

# New Lower Ordovician Odontopleuridae (Trilobita) from Öland

By

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ABSTRACT.—Two new species are described from the *Raniceps* limestone. One is made the type of a new genus, and placed in the subfamily *Apianurinae*; the subfamily diagnosis is emended. The cephalon and thorax of the new species are known, and odontopleurid pygidia from the same horizon in Öland are thought to belong. Similar pygidia are known from the *Expansus* limestone of Öland, an unknown horizon in Östergötland, and the Pakri sandstone of Estonia (“*Acidaspis*” *solis* ÖPIK, 1926). These pygidia may belong to the same species group. The second new species from Öland is a *Miraspis*, the oldest so far known. The occurrence of Middle and Upper Cambrian trilobites of odontopleurid type in USSR is further evidence that the origin and diversification of the family is earlier than had been thought.

## Introduction

The original of Plate 1, figures 1–4, from the *Raniceps* limestone of northern Öland, is here regarded as a new genus and species within the subfamily *Apianurinae* WHITTINGTON, 1956. Odontopleurid pygidia are known from rocks of the same, or slightly greater, age in Öland (Pl. 2, figs. 5–8; Pl. 3, figs. 5, 6), in Östergötland, and in Estonia (ÖPIK, 1926). This type of pygidium is presumed to belong to the new genus, and those from the *Raniceps* limestone of Öland to the type species. From a locality which in 1957 yielded to BOHLIN a cranidium and probable pygidium of *Boedaspis ensifer* n.gen., n.sp., came also a second odontopleurid cranidium here called *Miraspis ceryx* n.sp., belonging to the subfamily *Miraspinae*.

The *Raniceps* limestone is one of the higher members in a limestone succession in Sweden that overlies the Tremadoc and underlies the *Schroeteri* limestone of Llandeilo age (JAANUSSON and STRACHAN, 1954). This succession in northern Öland has been described by BOHLIN (1949, 1955). The exact age of the members of this succession, in terms of the standard Arenig and Llanvirn Series, cannot be given, because graptolites are unknown. BOHLIN (1955) included the *Raniceps* limestone in the Lower Ordovician, but STØRMER (1953) proposed a lower position for the boundary between Lower and Middle Ordovician, at the Arenig–Llanvirn boundary. This level is about that between Canadian and Champlainian, the Lower and Middle Ordovician of American workers (TWENHOFEL *et. al.*, 1954). In view of these uncertainties and confusions we use here only the Baltoscandian stratigraphical terms.

The new Swedish odontopleurids are the earliest members of the subfamilies to which they belong. Possibly slightly older is the occurrence of *Selenopeltis* (*Selenopeltinae*) in the Arenig of Shropshire, England (WHITTARD, 1952, p. 158). Within recent years trilobites of odontopleurid type have been described from the Middle and Upper Cambrian of Kazakh and Siberia. First to be made known was *Acidaspidites precurrens* LERMONTOVA, 1951 (pp. 27–29, Pl. 6, figs. 4–9), and a second species is *A. lermontovae* TCHERNYSHEVA, 1953 (pp. 81–83, Pl. 6, figs. 16, 17). In 1956 POLETAYEVA erected two additional monotypic odontopleurid genera, *Belovia* and *Eoacidaspis*, on Middle and Upper Cambrian specimens. Dr. V. JAANUSSON has kindly drawn our attention to a later publication by POLETAYEVA (1957) in which the three genera mentioned are placed in a new family *Eoacidaspidae*. Evidently the origin of odontopleurid-like trilobites was in Cambrian time, and diversification occurred much earlier than was formerly believed (WHITTINGTON, 1956*a*, pp. 186–187).

The terminology employed in the descriptions is that of WHITTINGTON, 1956*a*, pp. 160–162.

## Systematic Palaeontology

### Family *Odontopleuridae* BURMEISTER, 1843

#### Subfamily *Apianurinae* WHITTINGTON, 1956, emend.

The inclusion of *Boedaspis* n.gen. in this subfamily makes necessary emendation of the original diagnosis to read:

DIAGNOSIS.—Glabella narrows forward, occipital ring long (sag.), convex, long paired spines and median tubercle; parallel-sided fronto-median glabellar lobe, two pairs of lateral lobes fused, kidney-shaped. Eye lobe situated far back, two branches of suture approximately aligned and directed inward and forward, free cheek narrow, librigenal spine arising about midway along lateral border and curving back. Hypostome shield-shaped, middle furrow arises at antero-lateral corner of middle body and runs inward and backward; small, pointed shoulders and shallow lateral notch. Thorax in one genus of at least ten segments, pleurae convex, either lacking pleural furrow and with single large pleural spine, or divided by pleural furrow into two bands, and with short anterior and long posterior pleural spine. Pygidium with paired border spines, unpaired median border spine may be present, long major spine.

GEOLOGICAL RANGE.—Ordovician (Arenig—Llanvirn to Ashgill).

#### Genus *Boedaspis* n. gen.

TYPE SPECIES.—*Boedaspis ensifer* n.gen., n.sp.

DIAGNOSIS.—Differs from the two other genera in this subfamily, *Apianurus* and *Calipernurus* (WHITTINGTON, 1956*a*, pp. 252–279, pls. 17–24) in that: (1)

cephalon widest across posterior margin, genal angle acute (Pl. 1, fig. 2); (2) occipital ring with posterior band, ring not separated from median glabellar lobe by occipital furrow, only by a narrow, smooth band (Pl. 1, figs. 2, 3); (3) fronto-median glabellar lobe lower, the frontal portion shorter (sag.) and projecting only slightly in front of the second lateral glabellar furrows (Pl. 2, figs. 1, 3); (4) eye lobe higher, situated closer to axial furrow and far back, so that transverse line joining mid-points passes through bases of paired occipital spines (Pl. 2, figs. 1, 3); (5) eye ridge dies out opposite second glabellar furrow and is connected only by a narrow depressed band to frontal glabellar lobe (Pl. 2, fig. 1); (6) thoracic pleurae with shallow pleural furrow and bearing anterior and posterior pleural spines (Pl. 1, fig. 2); (7) pygidium that may belong in type species having major spine arising from border and eight or nine additional pairs of border spines (Pl. 2, figs. 5-7; Pl. 3, figs. 5, 6).

GEOLOGICAL RANGE.—? *Expansus* limestone, *Raniceps* limestone.

*Boedaspis ensifer* n. gen., n. sp.

Pl. 1; Pl. 2, figs. 1-4, ? 5-7; ? Pl. 3, figs. 5, 6.

HOLOTYPE.—Pal. Instit., Uppsala, no. Öl 817a, b, incomplete cephalon and thorax, lower *Raniceps* limestone, Böda parish, Hagudden, northern Öland, on north side of small drainage ditch above section in Figure 3, p. 537, of BOHLIN, 1949. Other fossils from this locality are listed by BOHLIN (1949, p. 539).

OTHER MATERIAL.—Cranidium from the upper *Raniceps* limestone, and, doubtfully, four pygidia from the *Raniceps* limestone, northern Öland.

DESCRIPTION.—Cephalon transversely ovate in outline, widest (c. 34 mm. in holotype) across genal angles, moderately convex. Glabella most strongly convex across occipital ring, gently convex longitudinally; in holotype of width at anterior margin 7.0 mm., across occipital ring 16.5 mm., length (sag.) 12.0 mm. Occipital ring ovate in outline, posterior margin projecting behind cheeks, vaguely defined anteromedially by smooth band, length (sag.) in holotype 5.5 mm.; posterior band narrowest (sag.) medially, widening outward, defined medially and behind occipital spine by vertical slope from anterior band, near extremity slope separating two bands dies out; anterior band convex, bearing large pair of spines which diverge posteriorly at about 65°; between anterior part of spine bases a median tubercle, between posterior part a shallow, transverse depression. Occipital furrow a vaguely defined, narrow, smooth band behind median glabellar lobe, distally a deep, diagonally-directed pit. Remainder of glabella divided into sub-rectangular fronto-median lobe and kidney-shaped fused lateral lobes, axial and preglabellar furrows faint unornamented bands marking changes in slope. Fronto-median lobe gently convex transversely, projecting only slightly in front of second lateral furrows, in holotype crossed, opposite outer extremity of first lateral furrow, by faint, broad depression. First and second lateral lobes (the second much the smaller)

with little independent convexity, except for swollen antero-lateral part of first (basal) lobe. First and second lateral glabellar furrows in form of sub-circular pits, the first isolated from the axial furrow by fusion of the two lobes. Subtriangular cheeks united in front of glabella by narrow (sag.), low anterior border. Palpebral lobe (Pl. 2, figs. 1, 3, right palpebral lobe preserved outside fracture) standing as high as median part of occipital ring, situated in inner posterior corner of cheek opposite anterior part of occipital ring, slope down to posterior border furrow vertical, slope down to axial furrow opposite occipital furrow steep. Anterior branch of suture (Pl. 2, figs. 1, 3) curves forward and inward to cross anterior border and reach cranial border at point in line (exs.) with mid-point of first lateral glabellar lobe. Course of posterior branch cannot be determined. Eye ridge broad, convex, curving forward just inside and sub-parallel to cranial margin, dies out opposite second glabellar furrow. Outside anterior extremity of eye ridge anterior border furrow is deepened into a pit. Between this pit and second glabellar furrow a narrow depressed zone runs between extremity of eye ridge and frontal glabellar lobe (Pl. 2, figs. 1, 3). Free cheek convex outside eye lobe, descending steeply to border furrows and to large depression in postero-lateral corner; broad antero-lateral and narrower, convex posterior border, lateral border drawn out at about half cephalic length into broad base of genal spine; latter oval in cross-section, directed horizontally outward and backward. Hypostome unknown. External surface of cephalon bearing large, sub-symmetrically arranged tubercles on convex areas, median tubercle on occipital ring between bases of spines, asymmetry of arrangement most marked on fronto-median glabellar lobe. Tips of tubercles sharp, but extreme tip broken in all cases.

Thorax of at least ten segments, only the median region being known of last four (Pl. 1, figs. 2, 4). In holotype axis 14 mm. wide and at fifth segment thorax is 50 mm. in width (excluding pleural spines). Axial ring with posterior margin curved convexly backward, articulating furrow similarly curved and deepest distally. Long (sag.) articulating half-ring extends forward almost to articulating furrow of next segment. Horizontal pleurae divided by broad, shallow diagonal pleural furrow into narrow (exs.) gently convex anterior band and broader (exs.) posterior band. Latter slopes down steeply posteriorly to flat posterior flange, which has a narrow marginal rim that swells at the distal tip into a boss, probably the fulcral articulating socket. Anterior flange slopes forward and fits beneath edge of posterior flange of next segment. Pleural spines blade-shaped, flattened on upper and gently convex on lower surface, forming horizontal continuations of pleural bands, posterior spine wider and twice as long as anterior; directed outward and slightly forward in first five segments, curvature in dorsal aspect convex forward. External surface with similar tubercles to those on the cephalon, closely spaced on axial rings and in double row on each pleural band; on both surfaces of pleural spines tubercles smaller, more widely-spaced, and becoming barb-like distally.

One odontopleurid pygidium is known from the *Expansus* limestone and four from the lower and upper *Raniceps* limestones of Öland, one of the latter (Pl. 2, fig. 7) being from the same locality and horizon as the cranidium (Pl. 2, figs. 1-4). Those from the *Raniceps* limestone are thought probably to belong to this species, and may be described as follows:

Outline sub-semicircular, length (sag.) one-third maximum width. Axis of width at anterior margin about one-quarter that of pygidium. Axis tapering back to reach inner edge of posterior border, strongly convex, defined by axial furrows which are broad and shallow beside the rings but descend into deep pits opposite the articulating and first two ring furrows; articulating furrow and half-ring like those of thorax, first two ring furrows shallow medially, deepening distally, shallow third ring furrow (Pl. 3, fig. 6); the four axial rings are successively narrower (tr.) and shorter (sag.) backwards. Pleural region horizontal and gently convex, broad, gently convex border defined by broad, shallow border furrow; from border arises one major and eight (Pl. 2, figs. 5, 6) or nine (Pl. 3, figs. 5, 6) minor pairs of spines, the minor spines directed slightly upward, the major curving more strongly upward. The upper surfaces of the spines are flattened. The spines are evenly spaced and there are three minor pairs between the major, the latter connected by a pleural ridge to the first axial ring. The anterior minor spine shows a slight backward curvature, the remainder being straight. Doublure (Pl. 2, figs. 6, 7) rolled under and of same width as border, ventral surface inward and upward sloping. On convex parts of external surface large tubercles are spaced in a sub-symmetrical pattern, on the border spines (as on the pleural spines of the thorax) there are smaller, distally-directed barbs.

The four pygidia described above differ from each other slightly in detail, e.g. definition of last two axial rings, depth of border furrow beside tip of axis, and lack of one pair of border spines in one specimen. Some of these differences are apparent, being between these features as seen on the inner or outer exoskeletal surface, but the difference in number of minor border spines seems to be real.

DISCUSSION.—A slightly older pygidium from the *Expansus* limestone (Pl. 2, fig. 8) exhibits most of the characters of those from the *Raniceps* limestone, but differs in proportions and in the prominence of the border. It is placed in *Boedaspis* with doubt. Another pygidium from an unknown horizon at Borghamn, Östergötland (Pal. Instit. Uppsala, no. Ög. 77) seems to be of the same general type as those attributed to *B. ensifer*? It is exposed from the ventral side, and shows the inner surface of the dorsal exoskeleton. It is incomplete laterally, and the number of pairs of minor spines cannot be determined, but there are at least five outside the major pair. Inside the major pair are five separate minor spines, i.e. there is asymmetry. This type of seemingly abnormal specimen has been observed in other odontopleurid pygidia (WHITTINGTON, 1956a, p. 178).

Another possible species of *Boedaspis* is "*Acidaspis*" *solis* ÖPIK, 1926, a

pygidium from the Pakri calcareous sandstone of Estonia (B<sub>III</sub>  $\gamma$  according to ÖPIK, 1926). In this species there are only four pairs of minor border spines outside the major, and three pairs inside.

**Subfamily *Miraspinae*** R. and E. RICHTER, 1917, emend. WHITTINGTON, 1956.

**Genus *Miraspis*** R. and E. RICHTER, 1917.

*Miraspis ceryx* n. sp.

Plate 3, figures 1-4.

**HOLOTYPE.**—Pal. Instit. Lund, no. LO 3902 T, incomplete cranium, Upper *Raniceps* limestone, Gunnarslund, northern Öland.

**DESCRIPTION.**—Cranidium of projected length 3.5 mm., width across eye lobes about 6.5 mm. Glabella defined by broad and extremely shallow axial furrows (which die out anteriorly) and by convexity of lobes; width across mid-point of first lateral lobes 3.8 mm., and slightly greater than width occipital ring. Latter longest sagittally, strongly convex, posterior band (Pl. 3, figs, 2, 4) wide (sag.) and backward sloping in mid-line, narrowing progressively distally; longer anterior portion of occipital ring with pair of stout occipital spines diverging at an acute angle, and median tubercle near anterior edge. Occipital furrow straight, broad and shallow behind median glabellar lobe, at outer margin of this lobe it turns abruptly back and descends steeply into deep pit at extremity. Median glabellar lobe rectangular in outline, gently convex longitudinally and transversely, separated from lateral lobes by broad furrow which is deepest posteriorly. Median lobe merges into an extremely short (sag. and exs.) and ill-defined frontal lobe, bounded anteriorly by the deep preglabellar furrow. Three pairs of lateral glabellar furrows are deepest adjacent to median lobe and die out about halfway to the axial furrows, first (basal) pair directed transversely, the second and third running diagonally outward and forward. First lateral lobe oval in outline (long axis longitudinal), gently convex; second lobe ovate in outline, smaller and less convex; third lobe one-third the length (exs.) of the second, faintly convex; third lobe and frontal lobe merge into adjacent part of fixed cheek (Pl. 3, fig. 1). Anterior border of cranium about same width as eye ridge, gently convex. Both palpebral lobes are broken off, but were situated in same transverse line as that joining mid-point of first lateral glabellar lobes. Fixed cheek widest posteriorly, descending vertically behind palpebral lobe, in front of this lobe sloping steeply forward and outward; antero-lateral margin gently curved and directed inward and forward; broad eye-ridge runs sub-parallel to, and just inside of, this margin, dies out at border furrow adjacent to lateral extremity of frontal glabellar lobe. Posterior border of fixed cheek not preserved. External surface, except in deeper parts of furrows, bearing tubercles of different sizes and without regular arrangement. Some of the largest tubercles show a sub-symmetrical arrangement, e.g. that

placed near the centre of the first lateral glabellar lobe, and those on the fixed cheek adjacent to first and second lateral lobes, but tubercles of the same size on the median glabellar lobe are not so arranged. The tubercles on the anterior border and posterior band of the occipital ring are all small.

DISCUSSION.—This cranium is remarkably similar to that of *Miraspis mira* (BARRANDE, 1846) from the Upper Wenlock of Bohemia, differing (in the parts preserved) only in such details as the lesser inflation of the fronto-median glabellar lobe, less marked separation between the two bands of the occipital ring, and coarser tuberculation. It is therefore referred to *Miraspis*, and not to *Ceratocephala*, though these two genera have many characters in common (cf. WHITTINGTON, 1956*b*, p. 514). The form of the glabella combined with the position of the eye lobe in the Swedish cranium seem more typical of *Miraspis* than *Ceratocephala*.

Pygidia of *Miraspis* type are known from the early Bala (Caradoc) of North Wales (WHITTINGTON and WILLIAMS, 1955, Pl. 40, fig. 119) and the Upper Drummuck Group (Ashgill) of Scotland (WHITTINGTON, 1956*b*, p. 515, Pl. 60, figs. 7, 8). The Swedish species extends the range of the genus still further downward, so that it is now Arenig–Llanvirn to Lower Devonian.

### Postscript

Since the above was written the odontopleurid from the early Arenig of Västergötland (TJERNVIK, 1956, p. 264) has been examined. The material includes the right pleura of a thoracic segment and two incomplete pygidia, but not a free cheek. It is the oldest odontopleurid from Sweden, but the subfamily to which it may belong cannot be decided.

The pleura is crossed by a straight, diagonally directed pleural furrow, and bears a short anterior and long posterior pleural spine, the external surface of convex parts tuberculate. The pygidium is three times as wide as long (sag.), axis of maximum width one-quarter that of pygidium, three axial rings decreasing in width (tr.) and length (sag.) posteriorly, and a small terminal portion. Pleural regions horizontal, with broad, gently convex border and broad, shallow border furrow. Tip of axis reaches border furrow. Pleural ridge of similar convexity and width to pleural border, flanked by broad, shallow furrows, directed outward from first axial ring, then curving so as to be directed backward as it crosses the border. Base of major spine situated about mid-way across pleural region, spine directed slightly upward and inward. Many pairs of tiny border spines, some eight pairs inside, and nine or ten outside, the major spines. First axial ring with prominent pair of short spines, smaller pair outside them. Second ring with three pairs of short spines, two pairs on third ring, and one pair on terminal portion. Convex parts of pleural regions with scattered short spines and tubercles.

This pygidium is not unlike that from the *Expansus* limestone described above (Pl. 2, fig. 8), but differs in that the major pleural spines are relatively

farther apart, and the other border spines are smaller and more numerous. It differs from known Ordovician miraspinid pygidia in the better definition of the axial rings, presence of the border, the major spines being closer to the axis and there being more minor spines outside them. The general form of the Västergötland pygidium is also like that of *Selenopeltis*, but the presence of the pleural border and numerous minor border spines distinguish it. The pleura is not of *Selenopeltis* type.

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## Plate 1

*Boedaspis ensifer* n. gen., n. sp.

- 1-4. Holotype, incomplete cephalon and thorax, counterparts; 1-3, anterior, dorsal, right lateral views of external surface of cephalic exoskeleton, internal mould of thorax,  $\times 1-1/2$ ; 4, ventral view, internal surface of parts of thoracic exoskeleton combined with external mould of other parts,  $\times 1$ . Lower *Raniceps* limestone, Hagudden, northern Öland. Pal. Inst. Uppsala, no. ÖI 817a, b, collected BOHLIN, 1941.

## Plate 2

*Boedaspis ensifer* n. gen., n. sp.

- 1-4. Incomplete cranidium; 1, 3, 4, anterior, dorsal, right lateral views of external surface of exoskeleton,  $\times 6$ ; 2, exterior view of external mould,  $\times 6$ . Upper *Raniceps* limestone, Gunnarslund, northern Öland. Pal. Institut. Lund, no. LO 3900 t, collected BOHLIN, 1957.

*Boedaspis ensifer* n. gen., n. sp. ?

- 5, 6. Incomplete pygidium, counterparts,  $\times 1-1/2$ . Lower *Raniceps* limestone, Hälludden, northern Öland. Pal. Institut. Uppsala, no. ÖI 818, collected BOHLIN, 1941.  
7. Incomplete pygidium, dorsal view, exoskeleton partially stripped off,  $\times 1-1/2$ . Upper *Raniceps* limestone, Gunnarslund, northern Öland. Pal. Institut. Lund, no. LO 3901 t, collected BOHLIN, 1957.

? *Boedaspis* sp.

8. Incomplete pygidium, internal mould,  $\times 1-1/2$ . *Expansus* limestone, about 85 cm. above the "*Limbata*" limestone, quarry north of Högstrum Church, central Öland. Pal. Institut. Uppsala, no. ÖI 822, collected BOHLIN, 1956.

## Plate 3

*Miraspis ceryx* n. sp.

- 1-4. Holotype, incomplete cranidium, anterior, right lateral, dorsal, oblique postero-lateral views,  $\times 9$ . Upper *Raniceps* limestone, Gunnarslund, northern Öland. Pal. Institut. Lund, no. LO 3902 T, collected BOHLIN, 1957.

*Boedaspis ensifer* n. gen., n. sp. ?

5. Latex cast from external mould of incomplete pygidium,  $\times 1$ . Lower *Raniceps* limestone, Hälludden, northern Öland. Pal. Institut. Uppsala, no. ÖI. 819, collected during excursion, 1944.  
6. Pygidium, ventral view, mainly internal surface of exoskeleton, external mould of part of right pleural region,  $\times 4$ . Lower Ordovician, exact level unknown, Hälludden, northern Öland. Riksmus., Palaeoz. Avd., Stockholm, no. Ar. 9800. Original of BOHLIN, 1949, fig. 8.





