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B.S. Norford

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Preface

This report presents a comprehensive description of a Silurian trilobite fauna from the reefal Attawapiskat Formation. During the past decade this rock unit has been a prime target in the exploration for petroleum resources of the Hudson Bay region but its dating and correlation have been equivocal. The conclusion of the present study is a late Llandovery to early Wenlock correlation.

Detailed taxonomic studies such as these provide the foundation for precise dating and correlation of the rock units that form the geological framework of Canada. Their ultimate benefit is to contribute towards the inventories of the mineral and energy resources of Canada by their application to surface and subsurface stratigraphy.

D.J. McLaren
Director General
Geological Survey of Canada

Ottawa, November 1980

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THE TRILOBITE FAUNA OF THE SILURIAN ATTAWAPISKAT FORMATION, NORTHERN ONTARIO AND NORTHERN MANITOBA

Abstract

Seventeen taxa are described from the biohermal and related limestones of the Attawapiskat Formation developed on the flanks of the Cape Henrietta Maria Arch. A new proetid genus, *Winiskia*, is proposed as are the new species *Chiozoon umisk*, *Stenopareia*? *julli*, and *Winiskia perryi*. The trilobites indicate late Llandovery or early Wenlock age for the Attawapiskat on both flanks of the arch; conodonts and corals from core from a well on the north flank imply late Llandovery for the bulk of the formation but the upper beds are not dated.

Résumé

L'auteur décrit dix-sept taxons et attribue leur provenance aux calcaires et récifs de la formation de l'Attawapiskat aux côtes de l'arche de Cape Henrietta-Maria. Il décrit un genre neuf, *Winiskia*, et les espèces nouvelles *Chiozoon umisk*, *Stenopareia*? *julli* et *Winiskia perryi*. L'étude des trilobites indique un âge du fin du Llandovery ou au commencement du Wenlock pour les deux côtes de l'arche. L'âge des sédiments d'après les conodontes et les coraux d'un puits au côte nord indique un âge du fin du Llandovery pour la plupart de la formation; cependant, les lits supérieurs n'ont pas été datés jusqu'à présent.

INTRODUCTION

The thin, virtually flat-lying Paleozoic succession of the Hudson Platform includes a sequence of fossiliferous Silurian carbonates followed by dolomites, mudstones and evaporites of the thick and virtually unfossiliferous Kenogami River Formation. Outcrop and subsurface evidence indicate facies relationships between the fossiliferous formations and between the uppermost of them, the Attawapiskat Formation, and the basal member of the Kenogami River Formation (Fig. 2 and Norford, 1972a). The upper part of the Kenogami River has yielded Early Devonian and possibly Downtonian microfloras (McGregor and Camfield, 1976) but the bulk of the formation is not dated.

The Attawapiskat is not developed throughout the Hudson Bay and James Bay region and seems to be restricted to the flanks of the Cape Henrietta Maria Arch (Fig. 1), a positive feature during Ordovician and Silurian time. Outcrops essentially are limited to tidal flats and the three major rivers: Severn, Ekwan and Attawapiskat. The Attawapiskat Formation consists of clusters of small steep bioherms, built by algae and stromatoporoids and among the first described from the geological record (Bell, 1887, p. 27G-29G). In outcrops the bioherms are scores of metres across and many are at least ten metres high but this may be only a small component of their true heights. Beds of detritus from the bioherms show depositional dips as high as thirty degrees. Many reefs coalesce but some outcrops show inter-reefal dolomites that lithologically are similar to parts of the basal member of the Kenogami River Formation.

Trilobites are not a prominent part of the fauna of the Attawapiskat Formation but locally are common in pockets within the reefs and also are present within detrital limestones. Very large species of *Chiozoon* and *Ekwanoscutellum* are the most common and often occur together in the pockets; *Meroperix* is fairly common but mainly is found associated with brachiopods and in the detrital beds. Most of the other genera are quite rare, especially the odontopleurids and lichid.

Acknowledgments

Most of the specimens were collected personally during Operation Winisk, 1967, a large, helicopter-supported, comprehensive study of the Hudson Bay Lowlands and James Bay Lowlands. L.M. Cumming collected some material in 1967 and D.B. Dowling collected specimens in 1901 that later were described by Whiteaves (1904, 1906). T.T. Uyeno provided determinations and correlations of samples collected for conodonts. B.D.E. Chatterton, P.D. Lane, R.M. Owens, A.T. Thomas, R.P. Tripp and H.B. Whittington very kindly discussed taxonomic problems at an early stage in the preparation of the manuscript, T.E. Bolton and B.D.E. Chatterton gave constructive criticism of drafts, and Wolfgang von Moltke provided an excellent translation of the proposal and diagnosis of *Ekwanoscutellum* by Přibyl and Vaněk (1971). Brian Rutley photographed the trilobites.

BIOSTRATIGRAPHY OF THE ATTAWAPISKAT FORMATION

The biohermal Attawapiskat Formation is about 60 m thick in the Kaskattama Well (minimum of 52 m, maximum of 68 m, samples not recovered from 16 m) and thins and changes facies into the lower Kenogami River Formation westward, away from the Cape Henrietta Maria Arch, and probably also southeastward towards the widespread outcrops along the Ekwan and Attawapiskat Rivers (Fig. 1; Norford, 1970, p. 6, 8, 35-36; 1972a, p. 200, 202-204, 207). No trilobites were recovered from core from the formation in the well but corals indicate late Llandovery to Wenlock age with *Palaeocyclus* [considered to be an index fossil for late Llandovery time by Hill (1959, p. 153)] found 38 m below the top of the formation. The brachiopod *Pentameroides* cf. *P. expansa* (Whitfield) is present lower in the core of the Kaskattama Well and *Pentameroides* sp. in core from the Comeault Well, both in the lower part of the Attawapiskat and in intertongued lower Kenogami River Formation. According to Boucot and Johnson (1979, p. 103), *Pentameroides* ranges from mid-Late Llandovery (C_4) to Wenlock.

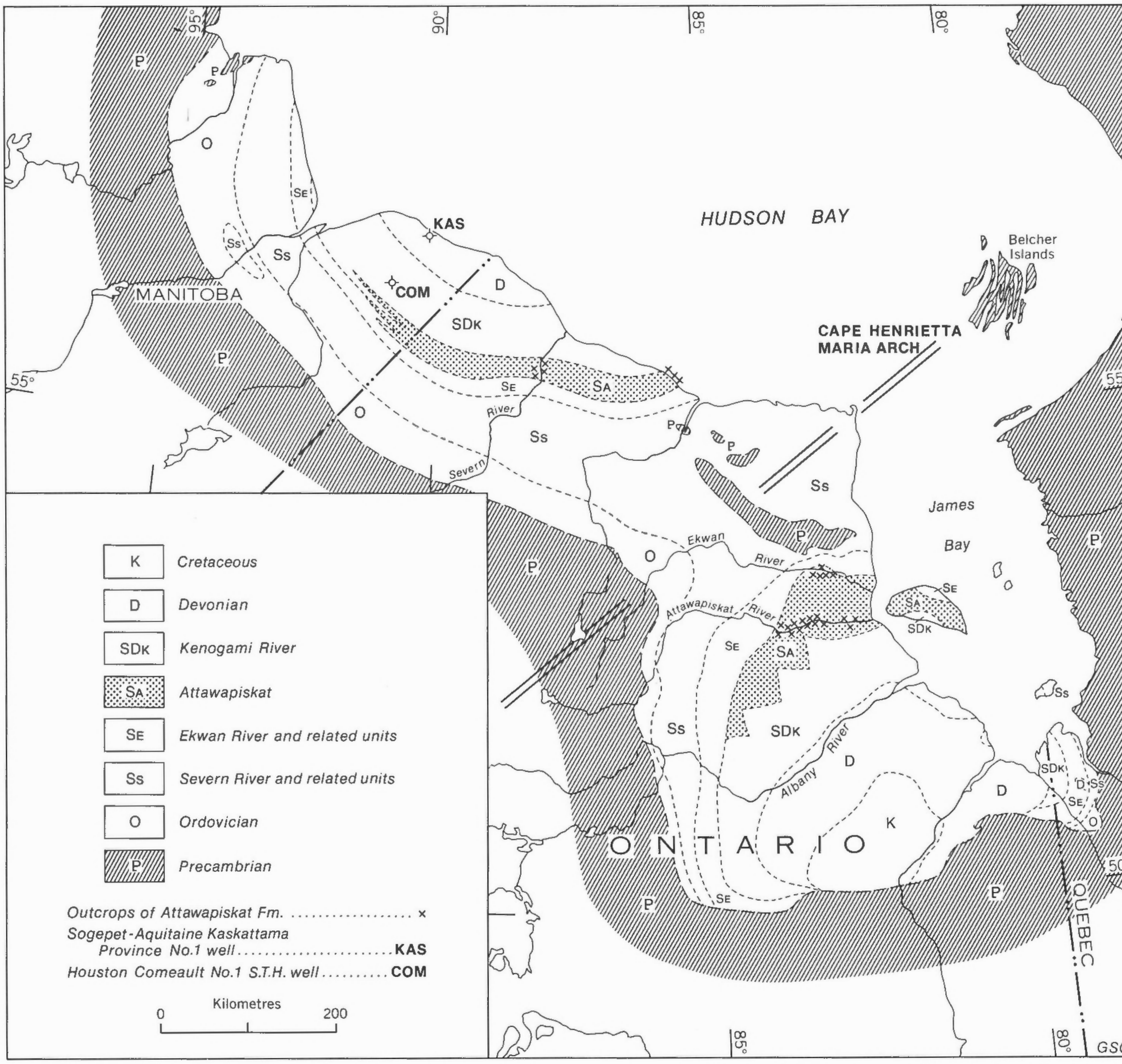


FIGURE 1. *Sketch map of the Silurian geology of northern Ontario and northern Manitoba.*

Extensive faunas from outcrops of the Attawapiskat Formation have been reported in the older literature (Low, 1887; Dowling, 1904; Whiteaves, 1904, 1906; Tyrrell, 1913; Savage and Van Tuyl, 1919) but detailed modern taxonomic studies are necessary before their biostratigraphic evidence can be evaluated. A new species of *Sapelnikovia* recently has been described (Boucot and Johnson, 1979, p. 119) from outcrops along the Attawapiskat (GSC locs. 80571, 80572); of the four other taxa assigned to *Sapelnikovia* from other parts of the world, two are cited by Boucot and Johnson as early Wenlock, one as late Llandovery or early Wenlock and one as late Llandovery to Wenlock. Estimates of the thicknesses of the formation in the outcrop areas are very difficult to make. The maximum stratigraphic thicknesses measured by me at any of the individual outcrops along the Severn River and the Attawapiskat River were 12 m and 14 m respectively, but the total thickness of the formation along each river probably is much greater. The Kaskattama Well and other wells provide reliable subsurface data on the thickness of the Attawapiskat Formation north of the Cape Henrietta Maria Arch but wells are few south of the arch and have not penetrated the formation.

Studies of conodonts (Le Fèvre and others, 1976, p. 72) assigned the bulk of the Attawapiskat Formation (about 60 m thick) of the Kaskattama Well to the *Llandoverygnathodus celloni* zone; (Upper but not highest Llandovery); above this a 6 m interval was assigned to an undescribed *Neospathognathodus* n. sp. Assemblage Zone but the top 24 m of the formation were not dated. Uyeno (pers. com., 1968, 1972) has identified the *celloni* Zone from outcrops of the Ekwan River Formation along the Severn and the Attawapiskat Rivers but samples from the overlying Attawapiskat Formation did not yield biostratigraphically diagnostic conodonts.

Trilobites of the Attawapiskat Formation (Table 1) are all from outcrops of uncertain stratigraphic position within the formation but the taxa are considered as a single fauna. However, the northern locality along Severn River (GSC loc. 80613) has only *Meroperix aquilonaris* (Whiteaves) and *Goldillaenus*? sp. in common with the faunas from the Ekwan River and Attawapiskat River localities. *Cheirurus*? sp. and *Encrinurus* sp. 1 are known only from the Severn River, so that this locality could be of slightly different age than the southern outcrops, four hundred kilometres away and the other side of the Cape Henrietta Maria Arch.

Acidaspis, *Bumastus*, *Cheirurus*, *Cyphoproetus*, *Encrinurus*, *Flexicalymene*, *Goldillaenus*, *Platylichas* and *Stenopareia* are long-ranging genera that are present in many Late Llandovery to Ludlow assemblages in North America and Europe but *Encrinurus* sp. 1 is closely related to *E. elegantulus* Billings from high in the Upper Llandovery of Anticosti Island. *Ekwanoscutellum* is known only from northern Ontario and *Chiozoon*, *Meroperix* and *Opoa* are known only from Greenland, northern Ontario and northern Manitoba. Only one other specimen of *Selenopeltoides* has been described and that from Bohemia.

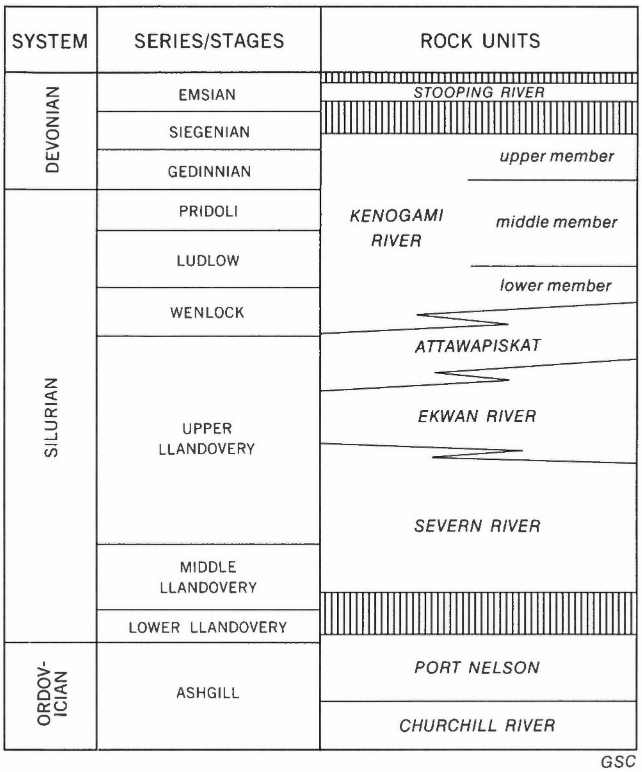


FIGURE 2. *Silurian sequence, northern Ontario and northern Manitoba.*

Trilobite faunas presently under study from Upper Llandovery rocks of northwestern Greenland (Poulsen, 1934; Norford, 1972b; Lane, 1979) are distinct from both the Attawapiskat fauna and a fauna described from northeastern Greenland by Lane (1972). Most of the faunas from northwestern Greenland are associated with the *Monograptus turriculatus* Zone and older Llandovery horizons and all are stratigraphically below beds assigned to the uppermost Llandovery *Monograptus spiralis* Zone at Kap Tyson and Kap Schuchert. The fauna with closest generic similarity to the Attawapiskat fauna is from northeastern Greenland (Lane, 1972) which includes the only previously documented occurrences of *Chiozoon*, *Meroperix* and *Opoa* although *Opoa regale* (Fritz) now is known from the Upper Llandovery Severn River Formation of northern Manitoba (as *Scutellum* sp. of Norford, 1970, p. 5, 28). Apparently the fauna from northeastern Greenland was collected from a stratigraphic interval about 15 m thick comprising the uppermost Drommebjerg Limestone and boulders in the base of the overlying Profilfjeldet Shales. Scrutton (1975, p. 8) has doubted the provenance of Lane's locality 1511 labelled as being from the Centrum Formation (dated by Scrutton as Middle and Late Ordovician) and almost 300 m below the other collections. The fauna is about 50 m below late Wenlock graptolites (Lane, 1972, p. 336); corals from the boulders indicate late Llandovery or early Wenlock ages (Scrutton, 1975, p. 12; modified by McLean, 1974, p. 19-20). The Drommebjerg-Profilfjeldet fauna well may be early Wenlock as suggested by Lane but a late Llandovery age cannot be discounted.

Thus by comparison with other trilobite faunas, the Attawapiskat presently can only be dated as late Llandovery or early Wenlock. North of the Cape Henrietta Maria Arch the lower and middle part of the formation in the Kaskattama Well are dated as late Llandovery on the evidence of both conodonts and corals and the upper part may be entirely very late Llandovery or extend into the early Wenlock. South of the arch the Attawapiskat is assumed to be of similar age but may include some older or younger horizons.

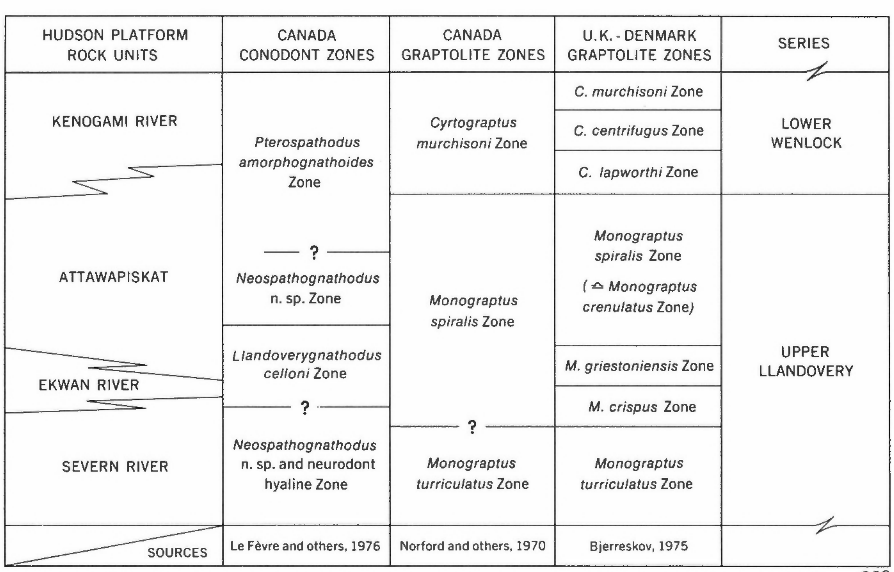


FIGURE 3. *Correlation of schemes of zonation.*

TABLE 1

Distribution of trilobites, Attawapiskat Formation

Area of Outcrop GSC locality Taxa	Attawapiskat River 80565	 80567	 80568	 80569	 80571	 80572	 80574	Severn River 80613	Ekwan River C-4450	 C-4453	 C-4457	 C-4459	 C-4461
Acidaspis sp.					x		x						
Bumastus? sp.			x	x									
Cheirurus? sp.								x					
Chiozoon umisk new species				x	x	x	x					x	x
Cyphoproetus sp.					x		x					x	
Ekwanoscutellum ekwanensis (Whiteaves)	x	x	x	x	x				x	x	x		
Encrinurus sp. 1								x					
Encrinurus sp. or spp.					x		x						
Flexicalymene sp.							x		x			x	
Goldillaenus? sp.	x	x				x		x			x		x
Meroperix aquilonaris (Whiteaves)	x		x	x	x	x	x	x		x			
Opoa sp.						x	x				x	x	x
Platylichas? sp.					x								
Selenopeltoides sp.							x						
Stenopareia? *julli* new species	x	x	x	x	x	x	x				x		x
Stenopareia? sp.				x							x		
Winiskia perryi new genus and species			x		x		x				x	x	x

SYSTEMATIC PALEONTOLOGY

Prefix GSC refers to type specimens and other designated material, all stored in the type collection of the Geological Survey of Canada, Ottawa. Within the taxonomic descriptions the occipital ring is regarded as separate from the glabella (Harrington, 1959, p. 046).

Phylum Arthropoda

Class TRILOBITA

Family Bumastidae Raymond, 1916

Genus *BUMASTUS* Murchison, 1839

Bumastus Murchison, Lane and Thomas, in Thomas, 1978, p. 11

Type species. Bumastus Barriensis Murchison, 1839 from the English Wenlock.

Bumastus? sp.

Plate 1, figures 1-3

Material and occurrence. Hypotype pygidia GSC 63480 (external surface), 63481 (internal mould), GSC loc. 80568; a larger undesignated pygidium (internal mould) GSC loc. 80569; Attawapiskat River.

Comments. The pygidia resemble those of *Bumastus* in their low convexity, transverse outline and the lack of any differentiation of the axis from the pleural regions except for that revealed by the changes of curvature of the anterior margin. Sparse very fine pits are present over most of the external surface, some fine terrace lines and very fine granules are developed near the anterolateral margins.

Genus *EKWANOSCUTELLUM* Přibyl and Vaněk, 1971

Ekwanoscutellum Přibyl and Vaněk, 1971, p. 383-384.
non *Ekwanoscutellum* Přibyl and Vaněk; Ludvigsen, 1979, p. 70.

Type species. Bronteus ekwanensis Whiteaves, 1904 from the Attawapiskat Formation, Ekwan River, Ontario.

Diagnosis. Cranidium large, preglabellar depression vestigial and only present at anterolateral corners of wye-shaped glabella that is narrowest at cranidial midlength. Occipital impression and lateral glabellar impression 1g large and strong, 2g and 3g faint; occipital ring without median node. Eye large, high, extending from opposite occipital furrow to cranidial midlength; palpebral lobe high; fixed and free cheeks wide. Pygidium very large, vaulted, with proportionally long, non-trilobate axis, seven pairs of broad, convex ribs and median rib that bifurcates at about half the distance from rear of axis to posterior margin. Dorsal surface of all parts virtually smooth.

Comments. Přibyl and Vaněk proposed the genus without knowledge of any parts other than the pygidium, stressing the length and shape of the axis and the pattern of the ribs.

Very few of the scutelluid genera that have seven pairs of ribs have the median rib bifurcated. *Opoa* Lane and *Meroperix* Lane have significant cephalic differences from *Ekwanoscutellum* and radically different pygidial ornaments and shapes of pygidial axes. *Decoroscutellum* (*Decoroscutellum*) Šnajdr and *Decoroscutellum* (*Flexiscutellum*) Šnajdr have very different cephala, their pygidial axes are trilobate and bifurcations of the median rib are far back (Šnajdr, 1960). *Planiscutellum* Richter and *Kosovopeltis* Šnajdr have very similar cranidial impressions to those of *Ekwanoscutellum* but, like *Protoscutellum* Šnajdr, have undivided median ribs; although a sagittal furrow is present on the doublure of *Planiscutellum kitharos* Lane and Thomas (in Thomas, 1978, p. 27, Pl. 6, fig. 4a). *Kosovopeltis* has a strong and distinctive ornament.

The essentially smooth external surface of the pygidium may be a generic feature, the cephalon similarly is virtually smooth except for fine irregular pits. Přibyl and Vaněk (1971, p. 384) assigned the Wisconsin species *Bronteus laphami* Whitfield, 1882 to *Ekwanoscutellum*. Whitfield's description and illustrations of the almost smooth pygidium indicate close relationships to *ekwanensis* but the other parts of the skeleton are virtually unknown. Pygidia from Iowa assigned to *laphami* by Miller and Unklesbay (1944, Pl. 58, figs. 3-6, Pl. 59) have strong and diverse ornaments very different from that described by Whitfield, as does the fragmentary pygidium from the La Vieille Formation of Quebec illustrated by Northrop (1939, Pl. 25, fig. 10) as *Goldius ekwanensis* (Whiteaves). At present the Iowa and Quebec materials are not assigned to *Ekwanoscutellum*.

Ekwanoscutellum ekwanensis (Whiteaves, 1904)

Plates 2 to 4; Figure 4a

Bronteus Ekwanensis Whiteaves, 1904, p. 58F.
Bronteus Ekwanensis Whiteaves; Whiteaves 1906, p. 266-267, Pl. 42, fig. 1.
Bronteus ekwanensis Whiteaves; Savage and Van Tuyl 1919, p. 357, 364.
non *Goldius ekwanensis* (Whiteaves); Northrop 1939, p. 230-231, Pl. 25, fig. 10.
Scutellum ekwanensis (Whiteaves); Bolton 1966, Pl. 19, fig. 8.
Ekwanoscutellum ekwanensis (Whiteaves); Přibyl and Vaněk 1971, Pl. 8, fig. 4.
non *Ekwanoscutellum ekwanensis* (Whiteaves); Ludvigsen, 1979, p. 69-70, Fig. 46c.

Material and occurrence. Lectotype (here selected) pygidium GSC 4406 (Whiteaves, 1906, Pl. 42, fig. 1), GSC loc. C-4457; paralectotype pygidium GSC 17753 (external surface and mould), GSC loc. C-4461; hypotypes GSC 63490-63500 and undesignated specimens; GSC locs. 80565, 80567, 80568, 80569, 80571, 80572, 80574, Attawapiskat River, GSC locs. C-4457, C-4459, C-4461, Ekwan River; total of 2 cephala (1 whole), 39 cranidia (14 whole), 15 free cheeks (7 whole), 7 hypostomes (3 whole), 1 thoracic fragment, 84 pygidia (12 whole).

Description. Cephalon very large, very gently arched transversely, outline parabolic, preglabellar impression only present anterolaterally. Glabella transversely evenly convex; sagittally anteriorly convex, mid and posterior parts flat and lower than occipital ring, with very subdued median keel; outline wye-shaped, narrowest at inflexion of wye. Axial furrows variably impressed along courses; forward of occipital furrow slightly convergent, straight and shallow with elongate pit at front of lateral impression (Pl. 2, figs. 1, 2, 7), swinging abruptly just in front of cephalic midlength to trend almost straight, oblique and anterolateral, deepened at inflexion, next shallow, next deepening abaxially, curving to be almost transverse as joins border furrow, there fading and not reaching border; broad shallow border furrow continues adaxially as preglabellar furrow but fades about midway to sagittal line. External surface of glabella with pair of shallow dimples (Pl. 2, fig. 7) marking adaxial rear parts of lateral glabellar impressions 1g that on internal surface are large, semioval, well impressed and abut against axial furrows from front of pit forward to just behind inflexion, each occupying a third of glabellar width at 1g, deepest adaxially and rearward, less impressed anterolaterally with a shallow shelf within the impression. Lateral glabellar impressions 2g and 3g obscure, shallow, close to axial furrow, only detectable on internal surface; 2g much smaller than 1g, transversely oval with its rear opposite inflexion of axial furrow; 3g about a third as large as 1g, suboval, centred about midway between inflexion and anterolateral margin. Lateral impression strong, large, abutting against axial furrow, extending from just in front of posterior border furrow to and including deep pit in axial furrow, bounded laterally and anterolaterally by slightly swollen parts of fixed cheek. Occipital impression strong, large, transversely suboval, a third of width of rear of glabella, extending from midlength (exsag.) of occipital ring onto rear of glabella. Occipital ring convex (sag.) gently arched (tr.), wider than rear of glabella, widening rearward, without median node; occipital furrow transverse, broad, with steep slope to rear of glabella, gentle slope to occipital ring, only defined in midthird, obscured laterally by occipital impressions.

Fixed cheek wide, gently convex; posterior border very short (exsag.) and convex at axial furrow, rearward swelling of part of fixed cheek from axial furrow to close to exsagittal position of palpebral lobe; border furrow broad, swings obliquely slightly posterior of transverse from axial furrow to margin, next slightly anterior of transverse, broadens and fades before reaching facial suture; posterior part of fixed cheek extends far abaxial of palpebral lobe (Pl. 2, fig. 1), which is subcircular, about a fifth of cranidial length and is about highest point on cranidium (Pl. 3, figs. 5, 6) extending from opposite occipital furrow to opposite deep pit in axial furrow, merges with adjacent fixed cheek; ill-defined eye ridge trends towards but does not reach axial furrow far forward of inflexion (Pl. 2, figs. 1, 4); front part of fixed cheek curving down to broad, shallow, gently concave border furrow; border convex. Facial suture (Pl. 2, fig. 1) curves abruptly from front of palpebral lobe to run straight, obliquely anterolateral to border furrow where curves gently to be almost forward at border, next swings obliquely towards axis, crosses margin (Pl. 2, fig. 4) and reaches ventral surface at about a third of distance to sagittal line; rostral suture continues very gentle curvature to form a very obtuse point at axis; posterior course of facial suture drops ventrally at edge of palpebral lobe (Pl. 3, fig. 5), curving slightly forward and adaxially, next curving outward to be transverse to rear of (and well below) abaxial limit of palpebral lobe, finally curving posterolaterally to cut margin.

Free cheek large, with evenly curved depression running from lateral extremity of posterior course of facial suture to near junction of anterior course with anterolateral border furrow. This depression separates an inner moderately convex area from an outer very gently convex area that extends to border furrow but flattens towards broad, flat, very short genal spine. Posterior margin abaxially curves gently posterolaterally, anterolateral margin with even curvature. Posterior border furrow lacking, anterior border strong, fading laterally, lateral border furrow wide at facial suture, becoming very broad and very shallow abaxially and fading well before reaching genal spine; doublure large, strongly reflexed. Eye very large, crescentic, strongly raised, bordered by indistinct broad shallow groove; composed of more than 5,000 very small lenses, mostly six-sided (Pl. 4, figs. 6, 7).

Rostral plate poorly known (Pl. 2, fig. 11; Pl. 4, fig. 1), wide, almost flat. Hypostome wider than long, anterior margin evenly rounded, anterior lobe of middle body strongly inflated, middle furrow sited posteriorly, maculae strongly defined, posterior margin subtlely pointed, anterior wings well reflexed. Thorax poorly known (Pl. 3, fig. 4).

External surface of cephalon smooth except for fine irregular pits (Pl. 2, figs. 1, 7), coarse terrace lines on border, hypostome, median part of front face of glabella and very coarse on doublure of free cheek.

Pygidium very large, vaulted, outline a truncated ellipse, very slightly longer than wide, greatest width behind axis but in front of midlength. Axis not exsaggitally divided, long (about a quarter of pygidial length), tapering gently to rounded rear, high, transversely arched, sagittally flat forward, gently convex to rear; broad shallow transverse furrow behind very short articulating half-ring, three pairs of indistinct short oblique furrows in anterolateral parts of axis (Pl. 2, figs. 8, 9) appear to be lined up with outer three pairs of interpleural furrows. Pleural field large, vaulted part gently convex, lateral part slightly concave, postaxial region almost flat near posterior margin. Interpleural furrows strong, broaden, shallow and fade towards margin, rear four pairs obscure at axial furrow; seven pairs of broad, low, very gently convex ribs and a median rib that is slightly keeled forward and bifurcates at slightly less than halfway to rounded posterior margin. Doublure long (almost half pygidial length) with gently convex ribs and broad shallow furrows on its ventral surface corresponding to those on the dorsal surface of pygidium but stronger and virtually reaching outer margin but furrows not extending to inner margin. External surface of pygidium smooth except for indistinct irregular anastomosing terrace lines near margins and orientated subparallel to posterior margin; dorsal surface of doublure with coarse terrace lines scalloped forward within ribs (Pl. 2, fig. 8; Pl. 3, figs. 1, 7, 10).

Discussion. The fragmentary pygidium illustrated by Northrop from the La Vieille Formation of Quebec has a similar pattern of ribs and a long axis but the well developed ornament is very different from the virtually smooth dorsal surface of *E. ekwanensis.* The specimen from the glacial drift of northern Ontario that was illustrated by Ludvigsen is the holotype of *Opoa regale* (Fritz). The Wisconsin taxon *Ekwanoscutellum*? *l aphami* (Whitfield) essentially is known only from its pygidium (Whitfield, 1882, Pl. 22, figs. 2-4) which appears to be very similar to that of *Ekwanoscutellum ekwanensis.* Description of the cephalon of *laphami* is needed to allow confident assignment to *Ekwanoscutellum* and assessment of the similarities and differences between the two species.

Genus *GOLDILLAENUS* Schindewolf, 1924

Goldillaenus Schindewolf, 1924, p. 201-206.

Type species. Trinucleus? *nilsoni* Münster, 1840 from the Silurian of Austria.

Goldillaenus? sp.

Plate 1, figures 4-9

Material and occurrence. Hypotypes GSC 63482, 63483 and undesignated specimens, GSC locs. 80565, 80567, 80572, Attawapiskat River, 80613, Severn River, C-4457, C-4461, Ekwan River; total of 8 pygidia (3 whole).

Comments. These pygidia are proportionally longer than those assigned to *Bumastus*? sp. and the border furrow is moderately well developed on the external surface except medianly. The doublure is long and with an even front. There is no differentiation of the axis from the pleural regions. The external surface bears very fine pits, sparse very fine granules are present anterolaterally, as are fine terrace lines that are coarser on the doublure.

As pointed out by Lane (1972, p. 345-346) and by Lane and Thomas (in Thomas, 1978, p. 8-11) the systematics of effaced trilobites are difficult. No cranidia are associated with the present material and thus the generic assignment is tenuous. However, the pygidia are longer than those of species of *Bumastus* and *Litotix* and can be compared in outline and sagittal profile to those of *Goldillaenus*, *Cybantyx* and Lane's (1972, p. 347) genus and species indet. 2.

Genus *MEROPERIX* Lane, 1972

Meroperix Lane, 1972, p. 343.

Type species. Meroperix ataphrus Lane, 1972 from the uppermost Drommebjerg Limestone and from boulders in the base of the overlying Profilfjeldet Shales, northeastern Greenland.

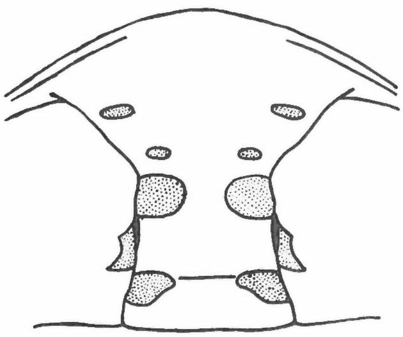
Meroperix aquilonaris (Whiteaves, 1904)

Plate 5, figures 1-13, 15; Figure 4b

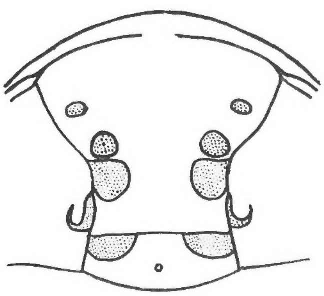
Bronteus aquilonaris Whiteaves, 1904, p. 58F-59F.
Bronteus aquilonaris Whiteaves; Whiteaves, 1906, p. 267, Pl. 42, fig. 2.
Bronteus aquilonarius Whiteaves (sic); Savage and Van Tuyl, 1919, p. 362.

Material and occurrence. Lectotype (here selected) pygidium GSC 17736 and 17736a (external surface and mould) and paralectotype pygidium GSC 17739, GSC loc. C-4453, Ekwan River (these appear to be the three specimens from the locality that were mentioned by Whiteaves but do not include his illustrated specimen which was from a different locality); hypotypes GSC 63501-63506 and undesignated specimens, GSC locs. 80565, 80568, 80569, 80571, 80572, 80574, Attawapiskat River; C-4453, Ekwan River; 80613, Severn River; total of 15 cranidia (10 whole), 68 pygidia (33 whole).

Description. Cranidium low, transversely evenly arched, sagittally gently convex forward, almost flat in main and rear parts. Glabella low, expanded forward, also slightly constricted just forward of strong, straight occipital furrow. Axial furrow strong, swinging into and deep at constriction of rear part of glabella, trends straight and obliquely anterolateral from inflection point opposite front of palpebral lobe and front part of 1g, joining border furrow to form preglabellar furrow that fades adaxially, not quite reaching sagittal line (Pl. 5, figs. 2, 3). Glabellar impression 1g large, deep, oval, at front half of narrow part of glabella, reaching from axial furrow halfway to sagittal line; 2g small, shallow, subcircular, just in front of 1g and distant from axial furrow; 3g small, deep, subcircular, distant from axial furrow and sited about midlength of its oblique course. Occipital ring large, gently arched (Pl. 5, fig. 7), narrowing forward, wider than rear of glabella, very slightly convex (sag.), with faint median tubercle placed rearward; deep, large semi-oval occipital impression abuts against abaxial half of occipital



4a



4b

FIGURE 4. Diagrams of cranidial impressions in Ekwanoscutellum ekwanensis (Whiteaves), 4a, and Meroperix aquilonaris (Whiteaves), 4b. Forward from rear of occipital rings the paired impressions are the occipital, lateral, lateral glabellar 1g, lateral glabellar 2g and lateral glabellar 3g.

furrow and occupies front two-thirds of occipital ring. Fixed cheek wide, low with pronounced swelling (paraglabellar area) against axial furrow just in front of occipital furrow, lateral impression a depressed area bordering this swelling. Palpebral lobe subcircular, extends from just in front of occipital furrow to opposite inflection of axial furrow (Pl. 5, fig. 4), eye ridge fades before reaching axial furrow. Anterior border furrow, wide, shallow, anterior border sharp, continues adaxially in front of glabella; posterior border absent close to axial furrow, small gently convex border and shallow border furrow developed adaxially but border furrow fades as reaches facial suture. Anterior course of facial suture straight, very slightly anterolateral of forward to border where curves evenly adaxially across border to merge with rostral suture just below anterior margin; posterior course curving gently and evenly out from rear of palpebral lobe to just in front of border furrow where curves abruptly rearward and crosses border (Pl. 5, fig. 4). Cranidium with ornament of very fine anastomosing ridges, anterior border with terrace lines. Hypostome poorly known (Pl. 5, figs. 11, 12); free cheek, rostral plate, thorax not known.

Pygidium paliferous, subquadrate, wider than long, almost flat except for short raised axis (width more than twice its length, which is about a sixth of pygidium's length) that lacks any exsagittal lobation; strong transverse furrow behind articulating half-ring. Interpleural furrows narrow, fade well before reaching margin, delineate seven pairs of very gently convex ribs and median rib that is divided posterior of pygidial midlength. Ornament of fine anastomosing ridges subparallel to posterior margin except laterally and anterolaterally where oblique to lateral margin; axis bears similar ridges but bowed forward. Doublure more than half pygidial length (Pl. 5, figs. 13, 15) with broad furrows in its dorsal surface reflecting interpleural furrows and detectable almost to margin and also to close to inner edge of doublure (median furrow stronger and reaches edge, where it is anterior of corresponding median furrow on dorsal surface); ornament of coarse anastomosing terrace lines subparallel to margin, abaxially these give way to finer and less continuous lines subparallel to those on dorsal surface (Pl. 5, fig. 13).

Comments. The cranidium closely resembles that of *Meroperix ataphrus* Lane (1972, p. 343-345, Pl. 60, figs. 1-12) but the frontal lobe of the glabella is less expanded and the anterolateral corners are more rounded, the preglabellar furrow is stronger, in the rear part of the fixed cheek the swelling against the axial furrow is more pronounced. The pygidium is similar to that of *ataphrus* but is proportionally shorter with a more subquadrate outline, the ribs are less strong and the point of division of the median rib is further rearward. Several of the illustrated pygidia of *ataphrus* show a fine median line on the front part of the median rib, no such line has been detected in *aquilonaris.*

Genus *OPOA* Lane, 1972

Opoa Lane, 1972, p. 340-341.

Type species. Opoa adamsi Lane, 1972 from the uppermost Drommebjerg Limestone and from boulders in the base of the overlying Profilfjeldet Shales, northeastern Greenland.

Opoa sp.

Plate 1, figures 10-13; Plate 5, figures 14, 16-18

Material and occurrence. Hypotypes GSC 63484-63489 and undesignated specimens, GSC locs. 80572, 80574, Attawapiskat River; C-4457, C-4459, C-4461, Ekwan River; total of 1 free cheek, 13 pygidia (5 whole).

Comments. The material is inadequate for formal description. The axis of the pygidium is not as highly raised as that of *Opoa adamsi* and is more clearly trilobate; the axis of *O. regale* (Fritz) is proportionally longer.

Family Illaenidae Hawle and Corda, 1847

Genus *STENOPAREIA* Holm, 1886

Steopareia Holm, Jaanusson, 1954, p. 570-572.

Type species. Illaenus Linnarssonii Holm, 1882 from the Upper Ordovician of Sweden.

Stenopareia? julli new species

Plate 6; Plate 10, figures 8-10

Material and occurrence. Holotype cephalon GSC 63507 and paratypes GSC 63508-63521 (all from GSC loc. 80572), hypotypes GSC 63522-63524 and undesignated specimens; GSC locs. 80565, 80567, 80568, 80569, 80571, 80572, 80574, Attawapiskat River; C-4457, C-4461, Ekwan River; total of 4 cephala (2 whole), 12 cranidia (8 whole), 3 free cheeks, 12 pygidia (5 whole).

Name. In memory of Robert K. Jull, University of Windsor, who died in a helicopter accident, August 2nd, 1979.

Description. Cephalon almost twice as wide as long, maximum width just in front of rounded genal angle, outline semi-oval with rear of free cheek deflected slightly rearward of virtually transverse rear margin of cranidium. Cranidium transversely very slightly arched, sagittal profile very gently convex to front fifth, where curves strongly downwards, flattens with an orientation just beyond vertical, slightly overhanging anterior margin (Pl. 6, figs. 3, 4); free cheek with similar subvertical orientation (Pl. 6, fig. 10). Rear of glabella more than half cephalic width, defined by shallow, forwardly converging axial furrows that are best shown by internal moulds and reach as far forward as well-marked oval muscle impressions sited about midlength. Very small median tubercle sited behind sagittal coordinate of rear of small palpebral lobe, whose centre is a quarter of cephalic length from rear margin; fixed cheek only defined posteriorly, gently convex, broad, very shallow border furrow trends towards rear of eye and fades abaxially, posterior border just a convex edge, anterior border furrow not developed. Facial suture trends almost straight forward (Pl. 6, figs. 3, 4) from palpebral lobe onto subvertical face of cephalon where curves evenly adaxially to cross margin just outside and below a very small tubercle sited almost at margin (Pl. 6, fig. 10); rostral suture runs transversely on doublure close to margin to sagittal line (Pl. 6, fig. 12); rear course of facial suture short, almost straight rearward, next curves gently abaxially before abruptly adaxially as reaches margin opposite outside limit of palpebral lobe. Eye small with numerous rows of very fine lenses, strongly raised (Pl. 6, fig. 1), without eye socle, sited slightly less than its length from posterior margin. Free cheek slightly convex with broadly rounded genal angle and strongly reflexed doublure that flattens and widens adaxially (Pl. 6, fig. 11), vincular furrow well developed (Pl. 6, fig. 15). Rostral plate gently convex with broadly bowed rostral flange; connective sutures almost straight, converging rearward at slightly less than a right angle, rear of rostral plate about half width (tr.) of front (Pl. 6, figs. 11, 12, 14). External surface with terrace lines, fine and anastomosing on rear half of cranidium in ring-patterns centred on sagittal margin (Pl. 6, fig. 6) stronger and more continuous forward (Pl. 6, fig. 8), subparallel to front and lateral margins, strongly developed on doublure and rostral plate (Pl. 6, fig. 12); extremely fine transverse ridges within vincular furrow (Pl. 6, fig. 15). Internal mould shows fan-like arrangement of shallow furrows and ridges on rear half of holotype cranidium (Pl. 6, fig. 2), radiating as though originating at several points along a locus a short distance behind rear margin. Hypostome and thorax not known.

Pygidium with rounded triangular outline, length slightly more than half width, transversely gently convex at front, to rear transverse convexity masked by sagittal convexity that is very gentle forward but strongly and evenly convex rearward with median region projecting far behind overhung posterior margin (Pl. 6, fig. 17). Axis broad, only defined anteriorly, and there by change of slope to pleural regions; prominent anterolateral facets. Doublure long, strongly recurved, sagittal point not detectable (Pl. 10, figs. 8, 9). Coarse terrace lines on internal moulds, on doublure and also on fragments which show external surface (Pl. 6, figs. 16-18; Pl. 10, fig. 9).

Discussion. Smoothness of the external surface of *Stenopareia* makes shape very important for the differentiation of species. The anterior face of the cephalon of *julli* is subvertical and the front slightly overhangs the anterior margin. Similarly, the rear of the median part of the pygidium substantially overhangs the posterior margin causing, in dorsal view, a rounded triangular outline that is unique for described Silurian species of the genus. The pygidial doublure is strongly reflexed but a sagittal anterior projection seems to be absent (Pl. 10, fig. 9), whereas one or more prominent projections are known in *S. linnarssonii* (Dean, 1978, p. 102) and in *somnifer* and other species (Lane, 1979, p. 16). This lack of a projection makes tentative the assignment of *julli* to the genus.

The fan-like pattern of furrows and ridges on the internal mould of the rear part of the holotype cranidium is very similar to that shown on an internal mould of *Stenopareia* sp. from the uppermost Drommebjerg Limestone of northeastern Greenland and interpreted as caecal markings (Lane, 1972, p. 349, Pl. 61, figs. 14a, 14b).

Stenopareia? sp.

Plate 7, figures 1-3

Material and occurrence. Hypotype pygidia GSC 63525-63527, GSC loc. 80569 Attawapiskat River; C-4457 Ekwan River.

Comments. Three pygidia have a bizarre subconical shape and very elongate triangular outline with a prominent rounded termination that projects far to the rear of the posterior margin which, according to conventional orientation (Pl. 7, fig. 3) lies only just behind the front margin, but considerably lower. Thus the dorsal surface curves laterally and posteriorly below itself to have a ventral aspect that is almost as long as the dorsal aspect. The axis is only defined forward but appears to continue to form the rounded termination. The doublure is long, with almost vertical orientation against the posterior margin but flexed abruptly at its midlength to approach the inner (dorsal) surface of the ventral aspect of the dorsal surface. Terrace lines well developed both on external surface and inner mould; fine pits on inner mould and a sagittal line on the ventral aspect.

Except for the extreme rearward prolongation, the pygidium resembles those of species of *Stenopareia*, particularly *S*? *julli* which shows a slight rearward projection overhanging the posterior margin. A cranidium at GSC loc. 80569 and a free cheek (Pl. 6, fig. 8) at C-4457 have been identified as *S*? *julli*; possibly these parts could belong with the present pygidia.

Family Proetidae Salter, 1864

Genus *CYPHOPROETUS* Kegel, 1927

Cyphoproetus Kegel, Owens, 1973, p. 27-30.

Type species. Cyphaspis depressa Barrande, 1846 from the Czechoslovakian Wenlock.

Cyphoproetus sp.

Plate 7, figures 4-10

Material and occurrence. GSC hypotypes 63528-63530 and undesignated specimens, GSC locs. 80571, 80574, Attawapiskat River; C-4459, Ekwan River; total of 4 cranidia (1 whole), 1 pygidium.

Comments. The cranidium has an extremely short preglabellar field, prominent occipital lobes and elongate ovate 1L lobes, 2S is faint, straight and obliquely rearward of transverse. The palpebral lobe is not preserved but both front and rear courses of the facial suture are very close to the axial furrow. The median node on the occipital ring is positioned only slightly forward. Outline of pygidium triangular, axial part damaged but probably formed a blunt marginal spine; no border. The pygidial axis is strongly raised with 7 detectable ring furrows, a terminal piece and a short, low, indistinct postaxial ridge. The pleural region shows three pairs of deeply incised, scalloped, pleural furrows and three of interpleural furrows that are faint adaxially but deep abaxially, where the anterior pleural bands are very depressed, posterior pleural bands reaching margin as three prominent ribs. Both cranidium and pygidium with delicate ornament of very fine anastomosing lines (Pl. 7, fig. 8), very similar to that common in *Decoroproetus.* The ornament is subtransverse on the cranidium and slightly bowed forward, especially so on the occipital ring; the pattern on the pygidial axis is strongly bowed forward, on the pleural regions it is subparallel to the lateral margin but slightly more transverse.

The taxon shows some general similarities to Greenland material (Lane, 1979) of *Cyphoproetus externus* (Reed). Lane's pygidia show slight accentuation of the posterior pleural bands and one (his Pl. 4, fig. 10) has a subtlely pointed posterior margin; both trends are developed more strongly in the younger pygidium from the Attawapiskat Formation.

Genus *WINISKIA* new genus

Type species. Winiskia perryi new species from the Attawapiskat Formation.

Name. After Operation Winisk, the helicopter-supported project of the Geological Survey of Canada that mapped the Hudson Bay and James Bay Lowlands in 1967.

Diagnosis. Glabella tapered forward with rounded front, occipital lobes present, lateral glabellar furrows virtually lacking, occipital furrow indistinct abaxially; small eyes very close to axial furrows and located forward (just behind cephalic midlength). Broad, tropidial depression adaxial to lateral and anterior borders, abutting against but continuous in front of glabella. Rostral plate trapezoidal, connective sutures anteriorly divergent. Pygidium and thorax with strongly raised axes. Semi-oval pygidium without border, external surface largely effaced, internal mould showing 6 or 7 pairs of scalloped pleural furrows, faint interpleural furrows, and about 8 ring furrows, with low postaxial ridge. Ornament extremely finely granular or smooth except for fine terrace lines on ventral and vertical surfaces.

Discussion. The term tropidial depression is introduced for a broad, trough-like feature on the dorsal surface of the cephalon of some proetid trilobites. The tropidial depression is bounded by the border furrow and, towards the glabella, by a tropidial line. The tropidial line separates two parts of the dorsal surface that have different convexities but is a line in *Winiskia*, not a ridge, which would have allowed use of the term tropidium (for discussion see Owens, 1973, p. 3-5). The distinctness of the tropidial lines is very variable, its prominence in *Winiskia* accentuates the tropidial depression, it is much more subtle in species of *Radnoria* (see Owens and Thomas, 1975, Pls. 95, 96; Textfig. 1). In *Winiskia*, the doublure abuts against the ventral surface of the cephalon far

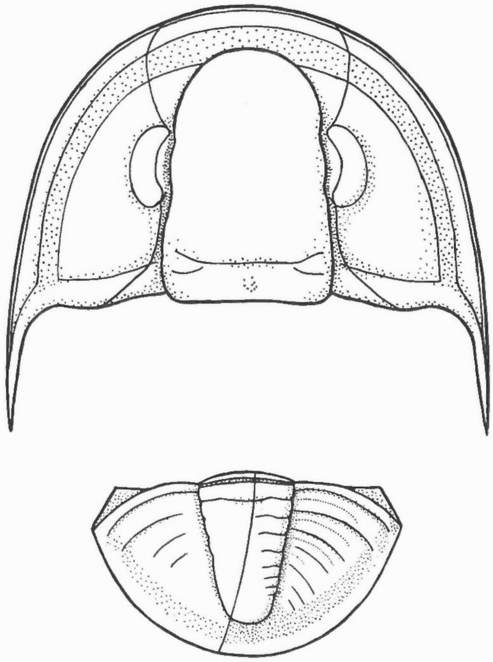


FIGURE 5. *Winiskia perryi new genus and new species.*

adaxial of the border furrow (Pl. 8, fig. 8) and the tropidial line on the dorsal surface appears to correspond to the edge of the doublure. The variable configuration of the proetid cephalic doublure has been analysed by Owens and Thomas (1975, p. 819, Textfig. 2) who recognised in a number of genera the feature now termed tropidial depression.

Winiskia complies with Owen's (1973, p. 8) diagnosis of the subfamily Proetinae except for the presence of a distinct postaxial ridge. There are considerable similarities to *Proetus* (*Proetus*) Steininger but the type species [*Proetus concinnus* (Dalman, 1827), see Owens, 1973, p. 12-15] has larger eyes sited further to the rear, broader thoracic and pygidial axes, shows no tropidial depression or postaxial ridge and the preglabellar field is virtually absent.

Winiskia perryi new species

Plate 8, figures 1-19, 21, 22; Figure 5

Material and occurrence. Holotype cephalon GSC 63539 and paratype 63540 (both from GSC loc. C-4457), hypotypes 63541-63548 and undesignated specimens; GSC locs. 80568, 80571, 80574, Attawapiskat River, C-4457, C-4459, C-4461, Ekwan River; total of 1 incomplete individual, 5 cephala (2 whole), 13 cranidia (9 whole), 9 free cheeks (6 whole), 2 thoracic fragments, 12 pygidia (6 whole).

Name. In memory of David Perry, University of British Columbia, who died in a helicopter accident, August 2nd, 1979.

Description. Cephalon strongly and evenly transversely convex, sagittally strongly convex forward, flattening at midlength to be very gently convex rearward. Glabella moderately raised, longer than wide, widest at occipital furrow, tapering gently forward with evenly rounded front; axial furrows strong, almost straight to anterolateral corners of glabella except for subtle sinuosities at 1S and 2S, curving evenly forward to form preglabellar furrow; lateral glabellar furrows absent on external surface except for two indentations of axial furrows near front and rear of palpebral lobe. Occipital ring wider than glabella, with median tubercle and indistinct occipital lobes, furrow defining rear of lobe failing to reach axial furrow; occipital furrow strong and deep medianly, faint abaxially and deflected in front of occipital lobe, not reaching axial furrow. Borders weakly convex, of even width throughout (but laterally flexed so that appear narrower in dorsal view), lateral and posterior borders join to form long, tapering genal spine that continues in plane of lateral border and bears a median furrow that is continuation of lateral border furrow. Distinct tropidial line joins axial furrow at about fifth of maximum glabellar width from sagittal line, parallels linear border furrow to outline a broad, flat-bottomed tropidial depression; front of glabella encroaches on this trough that is continuous axially (Pl. 8, figs. 2, 3). Preglabellar field limited to axial part of tropidial depression. Rear part of fixed cheek small, very narrow, palpebral lobe short (about quarter of cranidial length), very narrow, extending from 1S to 2S, very close to axial furrow and merging with fixed cheek that curves very steeply down into axial furrow; front part of fixed cheek slightly convex. Free cheek large, field wide, convex with small, raised, crescentic eye (with several thousand minute polygonal lenses), centred just behind cranidial midlength, eye socle laterally distinct and narrow, bordered by incised furrow, socle widens forward and rearward, becomes indistinct and furrow fades. Facial suture runs forward short distance to γ, next weakly divergent to border furrow, curving abruptly adaxially on border to cross margin opposite median third of glabella; posterior course very close to and parallels axial furrow to border furrow where swings oblique of transverse and very slightly outcurved as crosses border to reach margin well adaxial of genal spine. Doublure wide, beyond border strongly recurved (Pl. 8, fig. 8). Rostral plate, trapezoidal, connective sutures diverge forward. Hypostome unknown. Exoskeleton smooth except for fine terrace lines on doublure and edges of borders.

Thorax poorly known (Pl. 8, figs. 1, 4), with 10 segments; axis strongly raised, about as wide as pleura, tapering gently rearward; outer part of pleura more steeply inclined than almost flat inner part.

Pygidium semi-oval with prominent anterolateral facets, wider than long, without border but with slightly concave belt just inside posterior and posterolateral margins. Axis strongly raised, slightly narrower than pleural region, tapers to blunt rear, with low, broad, short, tapered postaxial ridge that fades halfway to margin (Pl. 8, fig. 22), 8 rings and terminal piece detectable, front ring furrows faint on internal mould and rear furrows even fainter, only first couple discernible on external surface. Pleural region gently convex except adjacent to margin, internal mould with 6 or 7 detectable pairs of scalloped pleural furrows and fewer fainter interpleural furrows, front 3 or 4 pleural furrows accentuated abaxially and virtually reach margin, external surface shows just 3 or 4 faint pairs of pleural furrows. Exoskeleton smooth.

Discussion. Two Gotland taxa, *Proetus distans* Lindström, 1885 and a manuscript species of Hedström, lack discernible lateral glabellar furrows, have attenuated fixed cheeks, small eyes, short preglabellar fields and very finely granular ornaments. Both show a broad, tropidial depression but the feature passes in front of the glabella with a distinct, sagitally convex component of the preglabellar field between it and the glabella.

The front of the glabella is more pointed in both species than in *perryi* and the eyes are located more rearward. The occipital furrow and lobes are more strongly developed in *distans* than in *perryi.*

Family Cheiruridae Hawle and Corda, 1847

Genus *CHEIRURUS* Beyrich, 1845

Cheirurus Beyrich, Lane, 1971, p. 11, 14.

Type species. Cheirurus insignis Beyrich, 1845 from the Czechoslovakian Wenlock.

Cheirurus? sp.

Plate 8, figure 20; Plate 9, figures 2, 4, 7, 10

Material and occurrence. Hypotypes GSC 63549-63551 and undesignated specimens, GSC loc. 80613, Severn River; total of 2 cephala (1 whole), 1 cranidial fragment, 4 hypostomes, 1 thoracic fragment, 2 pygidia (1 whole).

Comments. Major differences from the common cheirurid *Chiozoon umisk* include expansion of the frontal lobe of the glabella so that the axial furrows diverge considerably (Pl. 9, fig. 2) and the lack of a median marginal spine on the pygidium. The taxon generically is very close to *Cheirurus insignis* Beyrich (as illustrated by Lane, 1971, Figure 3) but the pygidium does not have a projecting terminal piece that Lane considers a generic feature of *Cheirurus.* A new genus from the Tegart Formation of southeastern British Columbia (Norford, in prep.), similarly lacks a terminal projection but other features of the pygidium and of the cephalon are very different from those of the present material.

Genus *CHIOZOON* Lane, 1972

Chiozoon Lane, 1972, p. 355-356.

Type species. Chiozoon cowiei Lane, 1972 from the uppermost Drommebjerg Limestone and boulders in the overlying Profilfjeldt Shales, northeastern Greenland.

Chiozoon umisk new species

Plate 8, figures 23, 24; Plate 9, figures 1, 3, 5, 6, 8, 9, 11-17; Plate 10, figures 6, 7

Ceraurus Tarquinius Billings; Whiteaves, 1904, p. 59; 1906, p. 267, 268.
non *Cheirurus Tarquinius* Billings, 1869, p. 121, 122, Pl. 3, fig. 22.
non *Cheirurus tarquinius* Billings; Northrop, 1939, p. 241-244, Pl. 27, Pl. 28, figs. 3-6; Kindle, 1945, p. 532, Pl. 68.

Material and occurrence. Holotype pygidium GSC 63552, paratypes GSC 63553-63570 (all from GSC loc. 80574), hypotype GSC 63571 and undesignated specimens, GSC locs. 80569, 80571, 80572, 80574, Attawapiskat River, C-4459, C-4461, Ekwan River; total of 35 cephala (17 whole), 16 cranidia (3 whole), 4 free cheeks, 6 hypostomes (3 whole), 1 thoracic fragment, 20 pygidia (17 whole).

Name. From the resemblance of the median spine of the pygidium to the tail of a beaver (umisk in the Cree language).

Description. Cephalon very large, semi-oval but bowed forward slightly at frontal lobe, twice as wide as long (less genal spines), transversely gently arched. Glabella large, expanding only slightly forward, sagittally almost flat except for convex frontal lobe, width at occipital furrow less than a third of cephalic width. Axial furrows strong, slight constriction at 1S, forward diverge very slightly, curve adaxially as preglabellar furrow but fade halfway to axis (Pl. 9, fig. 14). Lateral glabellar furrows well defined; 3S slightly convex forward, reaches halfway to axis, 2S very similar but slightly longer, 1S curving rearward adaxially to reach occipital furrow at about two-thirds of transverse component towards axis, isolating lobe 1L. Lateral glabellar lobes of similar convexity and subequal in length (exsag.), frontal lobe much longer and expanded forward of general cephalic outline. Occipital furrow strong, bowed well forward (Pl. 9, fig. 5), occipital ring less wide than adjacent glabella, about as long (sag.) as 1L (exsag.); no occipital node seen. Fixed cheek gently convex (tr. and exsag.), posterior border furrow strong, almost straight, lateral border furrow also strong, borders convex, join to form short, tapered, slightly divergent, genal spine that bears a faint keel on dorsal surface; posterior border much narrower and more convex adaxial to articulation process located at a third of distance between genal spine and axial furrow. Palpebral lobe very small, strongly raised, opposite rear two-thirds of 3L, indistinct eye-line between pits of fixed cheek to 3S. Facial suture slightly adaxial of forward to border furrow, there curves evenly across border to reach margin at less than a fifth of width of frontal lobe towards axis; rear course vertical off palpebral lobe, next posterolateral for very short distance, curves to almost transverse but slightly bowed forward, cuts border furrow opposite 2L, close to margin turns abruptly to run obliquely and virtually straight to reach margin opposite median part of occipital furrow. Free cheek small, triangular, gently convex with strong border furrow and convex border that swings forward and ends against frontal lobe. Eye small, high, crescentic, bordered by distinct furrow (Pl. 9, fig. 9). Hypostome with elongate, oval, inflated middle body, middle furrow continuous axially, posterior lobe almost a fifth of length of middle body; narrow anterior border obsolete axially but anterior border furrow is continuous, lateral and posterior borders well-marked, posterolateral margin abrupt, rear margin almost straight. Cephalon almost smooth but very finely granulate, glabella also with sparse fine tubercles, middle body of hypostome with evenly spaced sparse fine pits, main part of cheeks with closely packed medium and coarse pits. Rostral plate not known.

Number of thoracic segments not known, individual segments with strong axial furrow, high axial ring that is about a quarter of total width and has large articulating half-ring; inner third of convex (exsag.) pleura divided by deep, almost straight, oblique pleural furrow into subequal very convex areas, anterolateral of these is bounded by broad shallow exsagittal furrow, that curves adaxially rearward and fades, articulation processes sited lateral to furrow; rest of pleura flattens abaxially and curves evenly to terminate as a blunt rearward directed spine; ornament very finely granular or smooth, with sparse fine tubercles (Pl. 8, fig. 24).

Pygidium almost flat except for strongly raised axis, suboval (including spines), twice as wide as long, three pairs of broad, rearward curving marginal spines (first two subequal, third shorter) and a shorter, broad spatulate median spine that rearward curves slightly ventrally. Axis tapers gently rearward, prominent half-ring, three convex (tr. and sag.) rings and low terminal piece that merges with median spine; axial furrows strong, ring furrows strong, deeply incised abaxially, rear of each ring with median, socket-like furrow in front of ring furrow. Pleural regions slightly arched (tr.) adjacent to axis, interpleural furrows reach margin, first two pleural lobes with deep, oblique pleural furrows that abaxially curve to be transverse and fade, third has just a short rearward elongate pit; first lobe with exsagittal furrow similar to that of thoracic segment, indistinct change of slope on other lobes. Doublure not known. Ornament very finely granular (most prominent near margin), with sparse fine tubercles (Pl. 9, fig. 6).

Discussion. The glabellar characters and the cephalic outline are very similar to those of *Chiozoon cowiei* Lane from northeastern Greenland, but the cephalon is less arched transversely, the frontal lobe is shorter and 1S is stronger at its junction with the occipital furrow. The paired pygidial spines are slightly broader and shorter with the third pair being also proportionally shorter. The median spine is shorter, much wider (tr.) and bluntly rounded in contrast to the more tapered outline in *cowiei* (Lane, 1972, Pl. 63, fig. 11b). The terminal piece is much broader, whereas its distinct and narrow outline in *cowiei* gives a constriction to the axial region between the third axial ring and the median spine.

Cheirurus tarquinius Billings from the lower Ludlow White Point Formation of Gaspé probably can be assigned to *Chiozoon* but the known specimens do not provide conclusive information. The seven marginal spines of the pygidium are narrower and more convex than those of *cowiei* and *umisk* and the median spine appears to be significantly shorter than the paired spines, quite narrow and not spatulate (Northrop, 1939, Pl. 28, fig. 3; Kindle, 1945, Pl. 68, fig. 5).

Family Encrinuridae Angelin, 1854

Genus *ENCRINURUS* Emmrich, 1844

Encrinurus Emmrich, Tripp, 1962, p. 460.

Type species. Entomostracites punctatus Wahlenberg, 1818 from the Gotland Wenlock.

Encrinurus sp. 1

Plate 7, figures 15-32

Material and occurrence. Hypotypes GSC 63534-63538 and undesignated specimens, GSC loc. 80613, Severn River; total of 5 individuals (2 whole), 2 whole cranidia, 1 hypostome, 2 thoraxes, 5 thoracic fragments, 6 pygidia (4 whole).

Description. Cranidial outline slightly wider than long, transversely gently arched with fixed cheeks reflexed abaxially, sagittally low and almost flat at rear, very convex forward. Glabella almost parallel-sided at rear, strongly expanded forward with well rounded front; axial furrows well marked, parallel behind 2S, widely divergent forward. Short lateral glabellar furrows, 3 or 4 pairs, a longer, forward-oblique furrow behind anterior border of cranidium and reaching less than a third of way to sagittal line. Glabellar lobe 1L a short low ridge, 2L defined by a large tubercle that is composite adaxially (Pl. 7, figs. 22, 24), 3L similar, next 3 smaller tubercles against axial furrow behind furrow bounding anterior border of cranidium or 1 plus a composite tubercle; remainder of glabella covered by numerous small tubercles, irregularly arranged (Pl. 7, figs. 22, 24, 29, 31). Occipital ring gently arched, short, (sag.) convex with flat top, smooth, much wider than adjacent glabella, occipital furrow well marked, abaxial portions deflected rearward. Fixed cheek curves strongly downward abaxially, border convex, adaxially shorter than adjacent occipital ring, abaxially broadens evenly, gently convex, smooth except for about 5 unevenly sized tubercles on anterolateral part against strong, wide border furrow (Pl. 7, figs. 20, 30); genal field with numerous small tubercles, palpebral lobe opposite divergent part of axial furrow. Anterior course of facial suture poorly known, rear part almost transverse to border furrow, curves gently rearward across border, reaches margin well in front of rounded genal angle. Free cheek, rostral plate, hypostome unknown. Ornament of very fine pustules.

Thorax of 11 segments, axis broader than pleura, no pleural furrows, ornament of very fine pustules, without tubercles.

Pygidium elongate, triangular, with blunt rear, almost as long as wide, tapering strongly and evenly; sagittally evenly convex, transversely gently arched medianly; pleural region curving to be almost vertical abaxial of inflexion at its midpart (Pl. 7, figs. 19, 27). Axis almost half of total width, strongly raised, transverse convexity increasing rearward, about 24 axial rings and terminal piece that merges with obscure small postaxial ridge that reaches margin, ring furrows straight, complete, incised abaxially. Pleural field with 10 pairs of convex ribs, all reaching margin, tips of first three slightly isolated (Pl. 7, fig. 28). Doublure strongly constricted sagittally (Pl. 7, figs. 20, 25, 26), with shallow lateral groove. All parts of pygidium with ornament of very fine pustules; no tubercles on axial rings or on pleural field.

Discussion. The species is very different from most of the species-groups of *Encrinurus* and the assignment to the genus is rather tentative. Significant features include the enlarged frontal lobe of the glabella , the lack of tubercles on the thorax and on the pygidium and the very irregular pattern of dense small tubercles in the main part of the glabella. There are similarities to the poorly known *Encrinurus elegantulus* Billings from the uppermost Jupiter Formation (Upper Llandovery) of Anticosti Island, Quebec (Billings, 1866, p. 62, 63; syntype cranidium but not syntype pygidium; Twenhofel, 1928, p. 330, 331, Pl. LVI, figs. 4, 5; but not Bolton, 1972, Pl. X, fig. 14).

Encrinurus sp. or spp.

Plate 7, figures 9, 13, 14

Material and occurrence. Hypotypes GSC 63531-63532, incomplete cranidium and pygidium, GSC locs. 80571, 80574, Attawapiskat River.

Comments. Both specimens are internal moulds, possibly conspecific but certainly very different from *Encrinurus* sp. 1 from the outcrop at Severn River.

Family Calymenidae Burmeister, 1843

Genus *FLEXICALYMENE* Shirley, 1936

Flexicalymene Shirley, Whittington, 1959, p. 0452; 1971, p. 470-473.

Type species. Calymene caractaci Salter, 1865 from the British Ordovician.

Flexicalymene sp.

Plate 10, figures 4, 5; Plate 11, figures 4, 5, 7-10

Material and occurrence. Hypotypes GSC 63574-63576 and undesignated specimens, GSC locs. 80574, Attawapiskat River, C-4450 (float), C-4459, Ekwan River; total of 1 incomplete individual, 3 cranidial fragments, 2 pygidial fragments.

Comments. The material is inadequate for description but assignment to *Flexicalymene* is indicated by the profile of the anterior border together with the lack of papillae on the lateral glabellar lobes and of buttresses on the adjacent free cheek. Lobe 3p is a very slight bulge, furrow 3p is just an indentation of the axial furrow that is best shown by the internal mould.

Family Lichidae Hawle and Corda, 1847

Genus *PLAYTLICHAS* Gürich, 1901

Platylichas Gürich, Tripp, 1957, p. 116, Textfigs. 4P, 5A, 5B.

Type species. Lichas margaritifer Nieszkowski, 1857 from the Estonian Ordovician.

Platylichas? sp.

Plate 7, figures 11, 12

Material and occurrence. A single hypostome, hypotype GSC 63533, GSC loc. 80571, Attawapiskat River.

Comments. This lichid hypostome closely resembles that of the type species of *Platylichas* (Tripp, 1957, Textfig. 4P).

Family Odontopleuridae Burmeister, 1843

Genus *Acidaspis* Murchison, 1839

Acidaspis Murchison, Whittington, 1956, p. 232.

Type species. Acidaspis Brightii Murchison, 1839 from the English Wenlock.

Acidaspis sp.

Plate 10, figures 1-3

Material and occurrence. Hypotypes GSC 63572 and 63573 and undesignated specimens, GSC locs. 80571, 80574, Attawapiskat River; total of 1 cephalic fragment, 2 cranidial fragments, 1 occipital spine.

Comments. Only two pairs of lateral glabellar lobes can be detected on the internal moulds and in this feature the specimens resemble *Acidaspis brightii* more closely than *A. grayi* Barrande (as described by Bruton, 1968). The ornament of sparse tubercles is less intense than that of either species; similarly for the strength of the very poorly defined occipital furrow.

Genus *SELENOPELTOIDES* Prantl and Přibyl, 1949

Selenopeltoides Prantl and Přibyl, 1949, p. 204, 205.

Type species. Acidaspis Hawlei Barrande, 1852 from the Czechoslovakian Wenlock.

Selenopeltoides sp.

Plate 11, figures 1-3, 6

Material and occurrence. Hypotype GSC 63577, damaged incomplete cephalon, GSC loc. 80574, Attawapiskat River.

Comments. The poorly known genus is based essentially on a single specimen of *S. hawlei* (Barrande, 1852, Pl. 25, figs. 23-25). The damaged Attawapiskat cephalon similarly has two lateral glabellar lobes, the eye positioned far rearward, non-spinose lateral and anterior margins, and long genal spines positioned above the posterior margin. The occipital ring is damaged but bases of occipital spines cannot be detected. A small piece of external surface essentially is smooth.

As Bruton (1968, p. 59-60) has commented, *Selenopeltoides* is related closely to *Dicranurus* but is known very inadequately. The only published illustration of the now mislaid cephalon of *S. hawlei* is Barrande's drawing which does not show the prominent pair of occipital spines so characteristic of *Dicranurus.*

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APPENDIX 1

LOCALITY DATA

GSC Locality	Geographic Data	Stratigraphic Data	Collector
80565	Attawapiskat River, small island; 52°54'N, 83°57'W.	9 m of biohermal complex thought to be near base of formation.	Norford
80567	Attawapiskat River, islet near north bank, opposite junction with large creek from south; 52°53 1/2'N, 83°38 1/2'W.	2 m of core of bioherm.	Norford
80568	Attawapiskat River, islet at foot of rapids near north bank; 52°53 1/2'N, 83°31'W.	7.5 m of core of bioherm.	Norford
80569	Attawapiskat River, north bank; 52°56'N, 83°23 1/2'W.	6 m of core of bioherm.	Norford
80571	Attawapiskat River, north bank at foot of strong rapids; 53°57 1/2'N, 83°09 1/2'W.	4.5 m of flank deposits and core of bioherm.	Norford
80572	Attawapiskat River, small islet in centre of river, upstream end beside rapids; 52°56 1/2'N, 83°04'W.	2.5 m of core of bioherm.	Norford
80574	Attawapiskat River, north bank; 52°54 1/2'N, 82°41'W.	1 m of flank deposits and core of bioherm, thought to be near top of formation.	Norford
80613	Severn River, west bank, prominent cape opposite two islets; 55°41'N, 88°07'W.	7.5 m of core of bioherm.	Norford
C-4450	Ekwan River, north bank; 53°28'N, 83°04'W.	float at core of bioherm.	Cumming
C-4453	Ekwan River, north bank, west end of outcrop, "portage road at falls" of Dowling; 53°28'N, 83°02'W.	flank deposits.	Dowling, Cumming
C-4457	Ekwan River, rapids, two islets, "middle rapid" of Dowling; 53°27 1/2'N, 82°55 1/2'W.	flank deposits and cores of bioherms.	Dowling, Cumming, Norford
C-4459	Ekwan River, south bank at rapids; 53°26 3/4'N, 82°54 1/2'W.	core of bioherm.	Cumming
C-4461	Ekwan River, south bank at rapids, "first strong rapid" of Dowling; 53°27'N, 82°53'W.	1 m of flank deposits and cores of bioherms.	Dowling, Cumming, Norford

PLATE 1

Bumastus? sp. (page 4)

Figures 1-3. Dorsal, anterior and lateral views of pygidium GSC 63481, internal mould, GSC loc. 80568; x4.

Goldillaenus? sp. (page 6)

Figures 4, 9. Lateral and dorsal views of small pygidium GSC 63482, internal mould, GSC loc. 80572; x2.

Figures 5-8. Posterior, lateral, dorsal and posterior views of pygidium GSC 63483, external surface, GSC loc. 80565; x4. Figure 8 shows the ornament of very fine pits.

Opoa sp. (page 7)

Figures 10, 11. Dorsal views of pygidial fragments, GSC 63484, external surface, GSC loc. 80572, GSC 63485, internal mould, GSC loc. C-4459; x4.

Figures 12, 13. Dorsal and lateral views of damaged pygidium, GSC 63486, internal mould, GSC loc. 80572; x4.

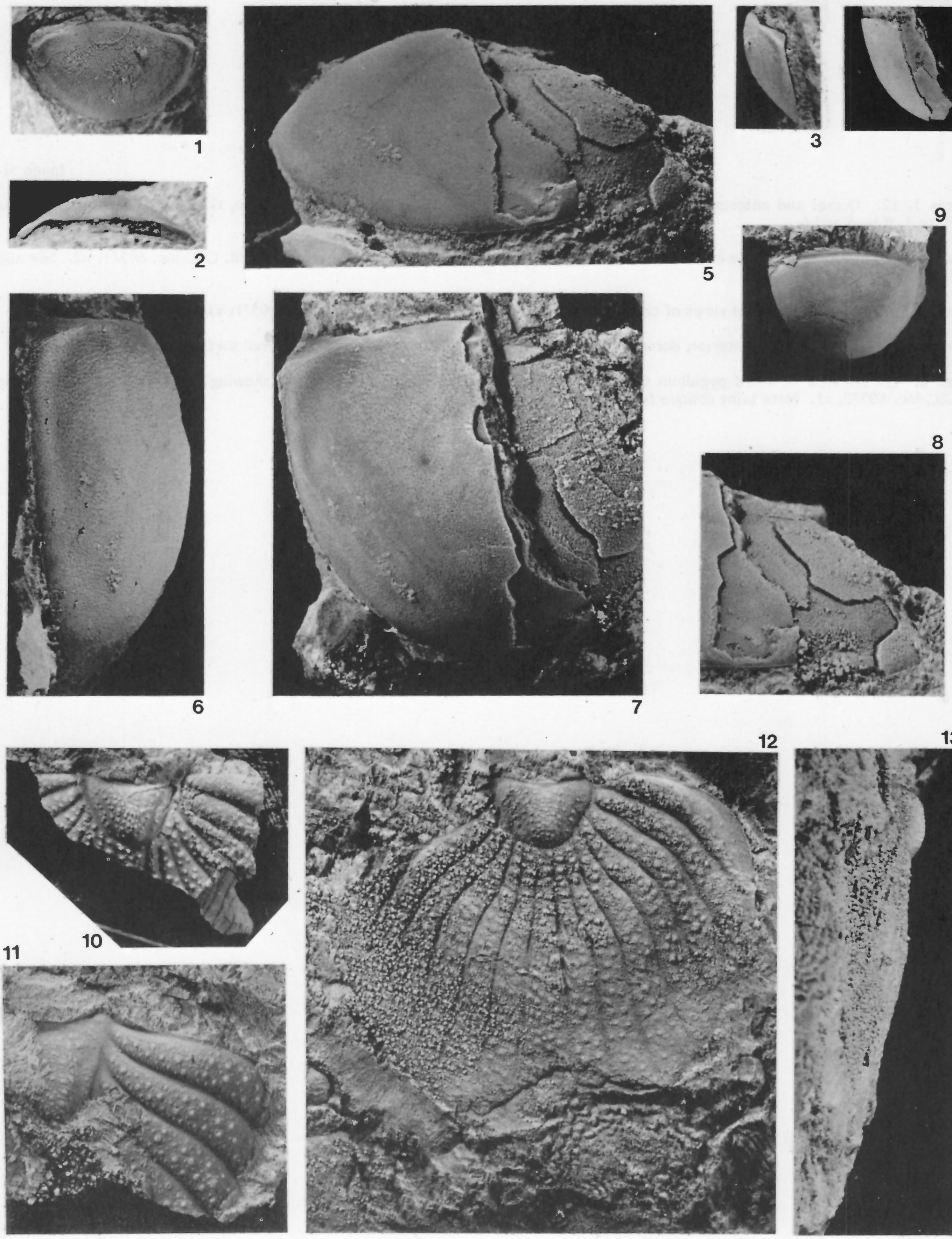
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PLATE 2

Ekwanoscutellum ekwanensis (Whiteaves) (page 5)

Figures 1, 12. Dorsal and anterior views of incomplete cranidium GSC 63490, external surface, GSC loc. 80568; x1. See also Plate 3, figs. 5 and 6.

Figures 2, 3, 11. Dorsal, oblique and anterior views of small cephalon GSC 63491, internal mould, GSC loc. 80571; x2. See also Plate 4, fig. 1.

Figures 4, 7. Anterior and dorsal views of cranidium GSC 63492, external surface, GSC loc. 80571; x1.

Figures 5, 6, 9, 10. Posterior, anterior, dorsal and lateral views of pygidium GSC 63493, external surface, GSC loc. C-4457; x1.

Figure 8. Dorsal view of small pygidium GSC 63494, external surface but partly stripped showing dorsal surface of doublure, GSC loc. 80572; x1. Note faint oblique furrows in anterolateral parts of axis.

PLATE 2

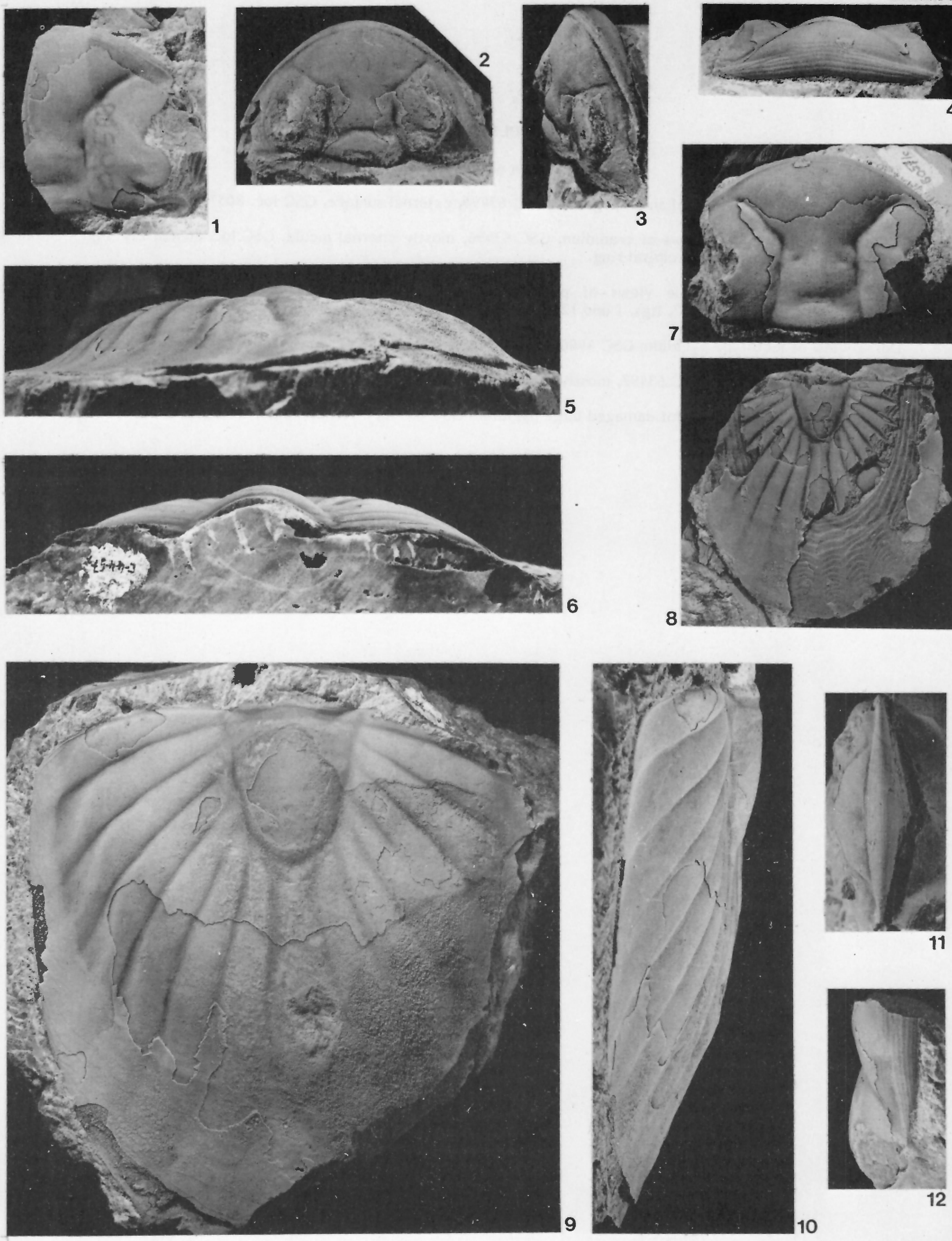

PLATE 3

Ekwanoscutellum ekwanensis (Whiteaves) (page 5)

Figures 1, 2. Dorsal and lateral views of small pygidium GSC 63495, external surface, GSC loc. 80571; x1.

Figures 3, 4. Anterior and lateral views of cranidium GSC 63496, mostly internal mould, GSC loc. 80568; x1. Fig. 4 shows the first thoracic segment behind the occipital ring.

Figures 5, 6. Posterior and oblique views of palpebral lobe of incomplete cranidium GSC 63490, external surface, GSC loc. 80568; x1. See also Plate 2, figs. 1 and 12.

Figure 7. Dorsal view of lectotype pygidium GSC 4406, mostly internal mould, GSC loc. C-4457; x1.

Figure 8. Lateral view of pygidium GSC 63497, mostly external surface, GSC loc. 80571; x1.

Figures 9, 10. Dorsal and lateral views of damaged large pygidium GSC 63498, internal mould, GSC loc. C-4457; x1.

PLATE 3

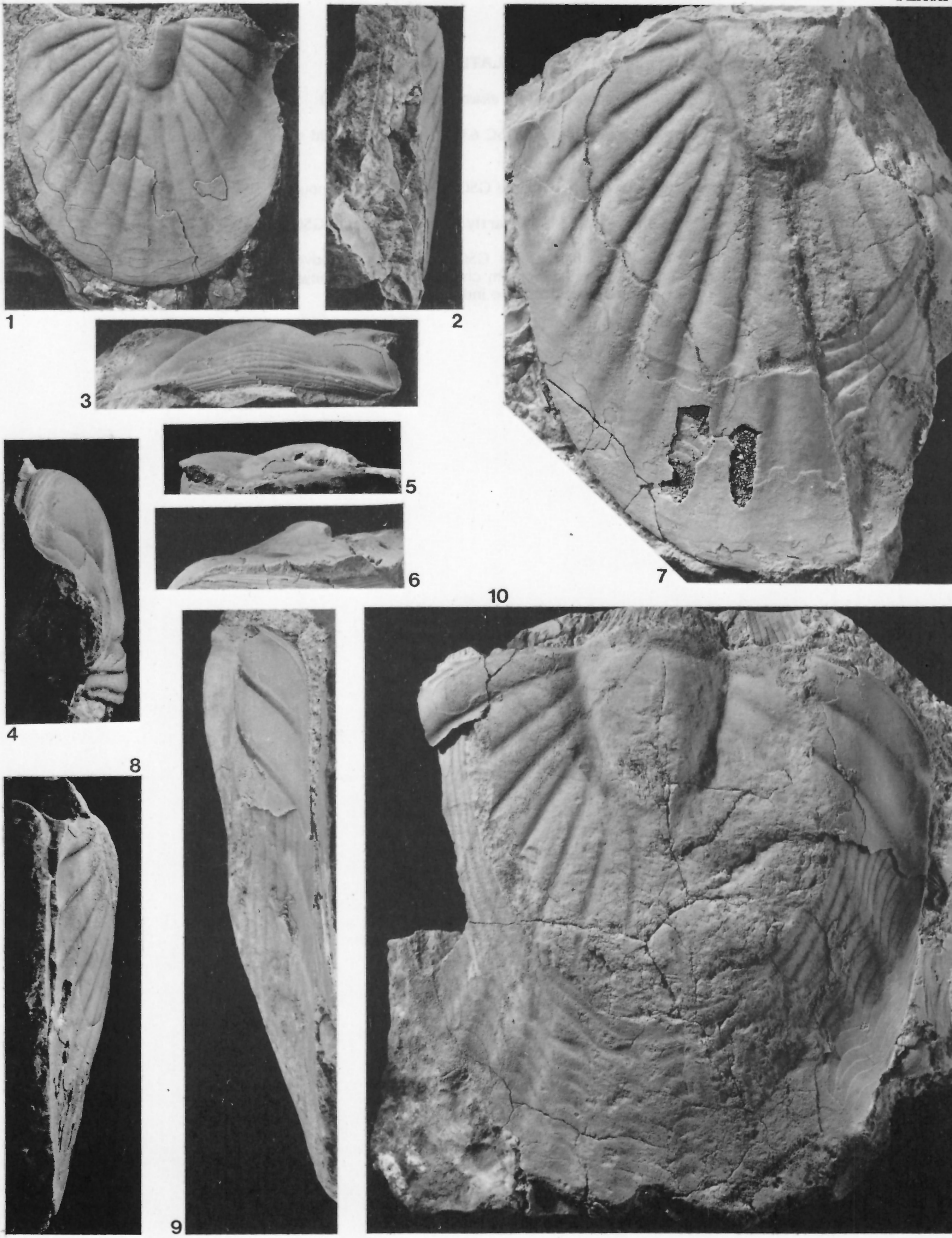

PLATE 4

Ekwanoscutellum ekwanensis (Whiteaves) (page 5)

Figure 1. Ventral view of anterior part of small cephalon GSC 63491, internal mould showing rostral plate, GSC loc. 80571; x4. See also Plate 2, figs. 2, 3, and 11.

Figures 2-4. Ventral, lateral and posterior views of hypostome GSC 63499, internal mould, GSC loc. 80565; x4.

Figure 5. Dorsal view of incomplete free cheek GSC 63500, partly external surface, GSC loc. 80571; x1.

Figures 6, 7. Enlarged dorsal views of eye of free cheek GSC 63500 (Fig. 5 above), external surface; x10. Figure 7 is a conventional view of the surface whitened with ammonium chloride; Figure 6 shows part of the eye photographed under oil and revealing more clearly the cross-sectional shapes of the individual lenses.

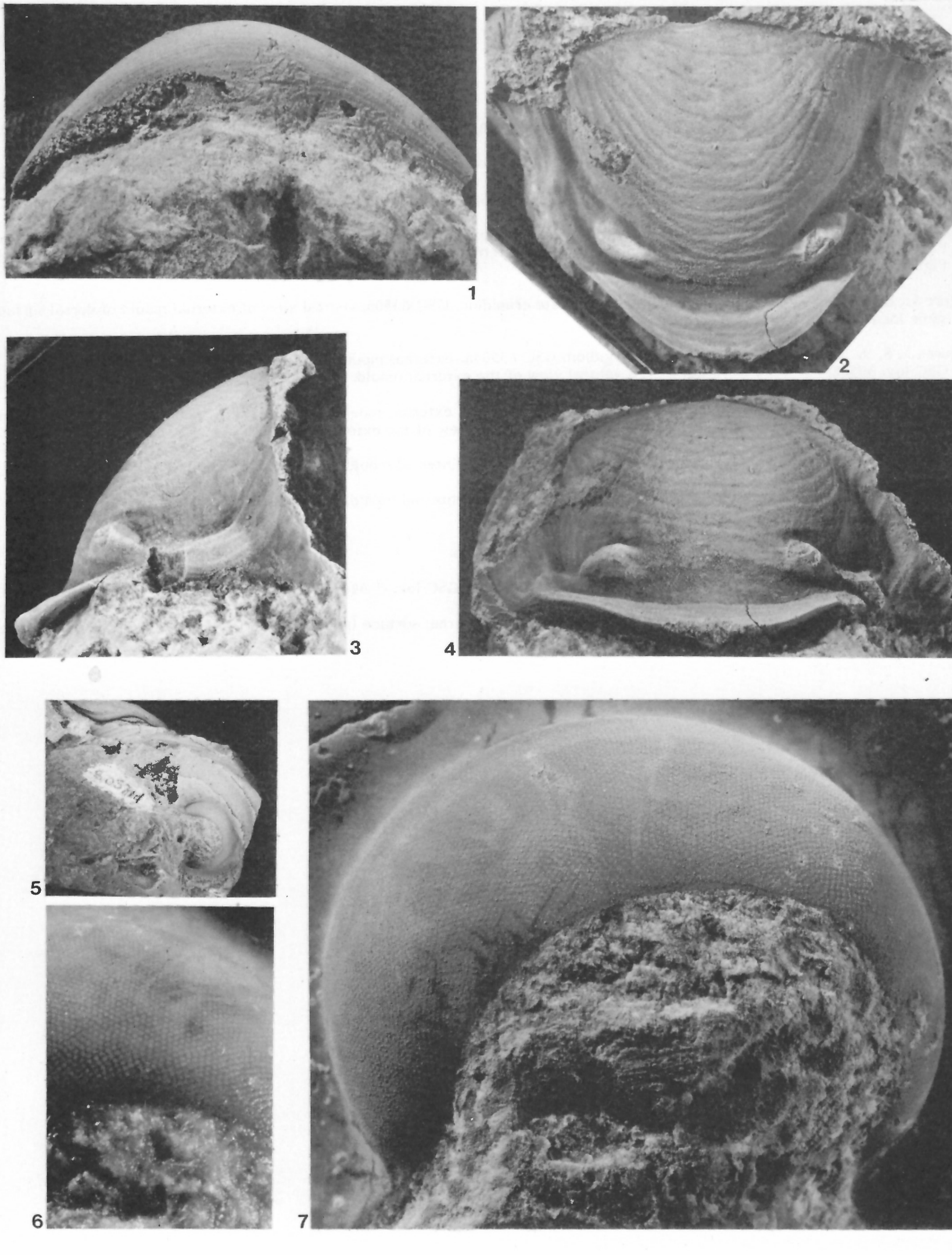

PLATE 5

Meroperix aquilonaris (Whiteaves) (page 6)

Figure 1. External mould of dorsal surface of small cranidium GSC 63501, GSC loc. 80572; x4.

Figures 2, 3, 6, 7. Dorsal, anterior, lateral and posterior views of cranidium GSC 63502, mostly internal mould, same locality; x2. Parts of the fixed cheeks and occipital ring show the external surface with ornament. Glabellar impressions well shown by Figure 2.

Figure 4. External mould of dorsal surface of incomplete cranidium GSC 63503, ventral view of external mould of dorsal surface, same locality; x4.

Figures 5, 8, 9. Dorsal and lateral views of pygidium GSC 63504a, external mould and GSC 63504, counterpart external surface, GSC loc. 80568; x2. Figure 5 actually is a ventral view of the external mould.

Figures 10, 13. Dorsal views of lectotype pygidium GSC 17736a, external mould and GSC 17736, counterpart mostly external surface, GSC loc. C-4453; x2. Figure 10 actually is a ventral view of the external mould.

Figures 11, 12. Ventral and lateral views of hypostome GSC 63505, internal mould, GSC loc. 80572; x4.

Figure 15. Dorsal view of small fragmentary pygidium GSC 63506, internal mould, GSC loc. 80613; x4.

Opoa sp. (page 7)

Figures 14, 16. Dorsal and lateral views of free cheek, GSC 63487, GSC loc. C-4461; x4.

Figures 17, 18. Incomplete pygidia, GSC 63488 dorsal view of external surface (part), GSC loc. 80572, GSC 63489, ventral view of external mould of dorsal surface, GSC loc. C-4457; x4.

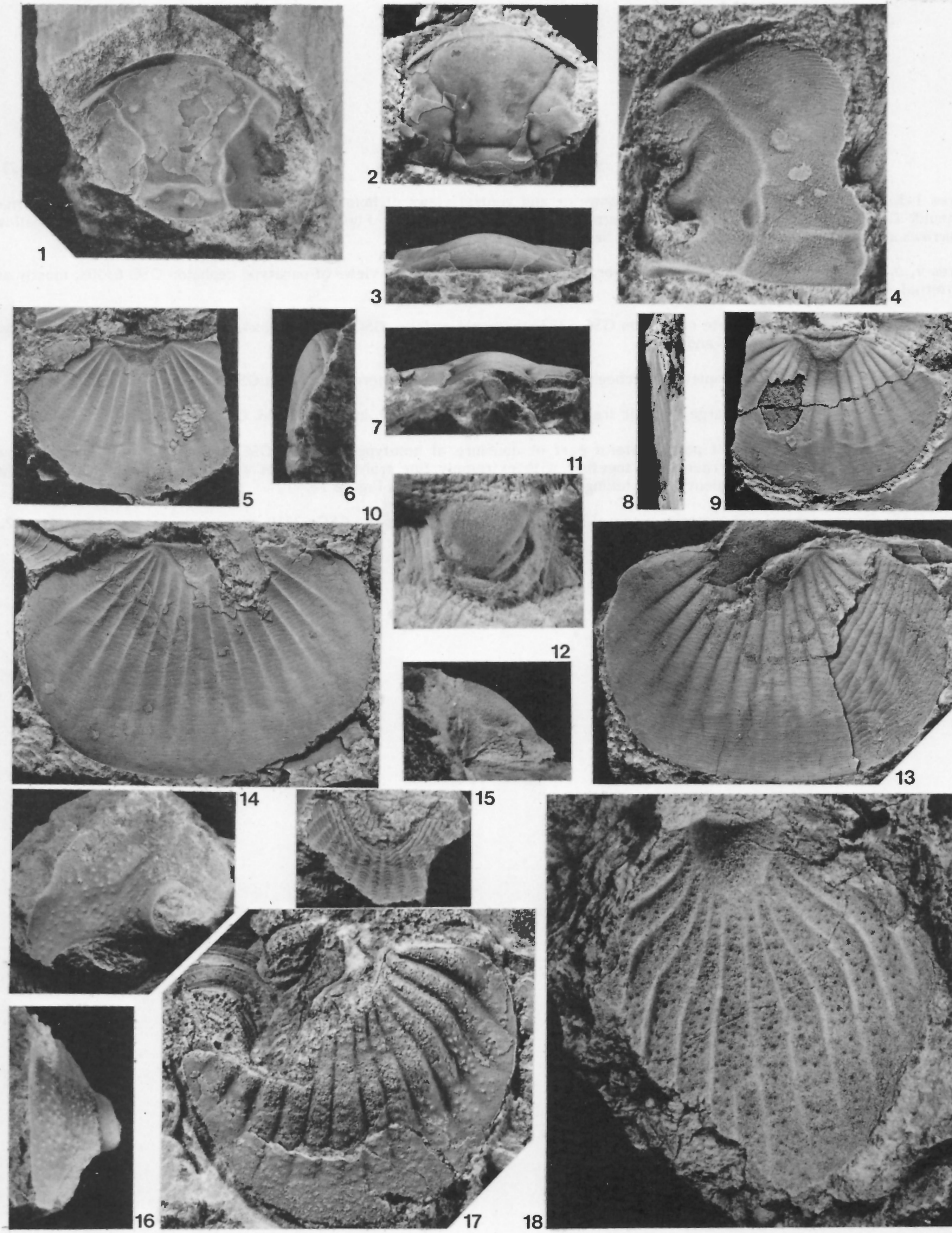
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PLATE 6

Stenopareia? *julli* new species (page 7)

Figures 1-3, 9, 13. Posterior, dorsal, lateral, anterior and ventral views of holotype cephalon GSC 63507, mostly an internal mould, GSC loc. 80572; x2. Pieces of external surface show ornament; Figure 2 shows fan-like arrangement of shallow furrows and ridges on rear part of crandium. See also Figure 15.

Figures 4, 5, 10, 12, 14. Lateral, dorsal, anterior, ventral and tilted ventral views of paratype cephalon GSC 63508, mostly an internal mould, same locality; x2.

Figure 6. Dorsal view of incomplete cranidium GSC 63522, external surface, GSC loc. 80567; x4. Cephalic ornament well shown by the combination of Figures 6 and 8.

Figures 7, 8. Dorsal views of incomplete free cheeks GSC 63523 and 63524, external surfaces, GSC locs. 80571 and C-4457; x4.

Figure 11. Tilted ventral view of large cephalic fragment, paratype GSC 63509, internal mould, GSC loc. 80572; x2.

Figure 15. Tilted ventral view of posterolateral part of doublure of holotype cephalon GSC 63507, external surface, same locality; x4. Ornament of terrace lines together with extremely fine transverse ridges within the vincular furrow. The specimen was excavated subsequent to the taking of the photograph that is Figure 13.

Figure 16-18. Dorsal, lateral and posterior views of incomplete paratype pygidium GSC 63510, internal mould, same locality; x2.

PLATE 6

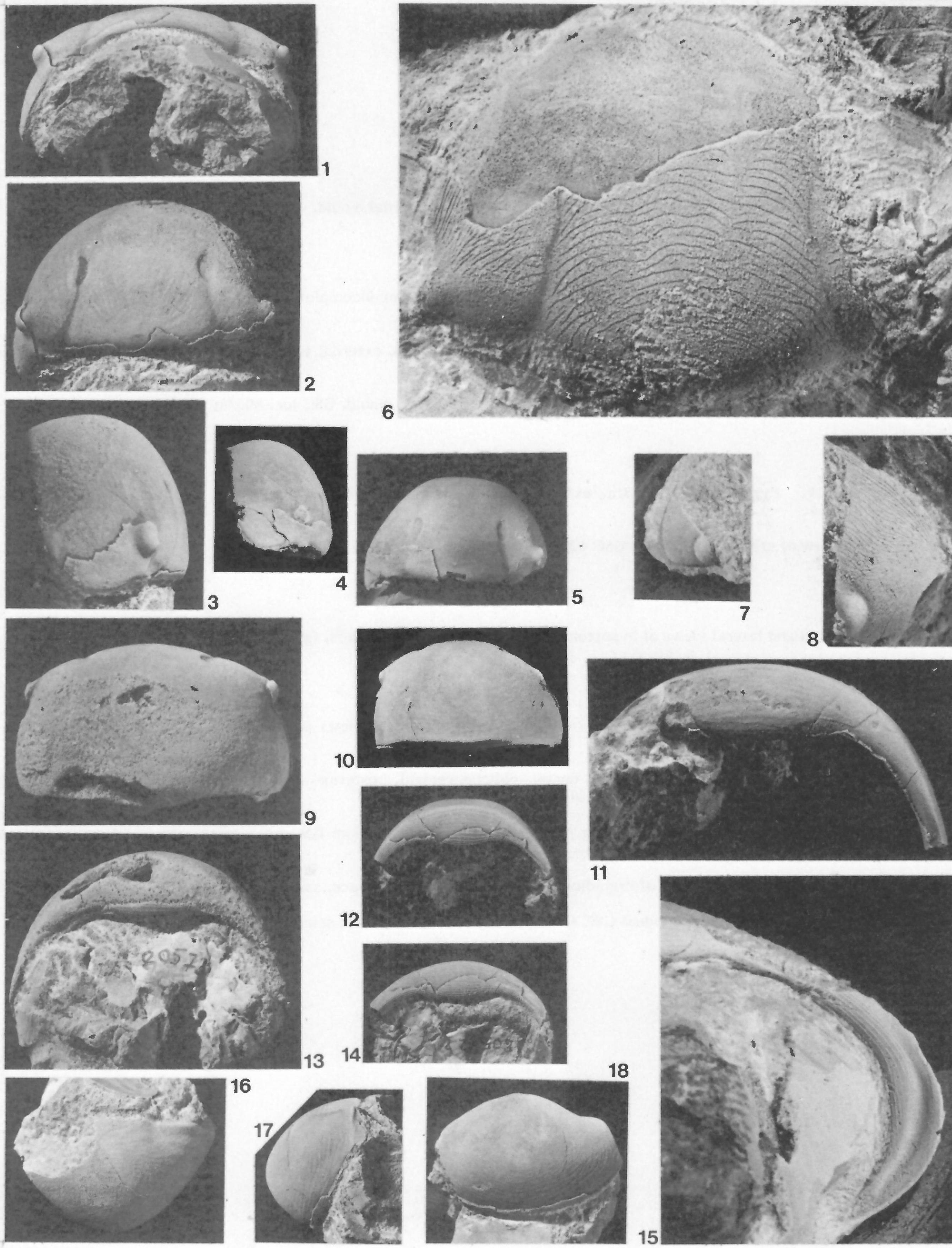

PLATE 7

Stenopareia? sp. (page 8)

Figures 1-3. Dorsal, ventral and lateral views of pygidium GSC 63525, internal mould, GSC loc. 80569, x2.

Cyphoproetus sp. (page 8)

Figures 4, 5, 7, 10. Posterior, tilted posterior, dorsal and lateral views of incomplete pygidium GSC 63528, external surface, GSC loc. 80571; x4.

Figures 6, 8. Lateral and dorsal views of incomplete cranidium GSC 63529, external surface, GSC loc. C-4459; x4 and x8. Very oblique lighting in Figure 8 reveals delicate ornament.

Figure 9 (lower). Dorsal view of incomplete cranidium GSC 63530, internal mould, GSC loc. 80574; x4.

Encrinurus sp. or spp. (page 12)

Figures 9 (upper), 14. Pygidium GSC 63531a, external mould and dorsal view of GSC 63531, counterpart internal mould, GSC loc. 80574; x4.

Figure 13. Dorsal view of cranidial fragment GSC 63532, internal mould, GSC loc. 80571; x4.

Platylichas? sp. (page 12)

Figures 11, 12. Ventral and lateral views of hypostome GSC 63533, external surface, GSC loc. 80571; x4.

Encrinurus sp. 1 (page 11)

Figures 15, 16, 18, 19, 26. Dorsal, lateral, anterior, posterior and ventral views of pygidium GSC 63534, external surface, GSC loc. 80613; x2.

Figures 17, 20, 21, 25, 27, 32. Lateral, lateral, dorsal, oblique ventral, posterior and dorsal views of incomplete individual GSC 63535, damaged external surface, same locality; x2.

Figures 22, 23, 29, 30. Dorsal, posterior, anterior and lateral views of cranidium GSC 63536 with attached first two thoracic segments, external surface, same locality; x2.

Figures 24, 31. Dorsal and anterior views of cranidium GSC 63537, external surface, same locality; x4.

Figure 28. Lateral view of damaged individual GSC 63538, partly external surface, same locality; x2.

PLATE 7

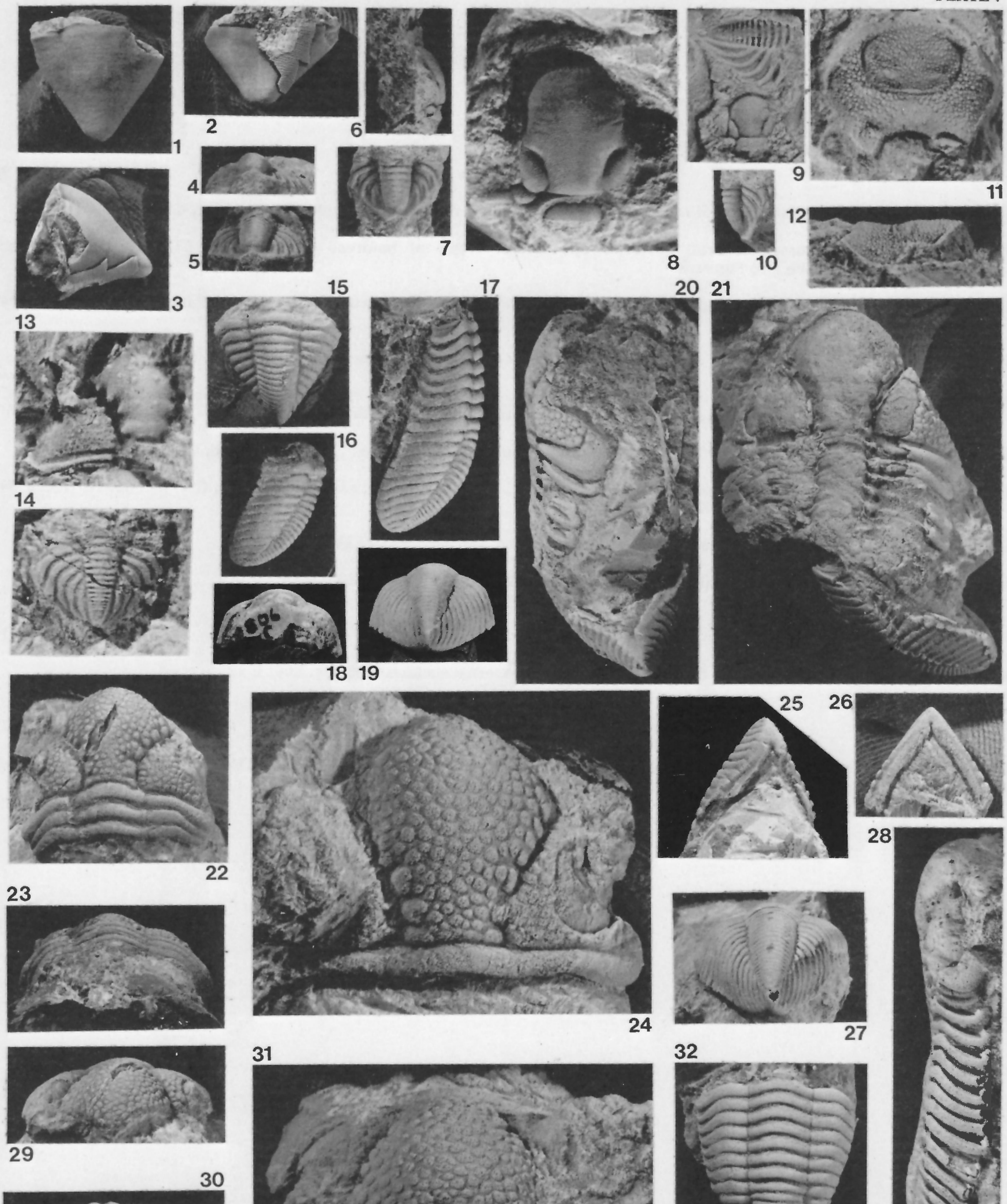
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PLATE 8

Winiskia perryi new species (page 9)

Figures 1, 4. Lateral and dorsal views of cast from internal mould of incomplete individual, GSC 63541, GSC loc. 80574; x4.

Figures 2, 5, 9, 15. Dorsal, anteral, posterior and lateral views of holotype cephalon GSC 63539, external surface, GSC loc. C–4457; x4. See also Figure 8.

Figures 3, 6, 10, 16. Dorsal, anterior, posterior and lateral views of cast from external mould of cephalon, paratype GSC 63540, same locality; x4.

Figures 7, 11. Dorsal and lateral views of incomplete pygidium GSC 63542, external surface, GSC loc. 80571; x2.

Figure 8. Tilted ventral view of front of holotype cephalon; x4. The median part of the border has been excavated subsequent to the photography for Figures 2 and 5 and shows the configuration and cross-section of the doublure.

Figures 12, 18, 22. Lateral, dorsal and posterior views of pygidium GSC 63543, mostly internal mould, GSC loc. 80574; x4.

Figures 13, 14, 17. Dorsal views of incomplete free cheeks, GSC 63544 and 63545, external surfaces, GSC loc. 80571, GSC 63546, mostly internal mould, GSC loc. 80574; x2, x4, x4.

Figure 19. Dorsal view of cranidium GSC 63547, external surface, GSC loc. 80571; x4.

Figure 21. Dorsal view of damaged pygidium GSC 63548, internal mould, GSC loc. 80571; x4.

Cheirurus? sp. (page 10)

Figure 20. Lateral view of incomplete hypostome GSC 63549, external surface, GSC loc. 80613; x2.

Chiozoon umisk new species (page 10)

Figures 23, 24. Lateral and dorsal views of two thoracic segments, paratype GSC 63553, mostly external surface, GSC loc. 80574; x4.

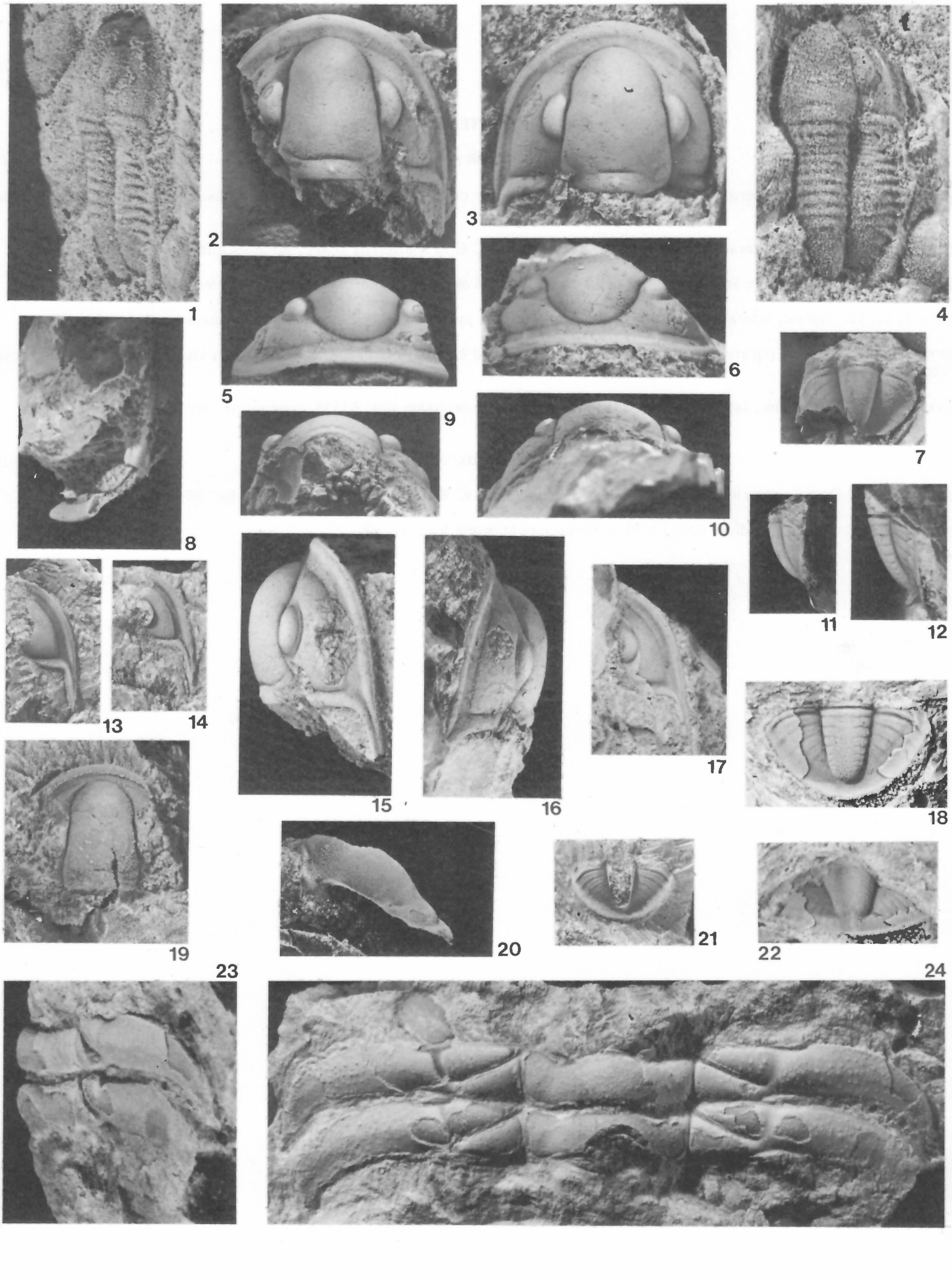
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PLATE 9

Chiozoon umisk new species (page 10)

Figures 1, 3, 13. Dorsal, anterior and lateral views of paratype cephalon GSC 63554, internal mould, GSC loc. 80574; x1. See also Figure 9.

Figures 5, 16. Dorsal and lateral views of paratype cephalon GSC 63555, internal mould, same locality; x2.

Figure 6. Dorsal views of two small paratype pygidia, GSC 63556 and 63557, mostly external surfaces, same locality; x2.

Figures 8, 11, 12. Dorsal, lateral and posterior views of holotype pygidium 63552, internal mould, same locality; x2.

Figure 9. Dorsal view of paratype free cheek and adjacent fixed cheek, GSC 63558, same locality; also oblique view of paratype cephalon 63554; x2.

Figures 14, 15, 17. Anterior, lateral and dorsal views of paratype cephalon GSC 63559, internal mould, same locality; x2.

Cheirurus? sp. (page 10)

Figures 2, 4, 10. Dorsal, anterior and lateral views of cephalon GSC 63550, internal mould, GSC loc. 80613; x2.

Figure 7. Dorsal view of pygidium GSC 63551, internal mould, same locality, x2.

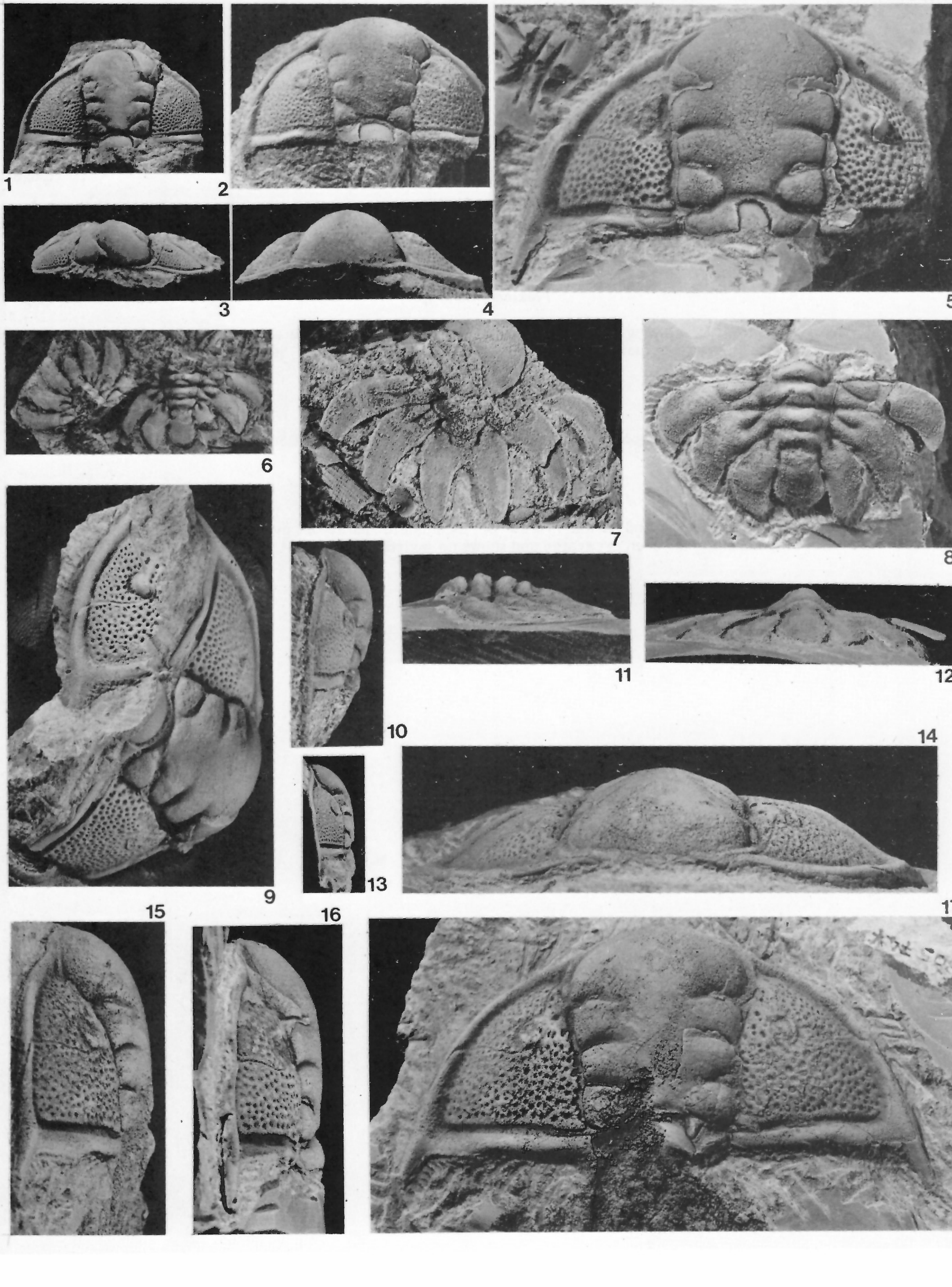
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PLATE 10

Acidaspis sp. (page 12)

Figures 1, 2. Dorsal and oblique views of cephalic fragment GSC 63572, internal mould, GSC loc. 80571; x4.

Figure 3. Cranidial fragment GSC 63573, ventral view of external mould of dorsal surface, GSC loc. 80574; x4.

Flexicalymene sp. (page 12)

Figures 4, 5. Lateral and tilted dorsal views of pygidium GSC 63574, external surface and counterpart GSC 63574a, external mould, GSC loc. 80574; x4. Figure 5 actually is a ventral view of the external mould. See also Plate 11, figs. 7 and 9.

Chiozoon umisk new species (page 10)

Figures 6, 7. Ventral and lateral views of hypostome GSC 63571, mostly internal mould, GSC loc. 80569; x4.

Stenopareia? *julli* new species (page 7)

Figures 8, 9, 10. Lateral, posterior and dorsal views of incomplete paratype pygidium GSC 63511, internal mould, GSC loc. 80572; x4. The doublure has been excavated and shows no sagittal point.

PLATE 10

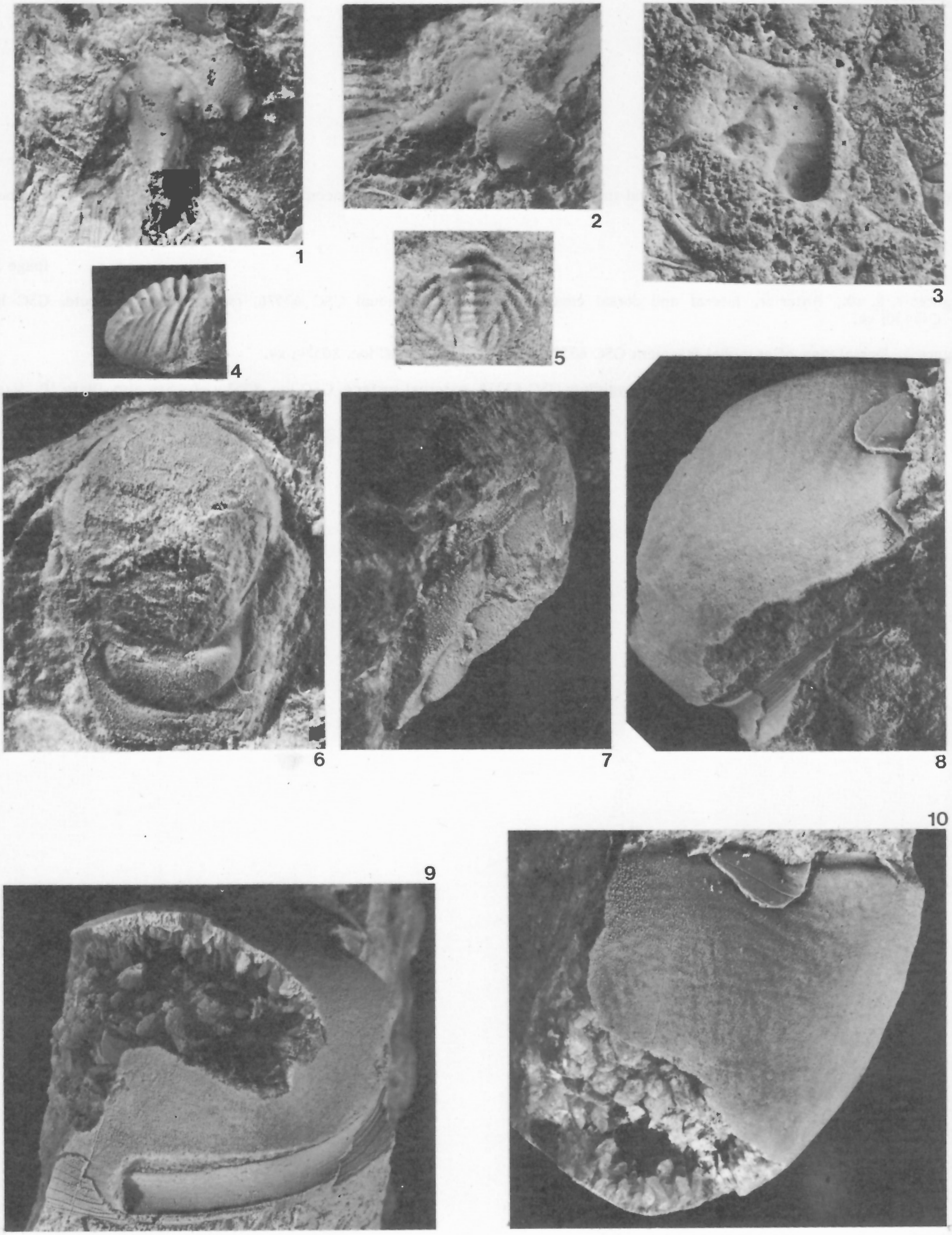


PLATE 11

Selenopeltoides sp. (page 13)

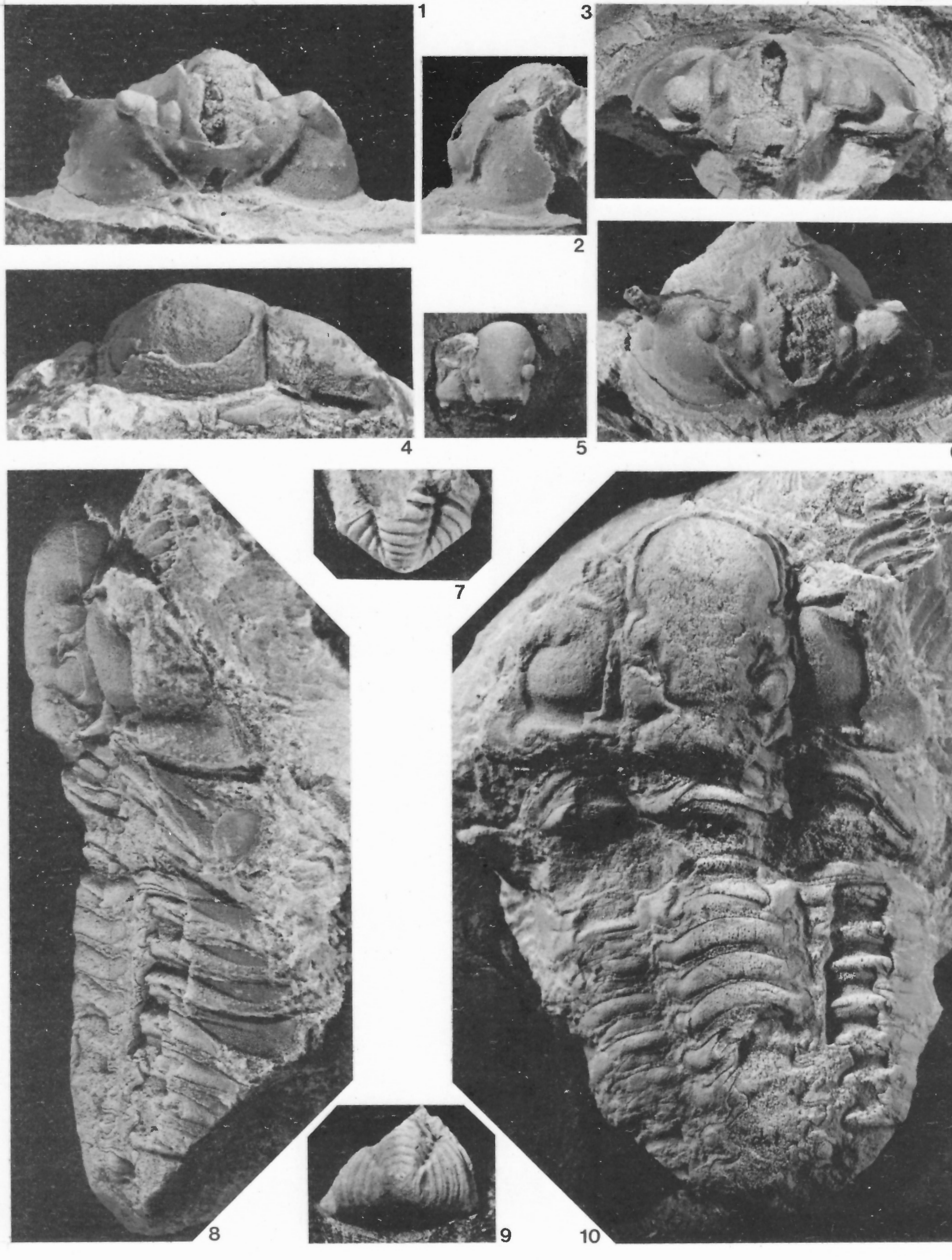
Figures 1-3, 6. Anterior, lateral, dorsal and tilted dorsal views of damaged and incomplete cephalon GSC 63577, internal mould, GSC loc. 80574; x4.

Flexicalymene sp. (page 12)

Figures 4, 8, 10. Anterior, lateral and dorsal views of damaged individual GSC 63576, mostly internal mould, GSC loc. C-4450; x4.

Figure 5. Dorsal view of cranidial fragment GSC 63575, internal mould, GSC loc. 80574; x4.

Figures 7, 9. Dorsal and posterior views of pygidium GSC 63574, external surface, GSC loc. 80574; x4. See also Plate 10, figs. 4 and 5.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