preserved exoskeletons and two cranidia (41049, 41053) ; 10344–10347, three partly complete exoskeletons and one thorax and pygidium.

Discussion. The Arenig species is quite like the type, *Ampyx nasutus* (Whittington 1950 : 554–556, pl. 74, figs. 3–9, text-fig. 6), particularly in the presence of the depressed muscle areas 1p and 2p in the flanks of the glabella, presence of the anterolateral border of the cheek, and outline of the pygidium. The glabella does not display an elongate, narrow (tr.), gently convex region between the axial furrow and the outer edges of the first two muscle areas. Such a region is present in the younger species *A. linleyensis* Whittard (1955 : 18–21, pl. 2, figs. 1–8), *"A." costatus* Boeck (Størmer 1940 : 132, pl. 2, figs. 13–18), and *A. virginiensis* (Whittington 1959 : 465–473, pl. 29 ; pl. 30, figs. 1–14, 16, 17, 20–30 ; pl. 31 ; text-fig. 7). This area was regarded by Whittard as the ala, but as discussed earlier (Whittington 1959 : 460–461) it seems more likely to be part of the true glabella.

The Arenig material is compressed and distorted, but shows a general resemblance to type material of *A. salteri* Hicks (Whittard 1940, pl. 5, fig. 8 ; 1955, pl. 1, fig. 15) and to material from Shropshire referred to this species by Whittard (1955 : 15–18, pl. 1, figs. 16–21). It appears to differ in not displaying the gently convex anterior lateral glabellar lobe, and in that the pygidial axis is so weakly defined. Pending the description of more material from South Wales, the Arenig material is considered to be congeneric with Hicks' species, but possibly not conspecific.

Family **ASAPHIDAE** Burmeister 1843

Genus ***OGYGIOCARIS*** Angelin 1854

Ogygiocaris ? cf. ***selwyni*** (Salter)

(Pl. 2, figs. 7–12 ; Pl. 3 ; Pl. 4, fig. 16)

1905. *Ogygia Selwynii* Salter ; Fearnsides : 620.

Description. Complete holaspides (Pl. 3, fig. 9) show the association of the parts of the exoskeleton, and the specimens range in length (sag.) from one centimetre

(Pl. 2, fig. 9) to approximately twelve centimetres. The gently convex glabella is outlined by shallow axial and preglabellar furrows, tapering forward slightly from the posterior margin to a minimum width between the eye lobes, in front of here expanding slightly. Internal moulds (Pl. 2, fig. 10) show a shallow furrow running along the posterior margin which ends in the axial furrow in a deep pit, the mould of the articulating boss. In external moulds this furrow is exceedingly faint. Approximately in line (tr.) with the anterior margin of the posterior border furrow is a small median tubercle. Faint glabellar furrows have been observed in one specimen (Pl. 3, fig. 9). Furrows 1p and 2p are lenticular depressions, equidistant from each other and the posterior margin, 2p being in line (tr.) with the posterior margin of the eye lobe. Furrow 3p is a larger depression, extending closer to the axial furrow, and in line with the anterior part of the eye lobe. Preglabellar furrow separates the glabella from a moderately wide (sag. and exs.), gently convex anterior border, which is continued around the cheek by the anterolateral and lateral border into the base of the fixigenal spine. Shallow anterior pit at intersection of axial and preglabellar furrows, border furrow on cranidium deeper than preglabellar furrow (Pl. 3, fig. 6). Eye lobe of length (exs.) approximately one-third that of cephalon ; eye surface bearing many tiny facets (Pl. 2, fig. 8). The two branches of the facial suture diverge in front of the eyes at an angle exceeding 90°, and meet at the anterior margin at a very oblique angle, producing a blunt anterior point to the cranidium (Pl. 2, fig. 10). Posterior branch of suture runs outward in sigmoidal curve to cross the posterior margin at more than half the width ; broad, shallow posterior border furrow dies out before reaching lateral border. Hypostome (Pl. 2, fig. 7 ; Pl. 3, figs. 1, 2) having gently curved anterior margin, no anterior border ; lateral border with projecting shoulder, posterolaterally broader where it curves around to join the posterior border which is narrowest medially. Margin of posterior border with a sharply folded edge, the median part of which is extended dorsally in a blunt point. Anterior wing large, triangular, dorsally directed. Middle body subdivided by middle furrow into large anterior body and small, crescentic posterior body, the tips of which are inflated. The curved sutural margin of the hypostome fits into an embayment in the anterior part of the doublure (Pl. 3, fig. 2 ; Pl. 4, fig. 16), and the tip of the anterior wing is directed up toward the boss formed by the anterior pit. Doublure of free cheek of similar width to the border, apparently no vincular furrow or panderian opening.

Thorax (Pl. 3, figs. 9–11) of eight segments, pleural furrow broad and shallow, doublure of pleurae poorly preserved but panderian openings not observed. Pygidium (Pl. 3, figs. 3–5, 7–11) with convex axis clearly outlined by broad, shallow axial furrows, the tip prominent. The articulating furrow is distinct, and some specimens show five or six additional ring furrows but in others such ring furrows cannot be seen. The border of the pleural region is of constant width, concave upward, and the broad, shallow first pleural furrow runs out to the inner margin. Three or four additional pleural furrows, exceedingly shallow, can be made out on some specimens, on others they are not visible. The paradoublural line is strong in many specimens (perhaps as a result of compression), the doublure of the same width as the border, concave distally but becoming convex upward near the inner edge.

This edge is parallel to the margin of the pygidium, and passes around the tip of the axis. As measured along the line of the third pleural furrow, the width of the border is less than half that of the pleural region.

Terrace lines are present on the frontal glabellar lobe, the anterior cephalic border, the hypostome, the pygidium, and the doublure. These lines are in the form of raised ridges, one side of the ridge steeper than the other.

The original of Pl. 2, fig. 9 is a meraspid of degree 6, which has well marked furrows on the pygidium, six axial rings and seven pleural furrows being visible. A small cranidium (Pl. 2, figs. 11, 12) is probably a meraspid of a similar degree, and has the frontal glabellar lobe more inflated than in larger examples.

Material. Common at localities 1–5. Specimens B.M., It. 305–315. SM A 10348, internal mould of thorax and pygidium, A 10350, internal mould of cranidium, A 10351, internal mould of cranidium, A 10352–53, internal moulds of pygidia, Llechwedd Erwent; A 45293, 45294 (45296 counterpart), 45295, 45297–99, all moulds of parts of thorax and pygidium, Llechwedd Erwent; A 45317, internal mould of hypostome, Llechwedd Erwent; A 45318 (counterpart 45330), mould of entire exoskeleton, Hafotty Ffilltirgerig; 45319, counterpart moulds of exoskeleton showing hypostome, Hafotty Ffilltirgerig.

Discussion. Whittard (1964 : 236) referred material in the Sedgwick Museum from Hafotty Ffilltirgerig (locality 1) to *Ogygiocaris selwyni*, and material from Llechwedd Erwent (localities 4, 5) to *O. murchisoniae*. I have examined these specimens, together with the much larger amount of material obtained from localities 2, 3 and 5, and conclude that they represent a single species. This species is like that described from the lower Arenig Series of West Shropshire by Whittard (1964 : 232–238, pl. 34, figs. 7–13; pl. 35; pl. 36, figs. 1–7; pl. 37, figs. 2–11) as *O. selwyni*. There are, however, slight differences between the two groups of specimens, for the pygidium of the Welsh material, as seen both in casts from external moulds and in internal moulds, is less furrowed than examples from West Shropshire, and has a relatively narrower doublure (compare Pl. 3, figs. 4, 5, 7, 9, 10, with Whittard 1964, pl. 37, figs. 2–11). Whittard was able to distinguish between two groups of pygidia in his material, one relatively longer than the other, but such groups cannot be distinguished in the Arenig material.

The holotype of the species *selwyni* (Whittard 1964 : 236–237, pl. 37, fig. 1) is a poorly preserved pygidium from ashes near Hengwrt uchaf, a locality about eight miles south-south-west of Llechwedd Erwent, and in early Arenig strata (Wells 1925). This pygidium is like some of those here described, but shows stronger pleural furrows, possibly as the result of distortion. A second Arenig species, from South Wales, is *murchisoniae*, the holotype being a distorted, incomplete exoskeleton (Whittard 1964 : 238–239, pl. 38, figs. 5, 6). As Whittard remarked, this is an unsatisfactorily defined species and the topotype pygidium he figures (pl. 38, fig. 7) is distorted and shows relatively strong axial and pleural furrows. Additional topotype material of both these species is required to define them more satisfactorily, and pending the collection of such material the present specimens are compared to

selwyni. I accept Whittard's (1964 : 232) view that the earliest definition of this species is by Salter (*in* Murchison 1859).

The differences between cf. *selwyni* from Arenig, and material from West Shropshire placed in this species by Whittard, appear to be minor, and Whittard places this species in *Ogygiocaris*. If the specimens from the Henllan Ash are compared with those of the type species of *Ogygiocaris*, *O. dilatata* (Henningsmoen 1960 : 213–221, pl. 1, figs. 1–7 ; pl. 2, figs. 1–6 ; text-fig. 4), it may be seen that they differ principally in not exhibiting the deep outer part of the occipital furrow and subdivision of the occipital ring, in showing in only one specimen the glabellar furrows, and in having the pygidium far less furrowed, with a narrower doublure which does not have the inner edge scalloped. These differences appear to me to preclude the placing of cf. *selwyni* in *Ogygiocaris*., if weight is given to the pygidial characters, as Henningsmoen does. However, Whittard does not consider pygidial characters, and specifically the nature of the inner edge of the doublure, to be of such weight, and hence places *selwyni* in *Ogygiocaris*.

In considering other genera in which cf. *selwyni* might be placed I compared the Welsh species to *Megalaspidella kayseri* Kobayashi 1937, the type species of the genus, which has recently been redescribed (Harrington & Leanza 1957 : 161–164, text-figs. 74, 75). The Argentine species has the glabella tapering slightly but evenly forward, shows no glabellar furrows, and has the anterior branch of the suture running almost straight forward. In other features of the exoskeleton, including the relatively narrow doublure, the lack of furrows on the pygidium, and the shape of the hypostome it is quite like the Welsh species. If weight is given to the course of the anterior branch of the suture (as Whittard does), cf. *selwyni* cannot be placed in *Megalaspidella* (nor in *Plesiomegalaspis* Thoral, 1946, type species from the Arenig of southern France, which Jaanusson, *in* Moore 1959, considers probably congeneric with *Megalaspidella*). I have adopted the compromise of placing cf. *selwyni* in *Ogygiocaris*? The present case illustrates well the problems of asaphid systematics, and the wide differences of opinion that exist (cf. Whittard 1964: 231–232, 245, 255).

Family **CALYMENIDAE** Edwards 1840

Genus ***NESEURETUS*** Hicks 1873

Discussion. The argument by Whittard (1960 : 138–139) for the use of this name rather than *Synhomalonotus* is here accepted. New evidence from the present specimens supports the view expressed by Whittard (1960 : 140–141) that *Neseuretus* is a calymenid and not a homalonotid. The cephalic border of *Neseuretus* (Pl. 5, figs. 5, 6, 8, 10) is rolled under so that the inner edge is close to the dorsal exoskeleton, as in *Flexicalymene* (Evitt & Whittington 1953, pl. 9, figs. 1–6), and the rostral, connective and hypostomal sutures are so situated that the rostral plate in *Neseuretus* is extremely like that of *Flexicalymene*. The hypostome is unlike those known of such other calymenids as *Flexicalymene* (Evitt & Whittington 1953, pl. 9, figs. 8–10) or *Platycalymene* (Whittard 1960, pl. 21, fig. 9) in possessing the trapezoidal extension of

the anterior border. However, the anterior wing, middle body, lateral and posterior borders are quite like those of known calymenids, except that the posterior border is not notched. Apart from the unique anterior extension of the border, the hypostome of *Neseuretus* is also like that of *Bavarilla hofensis* (Sdzuy 1955, pl. 6, figs. 50, 51), a genus which Sdzuy placed in Calymenidae, but later (1957) removed to the Homalonotidae. At this early stage in their evolution, it is difficult to decide whether particular genera are calymenids or homalonotids, and it would seem best to regard them as belonging to one family, here considered to be Calymenidae. The thorax and pygidium of *Neseuretus* (Pl. 5, figs. 1–4) are like those of younger calymenids such as *Pharostoma* (Whittard 1960, pl. 18, figs. 2–4, 8), *Platycalymene* (Shirley 1931, pl. 1, figs. 8, 10) and *Flexicalymene* (Shirley 1931, pl. 1, fig. 15 ; Whittington 1965, pl. 16, figs. 14–17 ; pl. 18, figs. 1–5) in the convexity of the axial ring (the distal inflation well seen on the inner surface but not apparent on the external surface), the broad, deep pleural furrow, the convex posterior band and the sharp downturn of the pleurae at the fulcrum. Just inside the fulcrum there is an oblique angulation in the outline of the posterior margin of the pleurae. Interpleural furrows are present distally on the pygidium (Pl. 4, figs. 9–13), the doublure narrow and curled under. These features of thorax and pygidium are not like those of Ordovician homalonotids (Whittard 1961, pl. 22, figs. 8–19 ; Dean 1961, pl. 54, fig. 3 ; pl. 55, figs. 1, 3–5, 7–10, 12–14). Considering the evidence reviewed by Whittard (1960 : 140–141), and that added here, I conclude that *Neseuretus* is best regarded as a calymenid possessing an unusual hypostome, the relatively long (sag. and exs.) preglabellar area being associated with the unusual forward extension of the anterior hypostomal border.

In the Tremadoc and Arenig are the genera *Bavarilla, Neseuretus, Pharostoma, Pharostomina,* and *Bathycheilus,* and it appears to be from this group of genera that evolutionary lines lead to later calymenids and homalonotids. Among younger calymenids *Neseuretus* is distinguished from *Platycalymene* (Llanvirn-Caradoc) by the relatively shorter glabella, much weaker 3p glabellar furrows, and the longer preglabellar area. The forked hypostome of *Platycalymene,* with the convex macula is also distinctive. *Flexicalymene* (Llandeilo-Ashgill) differs from *Neseuretus* in lacking the extended anterior border of the hypostome, the posterior border of which is forked, in the rounded outline of the 2p and 3p glabellar lobes which are separated from the median lobes by shallow furrows, the relatively shorter preglabellar area, and the relatively narrower pygidium.

Neseuretus parvifrons (M'Coy)

(Pl. 4, figs. 1–13 ; Pl. 5, figs. 1–10)

1851. *Calymene parvifrons* M'Coy : 167, pl. 1F, figs. 7, 7*a*.
1852. *Calymene parvifrons* M'Coy ; Salter : iii, pl. 1F, figs. 7, 7*a*.
1905. *Calymene parvifrons* M'Coy ; Fearnsides : 620.
1931. *Synhomalonotus parvifrons* (M'Coy) Shirley : 10–14, pl. 1, figs. 1–4.
1960. *Neseuretus parvifrons* (M'Coy) Whittard : 142–146, pl. 19, figs. 1–6.

Description. A much more complete synonomy is given by Whittard, but I

differ from him and other authors in attributing the species to M'Coy. His description, in Sedgwick & M'Coy (1851–1855), was published in 1851 in the first fascicule. Although M'Coy attributed the species to Salter, Salter's description was not published until 1852, in the appendix to the second fascicule. This procedure in dealing with those species first described in Fascicule I by M'Coy, and later by Salter in Appendix A, follows that adopted by Dean (1961 : 324, 346).

The following notes are in amplification of Whittard's description. Entire exoskeletons have been collected, and the largest cephalon is approximately 35 mm. in breadth (tr.). Faint glabellar furrows 3p are present on casts from external moulds (Pl. 4, figs. 1, 3, 7) and are " perched ", i.e. they commence a short distance in from the axial furrow. The preglabellar area (anterior area of Whittard) is convex transversely, most strongly so near the anterior margin, where it is widest. Longitudinally the profile may be almost horizontal (Pl. 4, fig. 6) or downward curving (Pl. 4, fig. 4), and in some specimens it appears to curve very slightly upward. Many specimens show a faint change in slope near to the anterior margin, but there is no distinct anterior border or border furrow. The openings of relatively large canals through the exoskeleton are visible along the anterior margin (Pl. 4, fig. 8). The paraglabellar area has not been observed in casts from external moulds, but is faintly visible in some internal moulds as a semi-circular area, set off by a slight change in slope from the inner posterior corner of the cheek. The cephalic border (Pl. 4, fig. 3) becomes defined laterally by a shallow border furrow, and is wider and more distinct on the anterior part of the cheek. On the cranidium the border furrow curves inward and backward (the " anterior furrow " of Whittard), becoming shallower as it approaches the junction of the axial and preglabellar furrows, to which it is connected by a broad, shallow depression. The area between these furrows, here called the preglabellar area (" anterior area " of Whittard), thus appears to be composed in large part by the anterior border. Ventral views (Pl. 5, figs. 5, 6, 10) show the curled-under doublure, which is flattened on the ventral-facing and inward facing slopes. The inner edge of the doublure lies close beneath the border furrow in the dorsal exoskeleton. The rostral suture runs along the outer edge of the margin, the connective sutures run inward at an oblique angle to each other across the ventral-facing part of the doublure, on the inward-facing part they curve and diverge slightly. The rostral plate is thus axe-shaped in outline, and divided by a sharp flexure into two parts. It is extremely like the rostral plate of *Flexicalymene* (Evitt & Whittington 1953, pl. 9, figs. 1–6). Hypostome (Pl. 5, figs. 5, 8) with middle body oval in outline, surrounded by narrow lateral and posterior borders. Anterior border extended laterally into the anterior wings, and anteriorly as a flat plate, subtrapezoidal in outline, that extends beneath the posterior part of the preglabellar area, the curved anterior margin (hypostomal suture) lying against the margin of the rostral plate (Pl. 5, figs. 6, 10). The anterior wing is rectangular in ventral aspect, and extends beneath the boss formed by the anterior (hypostomal) pit. The middle body is of length (sag.) slightly greater than width, divided by a deep middle furrow which runs a short distance backward and slightly inward, and is situated opposite the shoulder. The anterior lobe is thus smaller than the posterior, both lobes being

gently inflated. Lateral border furrow shallow beside and behind shoulder, deepening posteriorly and forming a smooth curve with the posterior border furrow. Posterolateral margin of borders obliquely angulate.

Thorax of thirteen segments, axis approximately one-third total width. Articulating furrow deepens distally, this deepening helping to give the distal part of the axial ring a lobate, inflated appearance in the internal mould (Pl. 5, fig. 2). On the external surface this appearance is much less conspicuous (Pl. 5, fig. 3). Pleural furrow deep, narrow, running slightly diagonally backward to beyond the fulcrum, the posterior band convex, the outer part of the pleura broadly facetted, the tip broad and rounded. About half way across the inner part of the pleura there is a distinct angulation in the posterior margin, so that outside here the margin of the pleura runs more strongly outward and backward to the curved, backwardly directed tip (Pl. 5, figs. 3, 4). Four or five axial rings are clearly outlined on the pygidium, beyond the fifth ring the axis is slightly distended, then the most posterior portion is narrower, and parallel-sided where it runs down the steep posterior slope (Pl. 4, figs. 9–11). Pleural regions divided by six pleural furrows, interpleural furrows are present distally on the first three pleurae, but extend from the axial furrow to the margin on succeeding pleurae. Doublure is narrow and curled under (Pl. 4, figs. 12, 13). During enrollment the outermost parts of the pleural regions of the pygidium, and the tip of the axis, lay against the vertical, inward-facing part of the cephalic doublure (Pl. 5, fig. 6). The concave face of the posterior part of the rostral plate forms a recess, which received the convex tip of the pygidial axis (Pl. 4, figs. 9, 11).

Holotype. SM A 9570, internal mould of incomplete cranidium (Whittard 1960 : 145, pl. 19, figs. 1, 2), from Taihirion, north-west of Arenig Fawr, National Grid Reference 811397. Salter (1853 : 57) describes this locality as " under the trap and volcanic ash beds of Arenig bach ", implying that it lay within the band of Henllan Ash shown running north of Taihirion on Fearnsides' map (1905, pl. 41). No new collections have been made hereabouts, but there seems no doubt that the material described above is conspecific with the holotype.

Other material. Common at localities 1–5. Figured specimens B.M., It. 316–324. SM A 9571 (Shirley 1931, pl. 1, fig. 3 ; Whittard 1960, pl. 19, fig. 3), 45684 (Whittard 1960, pl. 19, fig. 4), 9572–75, 45337–38, 45679–83, from Hafotty Ffilltirgerig ; 45635–45643, from Llechwedd Erwent.

Discussion. Smaller than any cranidia of *Neseuretus* described by Whittard are two from locality 2 and one from locality 3. The original of Pl. 5, fig. 7, is a partial and disarticulated exoskeleton, but ten thoracic segments may be seen, so that cranidia of this size may be late meraspides. The cranidium appears relatively more convex than larger ones (compare Pl. 5, figs. 7, 9, with Pl. 4, figs. 1, 3, 7) and the axial, preglabellar, and anterior furrows thus relatively deeper. A granulation is present on the external surface, and the palpebral lobe is relatively large—the anterior margin almost in line with the anterior margin of the glabella, the posterior margin opposite the outer end of lateral glabellar furrow 1p.

Whittard (1960 : 145) distinguished four species of *Neseuretus* coming from the

same beds in the Mytton Flags. His main criterion for *N. parvifrons* is that there is no border furrow in the preglabellar area, rather that it slopes evenly downward to the margin. As indicated in the above description, an extremely faint border furrow, or slight change in slope, is present in some specimens in the present collection. In *N. brevisulcus* Whittard (1960 : 146–147, pl. 19, figs. 7–14) such a border furrow and border are present, but the distinctness of these features varies (cf. Whittard's figures 7 and 13). The distortion of the Arenig material militates against making slight distinctions between specimens, but none in my collection appears to be as flat in profile as the holotype of Whittard's *N. complanatus* (compare Pl. 4, figs. 6, 7, with Whittard 1960, pl. 20, figs. 4, 5). *N. murchisoni* (Whittard 1960 : 148–150, pl. 20, figs. 6–15 ; pl. 21, figs. 1, 2) has the border clearly defined and also upturned, and rare specimens in the present collections appear to be of this type and are described below. Thus two of the species recognized by Whittard are also present in the Arenig area.

Shirley's (1936 : 401–402, pl. 29, figs. 1–4) species *N. monensis* is from the early Arenig of Anglesey, and is distinguished by having the palpebral lobes situated in line with glabellar lobes 2p. This position is apparently more posterior than that in *N. parvifrons*, but this distinction is slight in view of the distortion of the material and the few fragmentary specimens of *N. monensis* known.

Neseuretus murchisoni (Salter)

(Pl. 4, figs. 14, 15, 17–19)

1865. *Calymene parvifrons* var. *Murchisoni* Salter : 102, pl. 9, figs. 26–28.

Description. Only the cranidium has been recognized, and it agrees well with those described by Whittard (1960 : 148–150, pl. 20, figs. 6–15 ; pl. 21, figs. 1, 2) from the lower Arenig of West Shropshire. The glabella has the frontal lobe relatively wider and more inflated than in *N. parvifrons*, giving a less forwardly tapering appearance. The preglabellar area is markedly inflated, separated by the border furrow from the inflated, inner anterior corner of the cheek, and the anterior part of the area is abruptly flexed to form an upwardly and forwardly projecting border. At the margin of this border the exoskeleton curves over and extends backward and downward to the rostral suture—this suture being situated a short distance down the ventral side of the border (Pl. 4, fig. 14). This contrasts with the condition in *N. parvifrons* (Pl. 4, fig. 3), in which the rostral suture runs along the margin of the preglabellar area. The palpebral lobe is relatively high, rising higher than the mid-part of the glabella, and on the inner side slopes steeply down to the axial furrow. In *N. parvifrons* the palpebral lobe is relatively farther out from the axial furrow, is not so high and the slope into the axial furrow less steep.

Material. From locality 2 forty-seven cranidia are of *parvifrons* type, only one being referrable to *murchisoni* ; at locality 3 the corresponding figures are 8 and 1 ; one cranidium has been recovered from locality 4, and one from locality 5. This appears, therefore, to be a relatively rare but widespread species.

V REFERENCES

American Commission on Stratigraphic Nomenclature. 1961. Code of stratigraphic nomenclature. *Bull. Amer. Assoc. Petrol. Geol.*, **45** : 645–665.

Dean, W. T. 1961. The Ordovician trilobite faunas of South Shropshire, II. *Bull. Brit. Mus. (Nat. Hist.) Geol.*, London, **5** : 311–358, pls. 49–55.

Evitt, W. R. & Whittington, H. B. 1953. The exoskeleton of *Flexicalymene* (Trilobita). *J. Paleont.*, Tulsa, **27** : 49–55, pls. 9, 10.

Fearnsides, W. G. 1905. On the Geology of Arenig Fawr and Moel Llyfnant. *Quart. J. Geol. Soc., Lond.*, **61** : 608–640, pl. 41.

Harrington, H. J. & Leanza, A. F. 1957. Ordovician trilobites of Argentina. *Dept. Geol., Univ. Kansas, Sp. Publ.*, **1** : 1–276, 140 figs.

Henningsmoen, G. 1960. The Middle Ordovician of the Oslo region, Norway. 13. Trilobites of the family Asaphidae. *Norsk. geol. Tidsskr.*, Oslo, **40** : 203–258, pls. 1–14.

Hicks, H. 1875. On the succession of the ancient rocks in the vicinity of St. David's, Pembrokeshire, with special reference to those of the Arenig and Llandeilo Groups, and their fossil contents. *Quart. J. Geol. Soc., Lond.*, **31** : 167–195, pls. 8–11.

Moore, R. C. 1959. *Treatise on Invertebrate Paleontology. Part O. Arthropoda* 1. xix + 560 pp., 415 figs. Lawrence & Meriden.

Murchison, R. I. 1859. *Siluria.* 3rd Edition. xx + 592 pp., 41 pls., London.

Ramsay, A. C. 1866. The Geology of North Wales. *Mem. Geol. Surv. G.B.*, London, **3**. viii + 381 pp., 28 pls., map.

Salter, J. W. 1853. On the lowest fossiliferous beds of North Wales. *Rept. 22nd Meet. Brit. Ass. Adv. Sci.*, Belfast, **1852** : lxiii + 353 + 144 pp., London.

—— 1865. A monograph of the British trilobites from the Cambrian, Silurian, and Devonian formations, **2** : 81–128, pls. 7–14. *Palaeontogr. Soc.* [*Monogr.*], London.

Sdzuy, K. 1955. Die Fauna der Leimitz-Schiefer (Tremadoc). *Abh. senckenb. naturf. Ges.*, Frankfurt a. M., **492** : 1–74, pls. 1–8.

—— 1957. Bemerkungen zur Familie Homalonotidae. *Senckenb. leth.*, Frankfurt a. M., **38** : 275–290, pl. 1.

Sedgwick, A. & M'Coy, F. 1851–55. *A synopsis of the classification of the British Palaeozoic rocks, with a systematic description of the British Palaeozoic fossils in the geological museum of the University of Cambridge.* 1851 : i–iv, 1–184, II pls. ; 1852 : i–x, 185–406, pls. 1H, I, K, L, 2A, B ; 1855 : i–xcviii, 407–662, pls. 2C, D, 3A–I, K. London & Cambridge.

Shirley, J. 1931. A redescription of the known British Ordovician species of *Calymene* (s. l.) *Mem. Manchr Lit. Phil. Soc.*, **75** : 1–35, 2 pls.

—— 1936. Some British trilobites of the Family Calymenidae. *Quart, J. Geol. Soc. Lond.*, **92** : 384–422, pls. 29–31.

Størmer, L. 1940. Early descriptions of Norwegian trilobites. The type specimens of C. Boeck, M. Sars and M. Esmark. *Norsk. geol. Tidsskr.*, Oslo, **20** : 113–151, pls. 1–3.

Stubblefield, C. J. 1939. Some aspects of the distribution and migration of trilobites in the British Lower Palaeozoic faunas. *Geol. Mag., Lond.*, **76** : 49–72.

Thoral, M. 1946. Cycles géologiques et formations nodulifères de la Montagne Noire. *Nouv. Arch. Mus. Hist. nat. Lyon*, **1** : 1–103, pls. 1–16.

Tjernvik, T. E. 1956. On the early Ordovician of Sweden. Stratigraphy and Fauna. *Bull. geol. Instn. Univ. Upsala*, **36** : 107–284, pls. 1–11.

Wells, A. K. 1925. The geology of the Rhobell Fawr district (Merioneth). *Quart. J. Geol. Soc. Lond.*, **81** : 463–538, pls. 30–32.

Whittard, W. F. 1940. The Ordovician trilobite fauna of the Shelve-Corndon district, West Shropshire. Part 1. *Ann. Mag. Nat. Hist.*, London (11), **5** : 153–172, pls. 5, 6.

—— 1955–1964. The Ordovician trilobites of the Shelve Inlier, West Shropshire, **1–7** : 1–264, pls. 1–45. *Palaeontogr. Soc.* [*Monogr.*], London.

WHITTINGTON, H. B. 1950. Sixteen Ordovician genotype trilobites. *J. Paleont.*, Tulsa, **24** : 531–565, pls. 68–75.

—— 1959. Silicified Middle Ordovician trilobites : Remopleurididae, Trinucleidae, Raphiophoridae, Endymioniidae. *Bull. Mus. Comp. Zool. Harv.*, Cambridge, Mass., **121** : 371–496, pls. 1–36.

—— 1962. The Ordovician trilobites of the Bala area, Merioneth, **1** : 1–32, pls. 1–8. *Palaeontogr. Soc.* [*Monogr.*], London.

—— 1963. Middle Ordovician trilobites from Lower Head, western Newfoundland. *Bull. Mus. Comp. Zool. Harv.*, Cambridge, Mass., **129** : 1–118, pls. 1–36.

—— 1965. The Ordovician trilobites of the Bala area, Merioneth, **2** : 33–63, pls. 9–18. *Palaeontogr. Soc.* [*Monogr.*], London.

WHITTINGTON, H. B. & WILLIAMS, A. 1955. The fauna of the Derfel Limestone of the Arenig district, North Wales. *Philos. Trans.*, London (B) **238** : 397–430, pls. 38–40.

EXPLANATION OF PLATES

A light coating of ammonium chloride was applied to the specimens before taking the photographs. Numbers of specimens in the British Museum (Natural History), London, are prefixed by the letters B.M., It., those in the Sedgwick Museum, Cambridge, with the letters SM A.

PLATE 1

Myttonia fearnsidesi sp. nov.

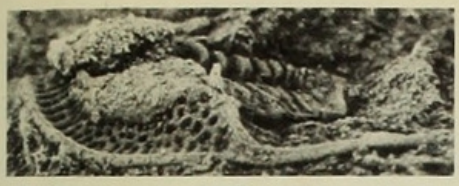
Counterpart moulds of exoskeleton, locality 3. Holotype. B.M., It. 303.

FIGS. 1–4. Latex cast from external mould, left lateral, anterior views, ×6 ; oblique view, ×12 ; dorsal view, ×6.

FIG. 5. Latex cast of external mould of ventral surface, exterior view, ×6.

FIG. 6. Mould of ventral surface (including lower lamella of fringe) of exoskeleton, exterior view, ×12.

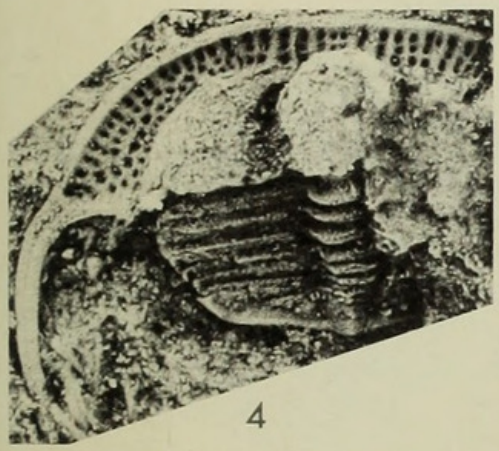
Radial rows of pits are numbered from the sagittal line (0) outward.



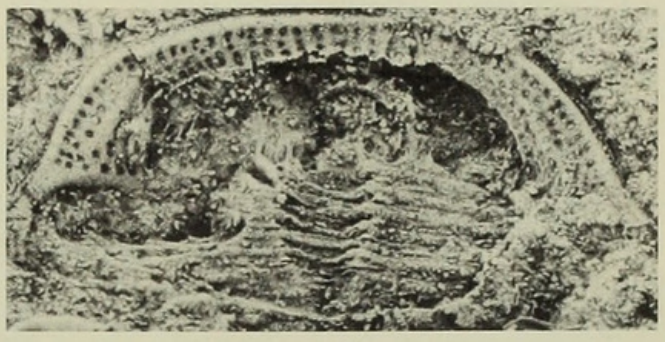
1

2

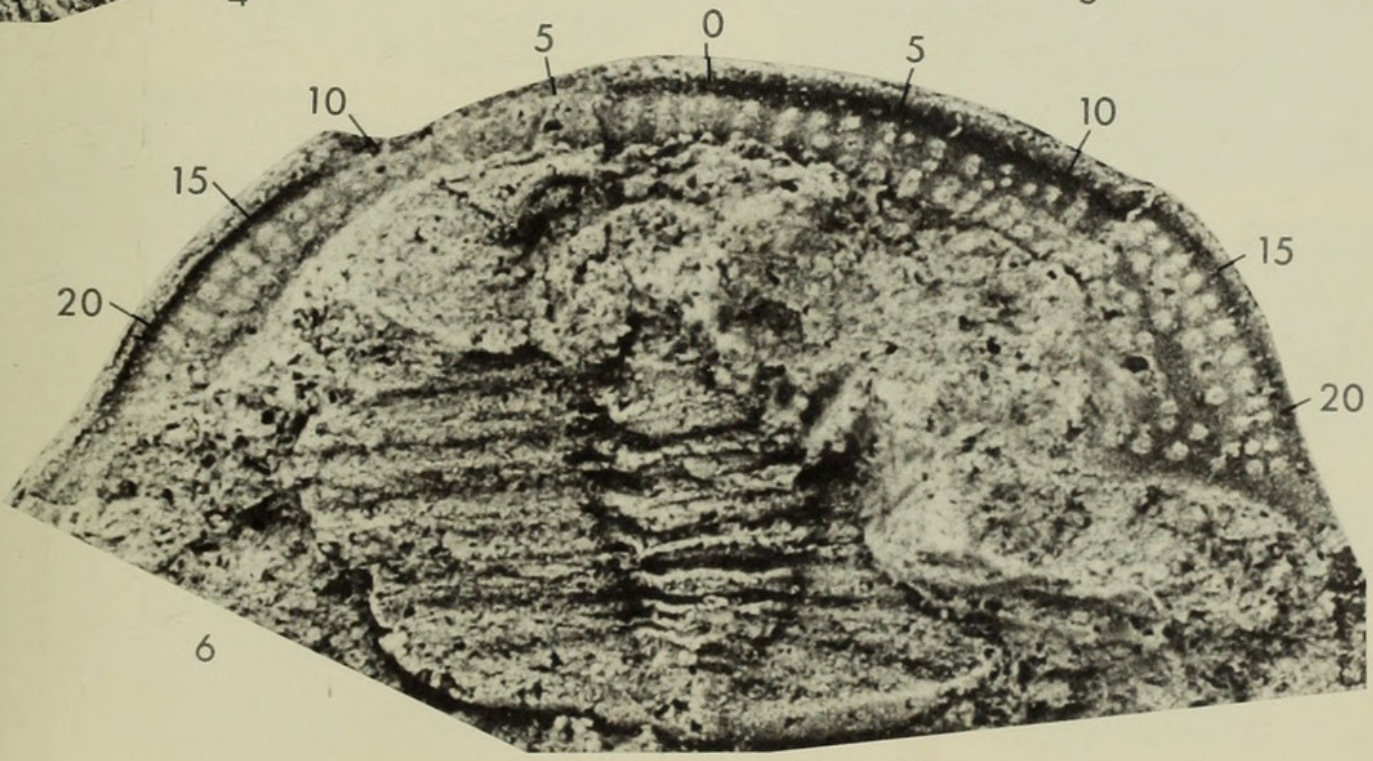
3



4



5



6

PLATE 2

Ampyx aff. *salteri* Hicks

FIGS. 1–3. Cast of external mould of partial exoskeleton, dorsal, anterior, left lateral views, ×3. SM A 41050. Locality 1.

FIGS. 4, 5. Internal mould of exoskeleton, probably enrolled, showing frontal glabellar and right genal spines, right lateral, dorsal views, ×3. B.M., It. 304. Locality 1.

FIG. 6. Internal mould of extended exoskeleton, dorsal view, ×3. SM A 41044. Locality 1.

Ogygiocaris ? cf. *selwyni* (Salter)

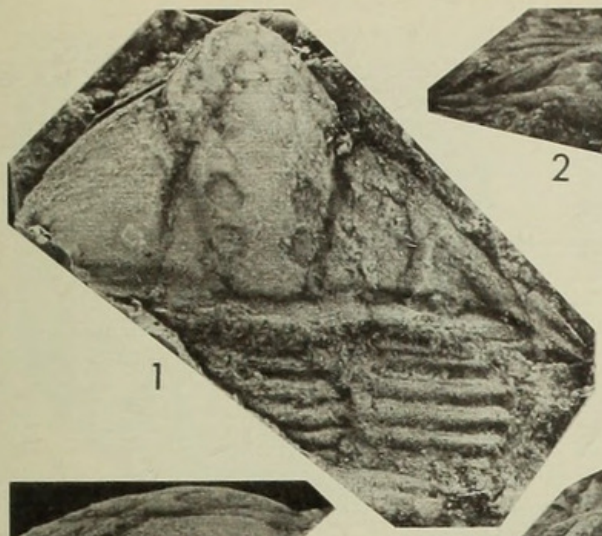
FIG. 7. Latex cast of external mould of hypostome, exterior view, ×4·5. Locality 4. B.M., It. 305.

FIG. 8. Internal mould of surface of eye lobe, exterior view, showing facets, ×9. B.M., It. 306. Locality 3.

FIG. 9. External mould of meraspid degree 6 exoskeleton, exterior view, ×6. B.M., It. 307. Locality 2.

FIG. 10. Incomplete internal mould of cranidium, dorsal view, ×1·7. B.M., It. 308. Locality 3.

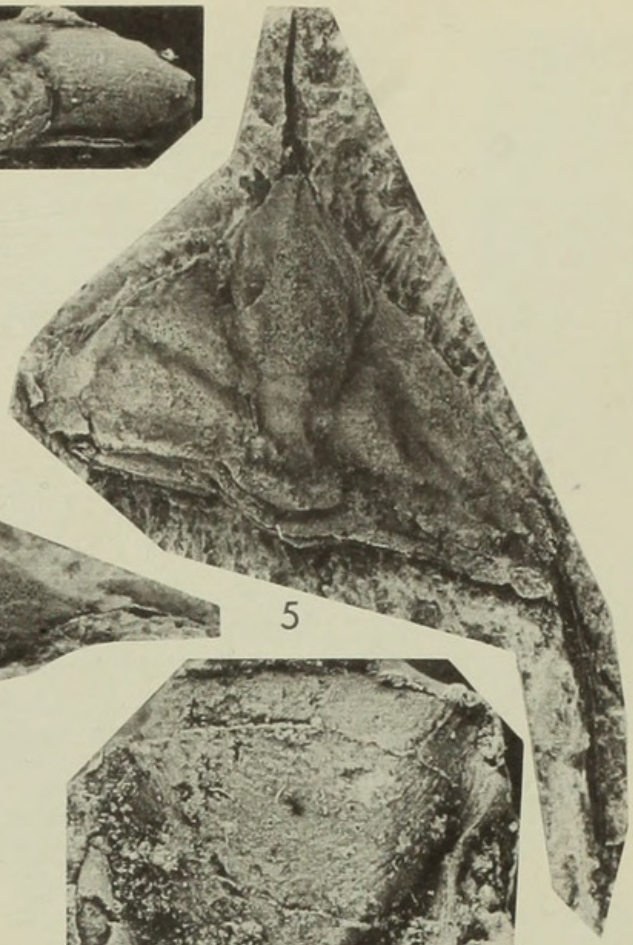
FIGS. 11, 12. Internal mould of small (probably meraspid) cranidium, showing inflated frontal lobe of glabella, dorsal, anterior views, ×3. B.M., It. 309. Locality 2.

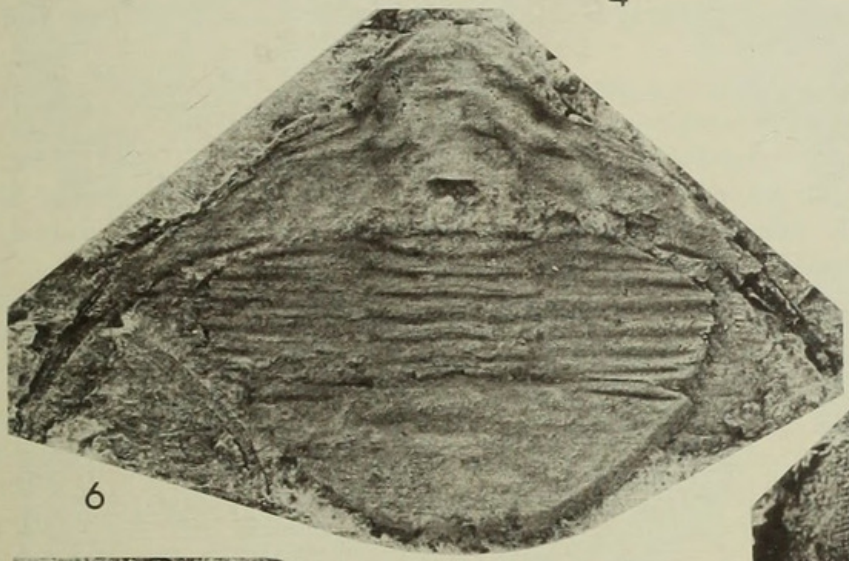

1


2

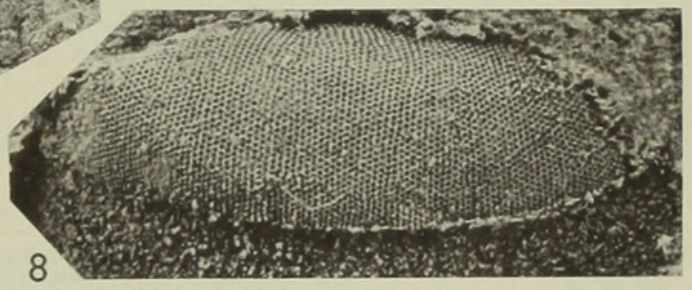

3

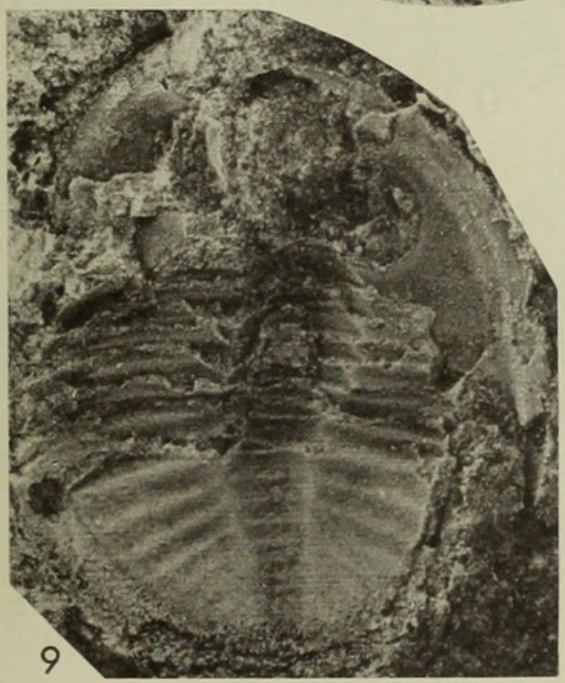

4

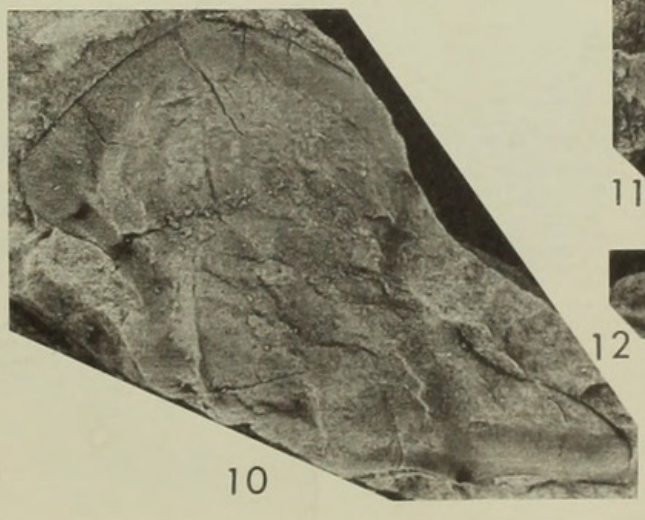

5


6

7


8


9


10


11

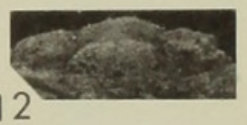

12

PLATE 3

Ogygiocaris ? cf. ***selwyni*** (Salter)

FIG. 1. Internal mould of hypostome, exterior view, ×4·5. B.M., It. 310. Locality 5.

FIG. 2. Internal mould of hypostome and adjacent parts of free cheeks, exterior view, ×4·5. B.M., It. 311. Locality 4.

FIGS. 3, 5. Internal mould of pygidium showing ventral surface of doublure, right lateral, dorsal views, ×3. B.M., It. 312. Locality 2.

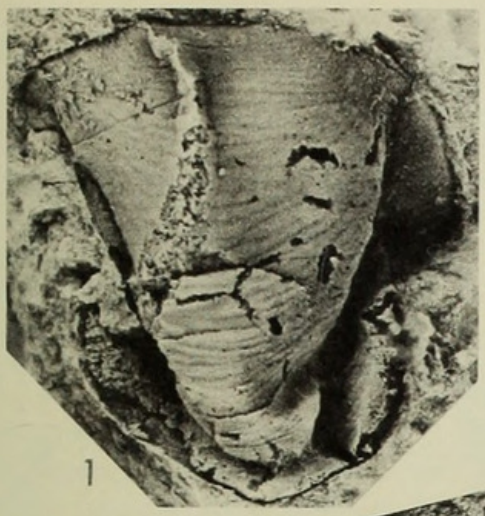
FIG. 4. Latex cast of external mould of incomplete pygidium, showing grooves in external surface, dorsal view, ×3. B.M., It. 313. Locality 2.

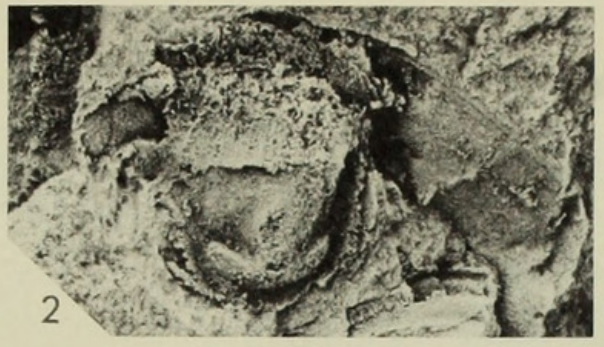
FIG. 6. Latex cast of external mould of frontal lobe of glabella and adjacent part of cranidium, dorsal view, showing lines on external surface and anterior pit, ×4·5. B.M., It. 314. Locality 2.

FIGS. 7, 8. Latex cast of external mould of two thoracic segments and pygidium, dorsal, right lateral views, ×1·7. SM A 45296. Llechwedd Erwent.

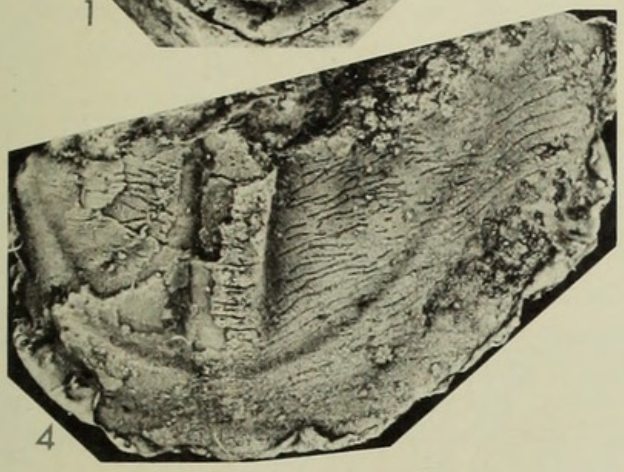
FIG. 9. Internal mould of entire exoskeleton, dorsal view, showing glabellar furrows, ×1·7. SM A 45318. Locality 1.

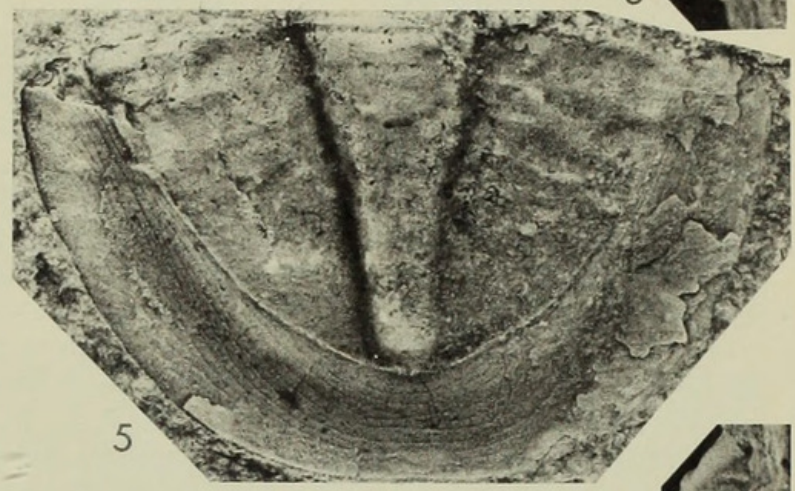
FIGS. 10, 11. Internal mould of thorax and pygidium, dorsal, right lateral views, ×2. SM A 45293. Llechwedd Erwent.


1

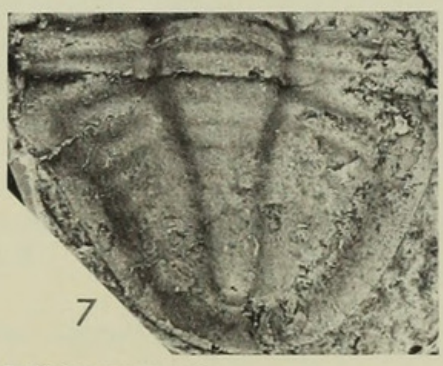

2


3

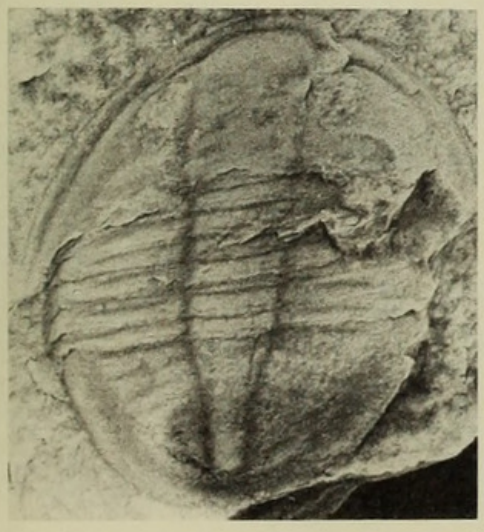

4

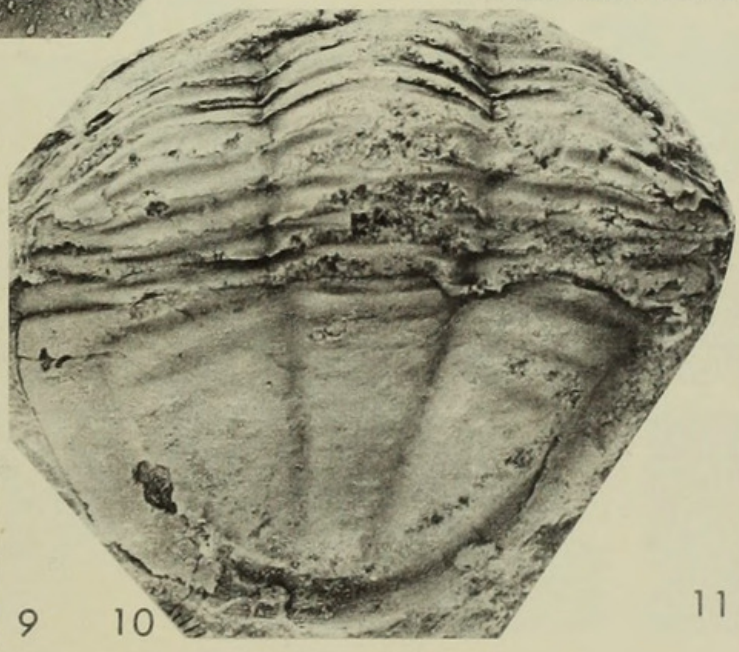

5


6


7


8


9


10


11

PLATE 4

Neseuretus parvifrons (M'Coy)

FIGS. 1, 2, 4, 8. Latex cast of external mould of incomplete cranidium, dorsal, anterior, right lateral views, ×3; anterior view of margin of preglabellar area showing canals, ×9. B.M., It. 316. Locality 2.

FIG. 3. Latex cast of external mould of incomplete cephalon, dorsal view, showing course of facial and rostral sutures along which the exoskeletal parts are slightly displaced, ×3. B.M., It. 317. Locality 2. The median depression in the anterior margin of the preglabellar area of the cranidium is an accidental feature of the cast.

FIGS. 5, 6, 7. Latex cast of external mould of incomplete cranidium, anterior, right lateral, dorsal views, showing flattened profile and almost horizontally extending preglabellar area, ×3. B.M., It. 318. Locality 2.

FIGS. 9–11. Latex cast of external mould of pygidium, dorsal, posterior, right lateral views, ×4·5. B.M., It. 319. Locality 3.

FIGS. 12, 13. Internal mould of posterior thoracic segments and pygidium, right lateral, posterior views, showing narrow, curled doublure, ×3. B.M., It. 320. Locality 2.

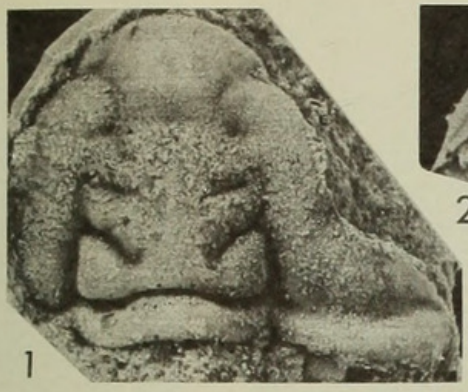
Neseuretus murchisoni (Salter)

FIGS. 14, 19. Latex cast of external mould of incomplete and distorted cranidium, anterior, dorsal views, ×3. B.M., It. 326. Locality 5. Anterior view shows that rostral suture crosses downward-facing surface of border, a short distance from the margin.

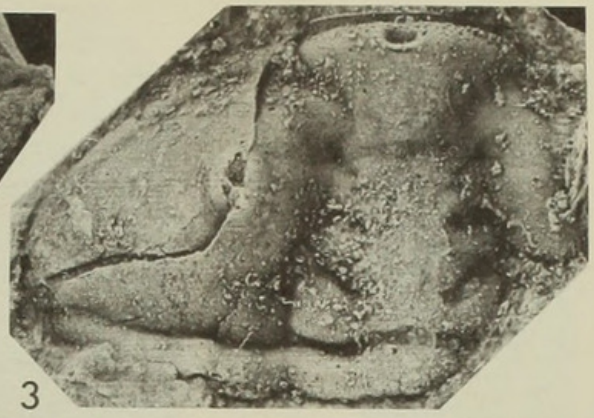
FIGS. 15, 17, 18. Latex cast of external mould of incomplete and distorted cranidium, right lateral, oblique, dorsal views, ×4·5. B.M., It. 325. Locality 2.

Ogygiocaris ? cf. *selwyni* (Salter)

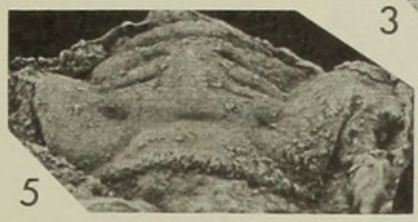
FIG. 16. Latex cast of external mould of ventral surface of free cheek, ventral view, showing doublure, emargination along hypostomal suture, and median suture, ×3. B.M., It. 315. Locality 2.


1

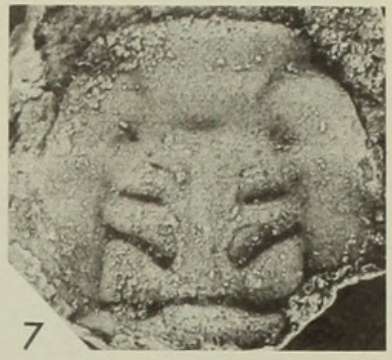

2

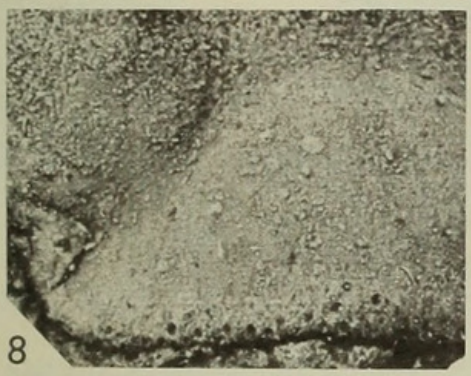

3

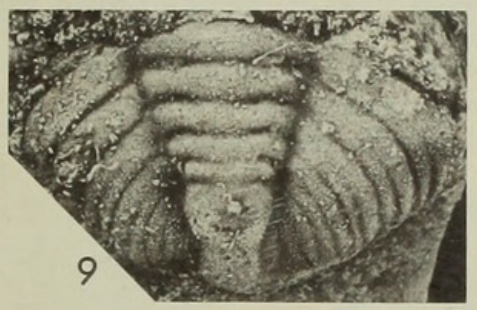

4


5

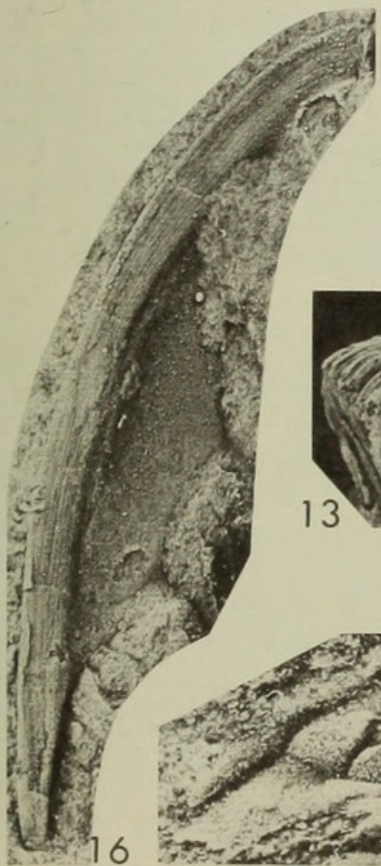

6


7


8


9


10


16


11

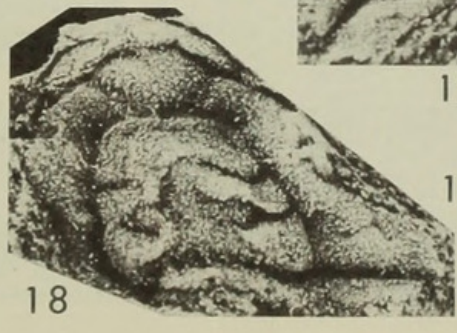

12


13


14


15


17


18


19

PLATE 5

Neseuretus parvifrons (M'Coy)

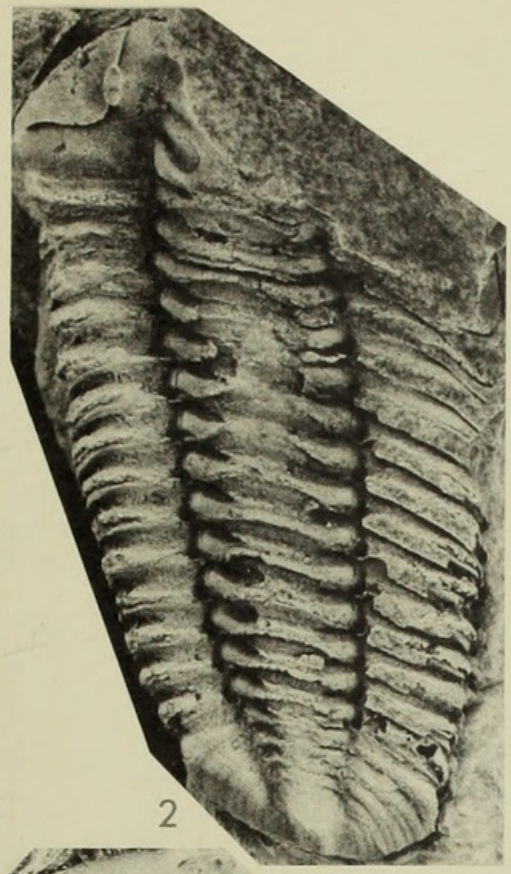
FIGS. 1–4. Counterpart moulds of partial exoskeleton ; 1, 2, internal mould, left lateral, dorsal views ; 3, 4, latex cast of external mould, dorsal, oblique views, ×3. B.M., It. 321. Locality 5.

FIGS. 5, 6, 8, 10. Latex casts from moulds of ventral surface of exoskeleton, including that of doublure and hypostome ; 6, 10, ventral and oblique views before the hypostome was entirely excavated ; 5, 8, ventral and oblique views after excavation of the hypostome, ×4·5. B.M., It. 322. Locality 2.

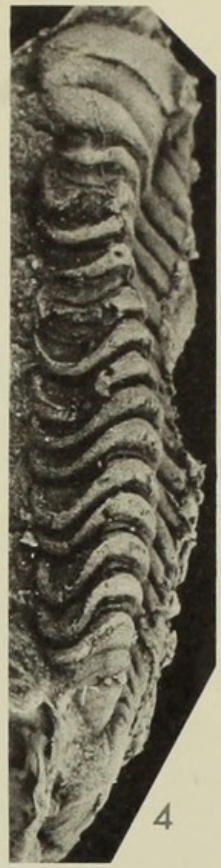
FIG. 7. Latex cast of disarticulated exoskeleton of meraspid, dorsal view, ×6. B.M., It. 323. Locality 2.

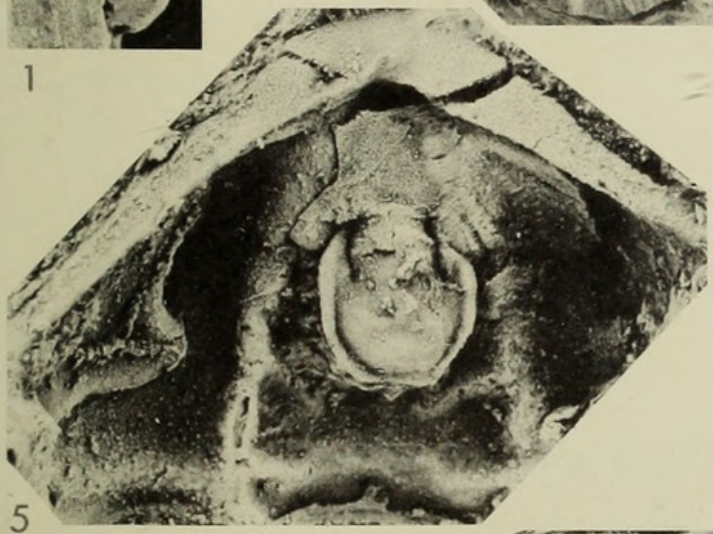
FIG. 9. Internal mould of cranidium of small, probably meraspid, cranidium, dorsal view, ×6. B.M., It. 324. Locality 2.

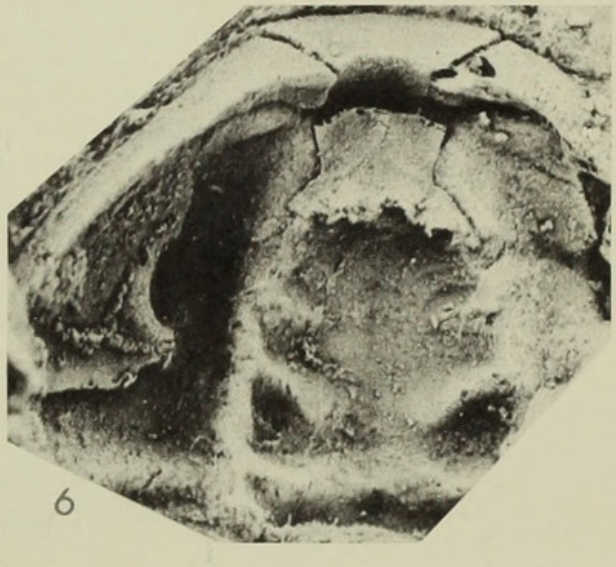

1


2

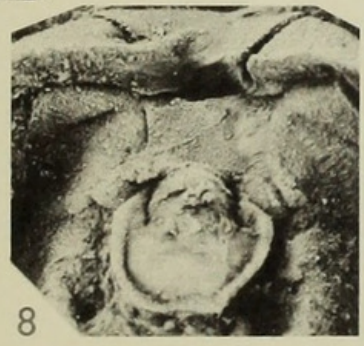

3


4

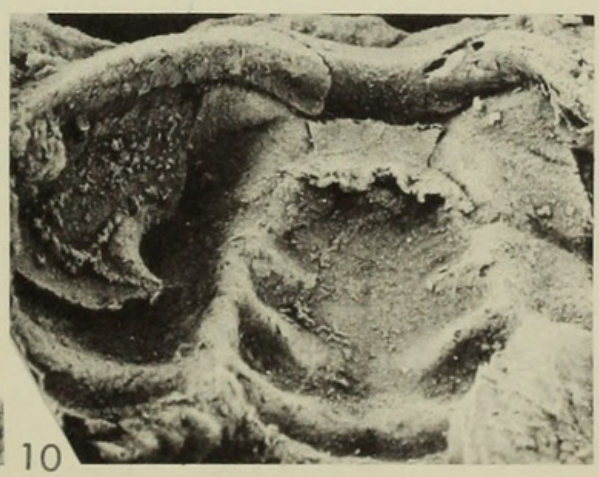

5


6


7


8


9


10