LATE MIDDLE CAMBRIAN TRILOBITES FROM TRIAL RIDGE, SOUTHWESTERN TASMANIA

by J.B. Jago & A.V. Brown

(with one table, one text-figure and three plates)


The first Middle Cambrian trilobites to be described from southwestern Tasmania come from two localities within siltstone in the Trial Ridge area on the HUNTLEY 1:50 000 sheet. Sixteen trilobite taxa are described. The 11 agnostoid species include one new species, Hypagnostus trali. Lisogoragnostus is recorded for the first time in Tasmania. The faunas of both localities are of a very similar late Middle Cambrian age, probably high in the Lejopyge laevigata Zone on the northern Australian biostratigraphic scale. One fauna is dominated by complete specimens of Goniagnostus nathorsti but has very few polymerosids. In the other fauna, there are no complete agnostoids. G. nathorsti is absent, and the most common trilobite is a member of the Proasaphiscidae, thus suggesting that the former fauna is of deeper water origin than the latter.

Key Words: Middle Cambrian, trilobites, Trial Ridge, southwestern Tasmania.

INTRODUCTION

During the mapping of the HUNTLEY 1:50 000 Geological Atlas Map Sheet (Brown et al. 1982) new fossil faunas were found in two localities on Trial Ridge. The southern locality (no.1, fig.1), yielded a fauna with abundant agnostoid trilobites, numerous phosphatic brachiopods as well as polymerosids and trilobite tracks. The northern locality (no.2, fig.1) contains a similar but more restricted fauna. The trilobites described in this paper allow their horizon to be dated as late Middle Cambrian, the first of that age to be described from southwestern Tasmania.

Geological Setting

The term "Trial Ridge Beds" was introduced by Corbett (1970) for the succession of sedimentary rocks on Trial Ridge. In the course of mapping the Huntley Quadrangle the sequence on Trial Ridge was re-mapped in greater detail than previously, allowing the rocks within the area to be subdivided into three members. The lowest member (Cml, fig.1) comprises thickly bedded, siliceous, granule to cobble conglomerate and siliceous sandstone. The fossiliferous middle member (Cmm, fig.1) consists of thinly and monotonously interbedded light to dark-grey sandstone and siltstone. Some siltstone units contain abundant muscovite whereas, in other places, siltstone beds contain a sand-grade component. Most of the siltstone beds contain multiple truncated cross-bedding, with some of the interbedded sandstone units having silt-grade basal flame structures. The highest member (Cmh, fig.1) consists of an irregularly interbedded sequence of granule to cobble conglomerate, siliceous pebbly sandstone and siltstone. A detailed description of this succession is contained in Brown et al. (1989: 40–45).

Composition and Age of the Faunas

Locality 1 contains the following agnostoid trilobites: Goniagnostus nathorsti (Bragger), Lejopyge laevigata (Dalman), Hypagnostus trali sp. nov., Liogoragnostus sp., Oidalagnostus changi Lu, Clavagnostus cf. repandus (Westergård), Glabragnostus sp., Valagnostus sp. and Agnostostis gen. et sp. indet. Polymorroid trilobites present are Amphoton sp. and Papyriaspididae gen. et sp. indet. Trace fossils, probably formed by polymorroid trilobites, are also present.

The following agnostoid trilobites are present at Locality 2: Lejopyge laevigata (Dalman), Hypagnostus trali sp. nov., H. brevifrons (Angelin), Amagnostus latiuwnensis (Lorenz), Oidalagnostus changi Lu and Agnostostis gen. et sp. indet. Polymorroid trilobites present are Fuchonia sp., Bathyuriscus? sp. and Proasaphiscidae gen. et sp. indet.

The overlap in the faunal compositions suggests that the two faunas are of similar, if not identical, age. The combination of Lejopyge laevigata, Goniagnostus nathorsti, Hypagnostus brevifrons, Amagnostus latiuwnensis, Clavagnostus cf. repandus and Oidalagnostus changi suggests correlation with the L. laevigata Zone on the northern Australian biostratigraphic scale. Amphoton and Fuchonia are well-known late Middle Cambrian genera from China and Australia. The specimens described herein as Proasaphiscidae gen. et sp. indet. belong in a genus known from several localities elsewhere in Tasmania. These include Native Track Tier and St Valentines Peak (see Laurie et al., 1995, for details of these localities), where the faunas are both of very late Middle Cambrian age (Bao 1995). The combination of the above species suggests an age high in the L. laevigata Zone on the northern Australian biostratigraphic scale or near the boundary of the L. laevigata and Proagnostus bulbus Zones of the late Middle Cambrian of China (Peng & Robison 2000).

The composition of the agnostoid component of both localities (table 1) shows that, while there are similarities in the composition of the faunas from the two localities, there...
are also some differences. At Locality 1, 59.77% of the known agnostoid cephal and pygidia are found in complete specimens (table 1); Goniagnostus nathorsti makes up 67.82% of the agnostoid fauna and only three polymeroid specimens are known.

In contrast to Locality 1, there are no known complete agnostoids from Locality 2. G. nathorsti is not present, and polymeroid trilobites make up about 50% of the trilobite fauna. Of the polymeroids, Proasaphiscidae gen. et sp. indet. is the most common trilobite at Locality 2. As noted above, this species is also common in faunas of similar age at Native Track Tier and St Valentines Peak in northern Tasmania. The abundance of complete agnostoids, particularly G. nathorsti, at Locality 1 and the absence of G. nathorsti and the presence of abundant Proasaphiscidae gen. et sp. indet. at Locality 2 all suggest that the faunas of Localities 1 and 2 respectively fit into Faunas 2 and 3 of Jago (1973), with the Locality 1 fauna being a deeper water fauna than that of Locality 2.

SYSTEMATIC PALAEONTOLOGY

All specimens described occur as internal and external moulds in weathered siltstone. For description, silicone rubber casts of the external moulds were prepared and then photographed after whitening with magnesium oxide. The terminology used for agnostoid trilobites is essentially that of Shergold et al. (1990). Specimens are housed in the collection of the School of Earth Sciences, University of Tasmania.

DESCRIPTIONS

Order AGNOSTIDA Salter, 1864
Superfamily AGNOSTOIDEA M'Coy, 1849
Family PTYCHagnostidae
Kobayashi, 1939
Genus Goniagnostus Howell, 1935b

Synonymy

Type species
Agnostus nathorsti Brügger 1878: 68, pl. 5, fig. 1.

Remarks
TABLE 1
Analysis of agnostoid trilobites from Trial Ridge*

<table>
<thead>
<tr>
<th>LOCALITY ONE</th>
<th>Complete specimens</th>
<th>Separate cephala</th>
<th>Separate pygidia</th>
<th>Total no. of specimens</th>
<th>Total cephalo and pygidia</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Goniagnostus nathorsti</em></td>
<td>21</td>
<td>10</td>
<td>7</td>
<td>38</td>
<td>59</td>
</tr>
<tr>
<td><em>Lejopyge laevigata</em></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td><em>Hyagnostus trali</em></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>Lisogoragnostus sp.</em></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><em>Oidalagnostus changi</em></td>
<td>6</td>
<td>1</td>
<td>7</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><em>Clavagnostus cf. repandus</em></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Glaberagnostus sp.</em></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Valenagnostus sp.</em></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Agnostoid gen. et sp. indet.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total number of cephalo and pygidia = 87. Number of cephalo and pygidia in complete specimens = 52. Percentage of cephalo and pygidia in complete specimens = 59.77%.

<table>
<thead>
<tr>
<th>LOCALITY TWO</th>
<th>Complete specimens</th>
<th>Separate cephalo</th>
<th>Separate pygidia</th>
<th>Total no. of specimens</th>
<th>Total cephalo and pygidia</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Lejopyge laevigata</em></td>
<td>3</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><em>Hyagnostus trali</em></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>H. brevifrons</em></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Ammagnostus latiwnensis</em></td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><em>Oidalagnostus changi</em></td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Agnostoid gen. et sp. indet.</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Every available agnostoid cephalo and pygidium is shown on this table. Each individual cephalo and pygidium is counted as one unit; thus a complete agnostoid comprises two units.

**Goniagnostus nathorsti** (Brøgger, 1878)

Pl. 1A–K

**Synonymy**
See Peng & Robison (2000: 72)

**Material**
Twenty-one complete, or nearly complete, specimens, plus ten separate cephalo and seven separate pygidia. Specimens UTGD 125320a, b, 125321a, b, 125322–125324, 125325a, b, 125326a, b, 125328–125330.

**Diagnosis**
See Laurie (1989: 177).

**Description**
Cephalo slightly larger than pygidium, with weakly and finely pustulose surface; cephalo slightly wider than long. Well-developed radial scrobicules. Narrow border; narrow, shallow border furrow. Very short cephalic fulcral spines. Unconstricted acrolobe. Well-developed preglabellar median furrow. Well-defined axial furrows. Glabella length 0.75–0.8 that of cephalo; width about one-third of cephalo. Subtriangular anteroglabella has length about 0.4 that of glabella. F3 well developed; deflected slightly forwards centrally. F1, F2 well developed, extend about one-third of distance into glabella from either side; central part of posteroglabella raised well above lateral parts of glabella. Some specimens (e.g. pl. 1A) have shallow longitudinal furrows that separate the central and lateral parts of the glabella. Central part of glabella increases in height posteriorly. Small subtrapezoidal basal lobes. Pygidium slightly wider than long. Low pustules on pleural areas coalesce to form a reticulate prosopon. Narrow, shallow border furrow; border widens posteriorly. Short posterolateral spines placed behind axial termination. Large shoulders and facets. Shallow postaxial median furrow shallows posteriorly to border furrow. Pygidial axis outlined by well-developed axial furrows. Axis about 0.7–0.8 length of pygidium; well-developed rosette with node. Axis constricted at M2 and at rosette. F1, F2 well developed. Central part of M1 and particularly M2 separated from lateral parts of axis by shallow longitudinal furrows that are more clearly developed on M2. Central part of M2 extends into a node that continues on to posteroaxial.

**Discussion**
These specimens fit into *Goniagnostus nathorsti* as discussed by Laurie (1989) and Peng & Robison (2000). *G. nathorsti*, as figured by Westergård (1946: pl. 12, figs 12-16), Opik (1979: pl. 47, fig. 6; pl. 60, figs 1–5; pl. 61, figs 1, 3–6), Xiang & Zhang (1985: pl. 20, figs 1–3, 6–10), Laurie (1989: fig. 1) and Peng & Robison (2000: fig. 56), shows considerable morphological variation. Variable features include the length of the glabella, the length and width of the pygidia axis and the position and length of the pygidial posterolateral spines. The Trial Ridge specimens show a similar variation, with some of the differences in appearance of the Tasmanian specimens, when compared to the specimens figured in the above papers, being due to the fact that the Trial Ridge
The available cephalas are poorly preserved. The very posterior of the glabella is outlined by shallow axial furrows; the basal lobes are very small. The pygidia, which are better preserved, have a narrow, shallow border furrow and a narrow, flat border. The anterior part of the axis is outlined by shallow furrows which fade posteriorly, becoming effaced about the position of the F2 furrow. There is a low node on M2; posterolateral spines are absent.

These specimens are assigned to *Lejopyge* based on the narrow pygidial border, the lack of pygidial spines and the high degree of effacement, suggesting affiliation with either *L. laevigata* or *L. calva*, with the former being preferred.

**Genus Lejopyge Hawle & Corda, 1847**

Type species *Battus laevigatus* Dalman 1828: 136.

**Remarks**

The concept of *Lejopyge* has been discussed at some length by Daily & Jago (1975), Opik (1979), Robison (1984, 1994), Laurie (1989), Westrop et al. (1996) and Peng & Robison (2000). On the basis of cladistic analysis Robison (1994) placed *Onymagnostus* in synonymy with *Lejopyge*. However, also on the basis of cladistic analysis, Westrop et al. (1996) placed *Onymagnostus* in synonymy with *Pychagnostus*. Peng & Robison (2000) dispute the work of Westrop et al. and return *Onymagnostus* to *Lejopyge*. Shergold & Laurie (1997) maintained *Onymagnostus* as a separate genus. A detailed analysis of this matter is outside the scope of this paper, but we would suggest that *Onymagnostus* does not belong in *Lejopyge*. We would prefer to retain *Onymagnostus* as a separate genus.

*Lejopyge laevigata* (Dalman, 1828)

*PL. 1L–M, P–S; PL. 2C*

**Synonymy**


**Material**

Two poorly preserved complete agnostoid, five poorly preserved cephalas and four reasonably well-preserved pygidia are available. Specimens UTGD 125331, 125332a, b, 125335a, b, 125336–125338, 125441.

**Remarks**

Two poorly preserved complete agnostoids, five poorly preserved cephalas and four reasonably well-preserved pygidia are available. Specimens UTGD 125331, 125332a, b, 125335a, b, 125336–125338, 125441.
Type species
Agnostus parvifrons Linnarsson 1869: 82, pl.2, figs 56, 57.

Diagnosis
See Shergold & Laurie (1997: 356), with the amendment that the F3 glabellar furrow may be effaced as may be the posterior parts of the axial furrows of the pygidium.

Discussion

The generally accepted concept of Cotalagnostus is that it is similar to Hypagnostus except that the F3 glabellar furrow is effaced, as may be the posterior parts of the pygidial axial furrows. Many of the pygidia of Cotalagnostus lens and C. lens claudicus as illustrated by Westergård 1946 (pls 6, 7) and Hutchinson 1962 (pl. 6) are indistinguishable from those of Hypagnostus. Westergård (1946) and Robison (1964) considered Cotalagnostus evolved from Hypagnostus by effacement of furrows. Westrop et al. (1996) concluded that the difference between the two genera, i.e. the presence of a distinct F3 furrow on the cephalon of Hypagnostus, was arbitrary and regarded Cotalagnostus as a junior synonym of Hypagnostus. Shergold & Laurie (1997) maintained the separation of the two genera. Peng & Robison (2000) disputed the placement of Cotalagnostus in synonymy with Hypagnostus, on the grounds that Cotalagnostus is differentiated by the effacement of F3 and the greater effacement of its axial furrows on both the cephalon and pygidium. We accept Cotalagnostus as a junior synonym of Hypagnostus on the grounds given by Westrop et al. (1996) and because, as noted above, it is difficult to distinguish the pygidia of the two genera.

Hypagnostus trali sp. nov.
Pl. 2A, B, D, E

Derivation of name
Anagram of Trial.

Material
The holotype, a complete specimen (UTGD125339), a pygidium with thorax attached (UTGD 125340) and two pygidia (UTGD 125342–43) are assigned to this species.

Holotype
Complete specimen UTGD125339 (Pl. 2A) is selected as holotype.

Diagnosis
Both cephalon and pygidium have unconstricted acrolobes, narrow borders and narrow, shallow border burrows. Posterior part of glabella outlined by shallow axial furrows. Narrow pygidial axis extends almost full length of acrolobe; F1 and F2 effaced. Terminal axial node present.

Description
Complete specimen 3.5 mm long. Acrolobes unconstricted. Cephalon about as wide as long. Narrow, shallow border furrow; narrow convex border. Small basal lobes. Broadly rounded glabellar posterior. Posterior part of glabella outlined by shallow axial furrows which extend almost 0.4 length of cephalon to a position just short of where F3 would be. Pygidium about as wide as long. Narrow, shallow border furrow; narrow, convex border widens posteriorly. Narrow pygidial axis extends almost full length of acrolobe; slight constriction at position of M2. F1, F2 effaced. Terminal axial node present.

Discussion
The pygidial axis of trali is narrower and extends further to the posterior than in H. lens or the subspecies H. lens claudicus (Westergård 1946). The pygidium of H. confusus is more effaced than that of trali; and where the outline of the axis of confusus can be seen (Westergård 1946; pl.7, figs 14, 16, 19), it is shorter than that of trali. H. laevus is

---

PLATE 2
(A,B,D,E) Hypagnostus trali sp. nov.: (A) UTGD125339 complete specimen, holotype, internal mould, ×10; (B) UTGD125340a pygidium with thorax attached, silicone rubber cast of external mould, ×10; (D) UTGD125342 small pygidium, silicone rubber cast of external mould, ×7.
(C) Lejopyge laevigata (Dalman 1828). UTGD125341 pygidium and thoracic segments, silicone rubber cast of external mould, ×10.
(F,I,J,M–P) Otdalagnostus changi Lu 1964: (F) UTGD125344 cephalon internal mould, ×8; (I) UTGD125347 cephalon, internal mould, ×6; (J) UTGD125348 pygidium and thoracic segments, internal mould, ×7; (M) UTGD125351 pygidium, internal mould, ×5; (N) UTGD125352 cephalon, internal mould, ×10; (O) UTGD125353 cephalon, internal mould, ×8; (P) UTGD125354 cephalon, silicone rubber cast of external mould, ×10.
(G,K,L) Ammagnostus laiwuenensis (Lorenz 1906): (G) UTGD125345 cephalon, internal mould, ×5; (K) UTGD125349 pygidium, internal mould, ×6; (L) UTGD125350 cephalon, internal mould.
(H) Hypagnostus brevifrons (Angelin 1851) UTGD125346 cephalon and thoracic segments, internal mould, ×8.
(Q) Glaiberegnostus sp. UTGD125355b complete specimen, internal mould, ×6.
(R) Valenagnostus sp. UTGD125356 partial pygidium, internal mould, ×15.
(S) Agnostoid gen. et sp. indet. UTGD125357 cephalon, internal mould, ×15.
(T, U) Clavagnostus cf. repandus (Westergård in Holm & Westergård 1930): (T) UTGD125358 partial pygidium, internal mould, ×8; UTGD125359 pygidium, internal mould, ×10.
(V) Bathyriscus (?) sp. UTGD125360 partial cranidium, internal mould, ×10.

much more effaced than _trali_ (Robison 1964: pl.80, figs 17–28). The pygidial axis of _Catalagnostus_ sp.1 of Egorova et al. (1982: pl.14, fig. 14) extends to the posterior of the acrolobe as in _trali_ but is wider than that of _trali_. The pygidium of _trali_ is similar to that of _H. hippalus_ Opik 1961; however, the cephalon of _hippalus_ is quite different.

**Hypagnostus brevifrons** (Angelin, 1851)

_Synonymy_

**Material**
One cephalon with attached thoracic segments (UTGD 125346).

**Remarks**
As noted by Peng & Robison (2000) and other authors, cephalas of _H. brevifrons_ and _H. parvifrons_ are difficult to distinguish. However, when compared with previously illustrated material, this cephalon appears to fit better into _H. brevifrons_.

**Genus Lisogoragnostus** Rozova in Lisogor, Rozov & Rozova, 1988

_Synonymy_

**Type species**
_Lisogoragnostus kalisae_ Rozova in Lisogor et al. (1988: 64, pl. 5, fig. 9).

**Diagnosis**
See Peng & Robison (2000: 64) with the amendment that the pygidium may have a narrow border.

**Remarks**
Peng & Robison (2000) discussed the genus comprehensively. The pygidium described by Jago (1976a: pl. 26, fig. 15) as Agnostid, gen. et sp. indet. no. 1 figured from St Valentines Peak, Tasmania, should be included in _Lisogoragnostus_. The explanation for plate 26, figure 15 in Jago (1976a) is incorrect in that it states that the specimen is Agnostid, gen. et sp. indet. no. 2.

**Lisogoragnostus** sp.

_Pi. 1N_O

**Material**
One almost complete specimen (UTGD 125333) and a partial pygidium (UTGD 125334). Neither specimen is well preserved.

**Description**
Both available specimens small. Complete specimen (pl. 1N) length of 1.5 mm. Acrolobes uncondstricted. Cephalon about as wide as long. Very narrow, shallow border furrow; very narrow border. Very small basal lobes. Shallow axial furrow effaced forwards of F3. F3 very shallow; concave anteriorly.

**Remarks**
These specimens differ from previously described species of _Lisogoragnostus_ by the presence of a distinct pygidial border. However, the preservation is not good enough to justify the erection of a new species. The Trial Ridge specimens are probably closest to _L. hybus_ Peng & Robison (2000: fig. 47). However, the cephalon of _L. hybus_ is more elongated than the Trial Ridge specimens. The pygidial axis of the Trial Ridge species appears to be angulate in a manner similar to the pygidia described and figured by Rasetti (1967: 38, pl. 10, figs 22–26) as Agnostida, pygidium no. 1, which belong in _Lisogoragnostus_ (Peng & Robison 2000). However, preservation of our specimens makes it difficult to be certain about this matter. The anteroaxis of the Trial Ridge specimens is more parallel-sided than in the specimen of _Lisogoragnostus_ illustrated by Jago (1976a: pl. 26, fig. 15) as Agnostid gen. et sp. indet. no. 1.

**Family AMMAGNOSTUS** Opik, 1967

**Genus Amagnostus** Opik, 1967

_Synonymy_

**Type species**
_Ammagnostus psammius_ Opik 1967: 139, pl. 55, fig. 3; pl. 66, figs 1–4; text fig. 40.

**Diagnosis**

**Remarks**
Peng & Robison (2000) comprehensively discussed the genus. The pygidium described by Jago (1976a: pl. 26, fig. 15) as Agnostid, gen. et sp. indet. no. 1 figured from St Valentines Peak, Tasmania, should be included in _Lisogoragnostus_. The explanation for plate 26, figure 15 in Jago (1976a) is incorrect in that it states that the specimen is Agnostid, gen. et sp. indet. no. 2.

**Ammagnostus laiwuensis** (Lorenz, 1906)

_Pi. 2G, K, L

**Synonymy**

**Material**
Three cephalas and one pygidium. Specimens UTGD 125345, 125349, 125350.

**Diagnosis**

**Remarks**
These specimens fit _Peronopsis ekip_ of Jago (1976a), which was placed in synonymy with _Ammagnostus laiwuensis_ (Lorenz, 1906) by Peng & Robison (2000). This synonymy is accepted herein.
Family DIPLAGNOSTIDAE
Whitehouse, 1936
Subfamily OIDALAGNOSTINAE Öpik, 1967
Genus Oidalagnostus Westergård, 1946

Synonymy

Type species
Oidalagnostus trispinifer Westergård (1946: 65, pl. 9, figs 4–7).

Diagnosis

Discussion
Robison (1988: 37) discussed Oidalagnostus and related genera in some detail and concluded that Ovalagnostus Lu 1974 (type species, O. changi Lu in Lu et al. 1974) and Tasagnostus Jago 1976 (type species, T. debori) are junior synonyms of Oidalagnostus Westergård 1946. Lu & Lin (1989: 81) placed Tasagnostus in synonymy with Ovalagnostus, which they retained as a separate genus from Oidalagnostus. Peng & Robison (2000) included Ovalagnostus as a junior synonym of Oidalagnostus, as did Shergold et al. (1990), Shergold & Laurie (1997) and the present authors. Peng & Robison (2000) place Tasagnostus compani of Jago (1976a) questionably in synonymy with Oidalagnostus changi. Certainly compani and changi are quite close and belong in the same genus, Oidalagnostus, but better specimens of both species are required before a final assessment is made. Peng & Robison (2000) included Tasagnostus as a junior synonym of Diplagnostus. However, the two genera are clearly differentiated on the basis of the structure of the pygidial axis and the glabellar anterior. Rushton (1978: 264) pointed out that genera such as Oidalagnostus, Tasagnostus, Cristagnostus, Oedorhachis, Linguagnostus and Dolichagnostus are best distinguished in the features of the pygidial axis.

Shergold et al. (1990) placed Tasagnostus in the Diplagnostinae along with Diplagnostus, Baltagnostus, Dolichagnostus, Linguagnostus and Oedorhachis, with Intostheniscus being included questionably in the Diplagnostinae. They suggested that Diplagnostus, Linguagnostus, Dolichagnostus and Tasagnostus fit into a tight morphological group characterised by a zonate pygidium in combination with an axiolobate or only slightly modified axiolobate condition, frequently with a transverse depression on the anterior of the posterior pygidial lobe and often sulate anterior glabellar lobe. Shergold & Laurie (1997) added Acadagnostus to the Diplagnostinae.

Shergold et al. (1990) and Shergold & Laurie (1997) placed Oidalagnostus, along with Cristagnostus, in the Oidalagnostinae and characterised the subfamily as having a zonate pygidium, but with a gap in the pygidial collar. They stated that the anteroaxis of the pygidium comprises three segments, that the posterior lobe is subquadrate and extends to the pygidial collar, and that a third, centrally placed marginal spine is present. They suggested that the major features in the phylogeny of Oidalagnostus and Cristagnostus are the separation of the anterior portion of the posterior lobe of the axis as the third segment of the anteroaxis and the presence of lateral bosses as appendages of this third segment.

As revised above, the only two species of Tasagnostus are T. debori Jago 1976a and Tasagnostus sp. Jago 1976b (pl. 2, fig.18). It is possible that Tasagnostus is ancestral to Oidalagnostus, with the best known species, T. debori, occurring in either the L. laevigata I or II Zones on the northern Australian biochronological scale. O. compani from St Valentines Peak, Tasmania, is from the L. laevigata III Zone or the Dansella torosa-Acmeapecta janitrix Zone. However, in Queensland Oidalagnostus ranges from the L. laevigata II Zone through to the lower part of the Acmarchas quasivespa Zone (Öpik 1967: table 4). Öpik (1967: 134) suggested that O. trispinifer is found in the Glyptagnostus solidotus Zone of Tasmania. However, to the best of the authors' knowledge, the youngest known Oidalagnostus from Tasmania is from the Brewery Junction Formation at Dundas, where it is in either the Eriediapis eretes or Acmarchas quasivespa Zone (Jago 1972).

Oidalagnostus changi Lu, 1964
Pl. 2F, I, J, M–P

Synonymy

Material
Nine cranidia and four pygidia, three of which have attached thoracic segments. Illustrated specimens UTGD 125344, 125347–125348, 125351–125354.

Diagnosis

Remarks
These specimens are similar to Oidalagnostus changi as illustrated by Peng & Robison (2000: fig. 43). The cranidia show some variation. The anterior margin may show a distinct anterior angularity (pl. 2O), may be quite smooth (pl. 2I) or have a slight angularity (pl. 2F, N). The depth of the transverse glabellar furrow is variable, as is the shape of the glabellar posterior. In the pygidium the pleural fields are slightly pitted. The collar is separated from the axis by a shallow, narrow furrow; the knobs on the collar are well developed. There is a well-developed furrow between the collar and the pygidial border.

Family CLAVAGNOSTIDAE Howell, 1937
Subfamily CLAVAGNOSTINAE Howell, 1937
Genus Clavagnostus Howell, 1937

Type species
Agnostus repandus Westergård in Holm & Westergård, (1930:13, pl.4, figs 11, 12 only).

Diagnosis

Clavagnostus cf. repandus (Westergård in Holm & Westergård 1930)
Pl. 2T, U

Material
Two small, poorly preserved pygidia, UTGD 125358–59.
(A, G) Amphoton sp.: (A) UTGD125361a cranidium, silicone rubber cast of external mould, ×4; (G) UTGD125367 pygidium, internal mould, ×10.
(B) Fuchouia sp. UTGD125362 pygidium, silicone rubber cast of external mould, ×5.
(C–E, H–J) Proasaphiscidae gen. et sp. indet.: (C) UTGD125363 cranidium, internal mould, ×4; (D) UTGD125364 cranidium, internal mould, ×6; (E) UTGD125365 right librigena, silicone rubber cast of external mould, ×8; (H) UTGD125368 right librigena, internal mould, ×5; (I) UTGD125369 partial cranidium, internal mould, ×3; (J) UTGD125370 cranidium, internal mould, ×6.
(F, K) Papyriaspidae gen. et sp. indet.: (F) UTGD125366 partial thoracic segment, silicone rubber cast of external mould, ×10; (K) UTGD125371 right librigena, silicone rubber cast of external mould, ×5.
(L, M) Trace fossils: (L) UTGD125372 internal mould, ×2; (M) UTGD125373b internal mould, ×1. The arrow points to a small complete specimen of Goniagnostus nathorsti resting on the tracks.
Remarks
These pygidia are similar to C. repandus as described and illustrated by Westergård (1946), and in particular to the pygidium figured by Westergård (1946: pl.4, fig.22) and refigured by Jago & Daily (1974: 11, fig.4).

Family INCERTAE SEDIS
Genus Glaberagnostus
Romanenko, 1985

Type species

Diagnosis

Glaberagnostus sp.
Pl. 2Q

Material
One almost complete specimen, UTGD125355a, b.

Description
Specimen length, 7.0 mm. Cephalon almost completely effaced; only very posterior of glabella distinguished. Border appears absent. Position of any glabellar node indeterminate due to preservation. Pygidium with wide border and border furrow; low centrally placed node about 0.2 of distance from anterior to posterior of acrolobe.

Genus Valenagnostus Jago, 1976a

Type species
Agnostus nudus Beyrich var. marginata Brogger 1878: 73, pl. 6, fig. 3.

Diagnosis
See Jago (1976a: 142).

Valenagnostus sp.
Pl. 2R

Material
Two small, poorly preserved pygidia. Illustrated specimen, UTGD 125356.

Remarks
The effaced acrolobe, wide pygidal border and suggestion of a terminal axial node suggest affiliation with Valenagnostus.

Agnostoid gen. et sp. indet.
Pl. 2S

Material
Five cephalae. Illustrated specimen, UTGD 125357.

Description
Narrow border; border furrow of moderate width. Glabella

0.6–0.7 length of cephalon. F1, F2 short, shallow; F3 shallow, straight. Posteroglabella length about 0.7 that of glabella. Glabellar posterior broadly rounded. Shallow preglabellar median furrow extends to anterior border. Small basal lobes confluent behind glabella. Smooth cheeks.

Remarks
These small cephalae are not assigned to any particular genus. They may belong in Agnostus or a related genus.

Family DOLICHOMETOPIDAE Walcott, 1916
Genus Amphoton Lorenz, 1906

Synonymy

Type species
Amphoton steinmanni Lorenz (1906: 89, pl. 4, figs 15–17).

Amphoton sp.
Pl. 3A,G

Material
One well-preserved cranidium is available both as the internal and external mould (UTGD 125361a, b); a small pygidium (UTGD 125367) may belong in the same species.

Description
Amphoton with shallow occipital furrow; base of what appears to have been a strong occipital spine preserved. Lateral glabellar furrows entirely effaced. Shallow axial furrows. Glabellar anterior almost straight. Anterior border of moderate width; shallow anterior border furrow. Palpebral areas of fixigenae gently convex. Shallow palpebral furrows. Narrow posterolateral limbs; well-developed posterior border furrow. Pygidial axis stops just short of posterior margin. Axis of four annulations plus terminus; four pairs of pleural furrows. No distinct border.

Remarks
The cranidium shows some similarities with Amphoton deois, although the anterior border of deois is a little wider, the palpebral areas of the fixed cheeks are a little narrower, and the anterior sections of the facial suture of deois do not diverge as much as those of the Trial Ridge form. The characters of the pygidium, including the absence of a distinct border, suggest affiliation with Fuchouia rather than Amphoton (e.g. Zhang & Jell 1987: 67). Although it is quite possible that the two specimens described here under Amphoton sp. belong in separate species or even separate, but related genera, they are placed together in open nomenclature until more material is obtained.

Genus Fuchouia Resser & Endo in Kobayashi 1935

Synonymy

Type species
Bathyuriscus manchuriensis Walcott (1911: 97, pl. 16, fig. 4).
**Fuchouia** sp.
Pl. 3B

**Description**
Although posterior of axis is poorly preserved there appear to be four axial annulations plus a terminus. Four pairs of pleural furrows, plus at least two pairs of faintly developed interpleural furrows. Very narrow border.

**Remarks**
The presence of the interpleural furrows and a very narrow border indicates that this pygidium belongs in *Fuchouia* rather than *Amphoton* (Zhang & Jell 1987: 67).

---

**Genus Bathyuriscus** Meek, 1873

**Type species**
*Bathyurus(?) haydeni* Meek (1873: 484).

**Diagnosis**
See Robison (1964: 534).

*Bathyuriscus (?) sp.*
Pl. 2V

**Material**
One partial cranidium, UTGD125360.

**Remarks**
This specimen is questionably assigned to *Bathyuriscus* as defined by Robison (1964: 534). In *Bathyuriscus* the glabella expands anteriorly, but this feature is not clear on the available specimen. Robison’s diagnosis stated that the palpebral lobes have a length one-third that of the cranidium. However, although a complete cranidium is not available, it is probable that the palpebral lobes of the Tasmanian specimens are considerably longer. When compared with *Bathyuriscus fimbriatus* Robison 1964, *Bathyuriscus (?) sp.* has wider fixigenae.

---

**Family PROASAPHISCIDAE** Chang,1963

**Material**
Six partial cranidia and several librigenae. Illustrated specimens, UTGD 125363–125365; 125368–125370.

**Description**
Large, convex subrectangular glabella about 0.75–0.8 cephalic length and about 0.43 cranidial length. Glabella tapers slightly forwards to a truncated front at anterior border furrow. Deep axial furrows. Lateral glabellar furrows very poorly defined. Shallow occipital furrow; occipital ring narrows abaxially. Long, crescentic palpebral lobes extend from just forwards of occipital furrow to about three-quarters length of glabella. Anterior ends of palpebral lobes close to axial furrows. Wide palpebral furrows. Palpebral areas of fixigenae gently convex. Gently convex anterior border furrow. Anterior sections of facial suture diverge slightly; posterior sections diverge markedly. Wide posterior border furrow. Gently convex librigena with shallow border furrow. Moderately wide border widens posteriorly and extends into long genal spine.

**Remarks**
These specimens belong to a new genus of the Proasaphiscidae that is also found in other late Middle Cambrian faunas from Tasmania, at Riana, Native Track Tier and St Valentines Peak (Laurie et al. 1995). Much better preserved, and more complete specimens, are known from these localities (Bao 1995).

---

**Family PAPYRIASPIDIDAE** Whitehouse, 1939

**Papyriaspididae gen. et sp. indet.**
Pl. 3F, K

**Remarks**
A single well-preserved partial librigena (UTGD 125371) and a partial thoracic segment (UTGD125366) may belong in a single genus of the Papyriaspididae. It has a narrow border and part of a well-developed genal spine. A very well-developed and prominent caecal pattern radiates out from the shallow palpebral furrow. The librigena is similar to that figured by Opik (1961: pl.15, fig. 6) for *Pianaspis sors* (Opik).

---

**Trace Fossils**
Pl. 3L, M

**Remarks**
Two sets of what appear to be trilobite resting places occur at Locality 1. The larger one (Pl. 3M) has a length of almost 100 mm, while the smaller one (Pl. 3L) has a length of almost 30 mm. Both are incomplete. Given that only two specimens are available, it is difficult to assign these specimens to any particular ichnogenus, but they appear to be related to *Rusophycus*. One of the specimens (Pl. 3M) has a small specimen of *Goniagnostus nathorsti* resting on it.

---

**ACKNOWLEDGEMENTS**
These fossils were collected by AVB as part of the regional mapping programme of the Tasmanian Department of Resources and Energy. Logistic support from the Department is acknowledged. The assistance of the former curators of the collections of the School of Earth Sciences, University of Tasmania, Penny Williamson and Kathi Stait, is gratefully acknowledged. The comments of two anonymous referees as well as those of the former editor, Dr M.R.Banks, improved the paper. R.A. Robison (University of Kansas) is thanked for constructive comments on an earlier version of this paper. JBJ was supported by a grant from the Australian Research Council.
REFERENCES


(accepted 25 June 2001)